

**CURRICULUM
FOR THE FIRST SEMESTER
OF THREE YEAR DIPLOMA PROGRAMME
COMMON TO**

ARCH. ASSTT., AUTOMOBILE ENGG., CIVIL ENGG., COMPUTER ENGG., ELECTRICAL ENGG.,
ELTX. & COMM. ENGG., ELECTRICAL & ELECTRONICS ENGG., MECHANICAL ENGG.,
INSTRUMENTATION ENGG., INFORMATION TECHNOLOGY.

(N-2017 SCHEME)

FOR THE STATE OF HIMACHAL PRADESH

(Implemented from the session 2017-18)

Composite Curriculum Development Centre
Directorate of Technical Education,
Vocational & Industrial Training, Himachal Pradesh,
Sundernagar.

**STUDY AND EVALUATION SCHEME FOR MECHANICAL ENGINEERING / AUTOMOBILE ENGINEERING
AND CIVIL ENGINEERING**

FIRST SEMESTER

SR NO	SUBJECTS	STUDY SCHEME Periods/Week		MARKS IN EVALUATION SCHEME								Total Marks
				INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		Th	Pr	Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
1.1	*English and Communication Skills – I	3	2	25	25	50	75	3	25	3	100	150
1.2	*Applied Mathematics - I	5	-	25	-	25	75	3	-	-	75	100
1.3	*Applied Physics – I	4	2	25	25	50	75	3	25	3	100	150
1.4	*Applied Chemistry – I	4	2	25	25	50	75	3	25	3	100	150
1.5	*Basics of Information Technology	-	3	-	50	50	-	-	50	3	50	100
1.6	*Engineering Drawing – I	-	6	-	50	50	100	4	-	-	100	150
1.7	*General Workshop Practice – I	-	6	-	100	100	-	-	75 ⁺	4	75	175
#Student Centred Activities		-	3	-	25	25	-	-	-	-	-	25
Total		16	24	100	300	400	400	-	200	-	600	1000

* Common course with other diploma programmes

SCA will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities, yoga sessions and participation in programs like Swachh Bharat, technical and cultural events etc.

+ Including 25 marks for viva-voce.

DETAILED CONTENTS

FIRST SEMESTER

1.1 ENGLISH AND COMMUNICATION SKILLS – I

L	P
3	2

RATIONALE

*Language is the most commonly used medium of self-expression in all spheres of human life – personal, social and professional. A student must have a fair knowledge of English language and skills to communicate effectively to handle the future jobs in industry. The objective of this course is to enable the diploma holders to acquire proficiency, both in spoken(oral) and written language. It is expected that each polytechnic will establish a **communication skill laboratory** for conducting the practical mentioned in the curriculum.*

DETAILED CONTENTS

1. **Facets of Literature** (14 hrs)
 - 1.1 Short Stories
 - 1.1.1 Homecoming – R.N. Tagore
 - 1.1.2 The Diamond Necklace-Guy-DeMaupassant
 - 1.2 Prose
 - 1.2.1 I Have A Dream-Martin Luther King
 - 1.2.2 On Habits- A. G. Gardiner
 - 1.3 Poems
 - 1.3.1 Ozymandias –P.B.Shelley
 - 1.3.2 Daffodils - William Wordsworth
 - 1.3.3 Stopping by Woods on a Snowy Evening – Robert Frost
2. **Grammar and Usage** (10 hrs)
 - 2.1 Parts of speech
 - 2.1.1 Nouns
 - 2.1.2 Pronouns
 - 2.1.3 Adjectives
 - 2.1.4 Articles
 - 2.1.5 Verbs
 - 2.1.6 Adverbs
 - 2.1.7 Prepositions
 - 2.1.8 Conjunction
 - 2.1.9 Interjection
 - 2.1.10 Identifying parts of speech
 - 2.2 Pair of words (Words commonly confused and misused)
 - 2.2.1 Identification of Tense
 - 2.2.2 Correction of incorrect sentences
 - 2.2.3 One word Substitution
 - 2.2.4 Active & Passive Voice

3. **Translation** (04 hrs)
 - 3.1 Glossary of Administrative Terms (English and Hindi)
 - 3.2 Translation from Hindi into English and English to Hindi.
4. Paragraph of 100-150 words from the given out outlines (08 hrs)
5. **Comprehension** (04 hrs)

Unseen passages of literary, scientific, data /graph based for comprehension exercises.
6. **Communication** (08 hrs)
 - 6.1 Definition, Elements and Process of Communication
 - 6.2 Levels of Communication
 - 6.3 Objectives of Communication

LIST OF PRACTICAL

1. The practice of the Sounds of English i.e. the Phonetic Symbols (Vowels & Consonants)
2. How to look up words in a Dictionary: meaning and pronunciation of words as given in the standard dictionary using Phonetic Symbols.
3. How to Seek Information from an Encyclopedia
4. Listening to pre-recorded English language learning programme.
5. Paper Reading before an audience (reading unseen passages)
6. Spelling Rules.
7. Essentials of a Good Speech to respond to and comprehend visual, oral themes, situations or stimulus and practice before select gathering.
8. Exercises on use of different abbreviations
9. Greetings for different occasions
10. Introducing oneself, others and leave taking
11. Exercises on writing Notices.

Note:

1. A communication laboratory may be set up equipped with appropriate audio-video system with facility of playing CDs/DVDS and a video camera with facility to record & play back the performance of each student. A set of CDs from any language training organization e.g B.B.C , British Council etc. may be procured for use of students.
2. Elements of body language will be incorporated in all practical.
3. The practical exercises involving writing may also be included in Theory Examination.
4. Elements of body language will be incorporated in all practical exercises.

RECOMMENDED BOOKS

1. *English and Communication Skills, Book-I* By Kuldip Jaidka, Alwainder Dhillon and Parmod Kumar Singla, Prescribed by NITTTR, Chandigarh Published By Abhishek Publication, 57-59, Sector-17, Chandigarh
2. *Spoken English* by R.K. Bansal & J.B.Harrison Published by Orient Longman
3. *Essentials of Business Communication* by Pal and Rorualling; Sultan Chand and Sons

4. *The Essence of Effective Communication, Ludlow and Panthon; Prentice Hall of India*
5. *New Design English Grammar, Reading and Writing Skills by AL Kohli (Course -A and course- B), Kohli Publishers, 34 Industrial Area Phase-II, Chandigarh,*
6. *New Design English Reading and Advanced Writing Skills for Class XI and XII by MK Kohli and AL Kohli; Kohli Publishers, 34 Industrial Area Phase-II, Chandigarh,*
7. *A Practical English Grammar by Thomson and Martinet*
8. *Spoken English by V Sasi Kumar and PV Dhamija; Tata McGraw Hill*
9. *English Conversation Practice by Grount Taylor; Tata McGraw Hill*
10. *Developing Communication Skills by Krishna Mohan and Meera Banerji; MacMillan India Ltd., Delhi*
11. *Business Correspondence and Report Writing by RC Sharma and Krishna Mohan; Tata McGraw Hill Publishing Company Ltd. New Delhi*
12. *Communication Skills by Ms R Datta Roy and KK Dhir; Vishal Publication, Jalandhar*

Websites for references:

1. <http://www.bbclearningenglish.com>
2. <http://www.mindstools.com>
3. <http://www.letstalk.com.in>
4. <http://www.learnenglish.britishcouncil.org/en/>

SUGGESTED DISTRIBUTION OF MARKS		
Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	14	40
2	10	15
3	4	10
4	8	10
5	4	10
6	8	15
Total	48	100

Glossary of Administrative Terms

1.	Senior	वरिष्ठ
2.	Cashier	खजांची
3.	Consent	सहमती
4.	Earned Leave	जमा छुट्टी
5.	Under Consideration	विचार अधीन
6.	Criterion	कसौटी
7.	Staff	कर्मचारी
8.	Tenure	कार्यकाल
9.	Working Committee	कार्य समिति
10.	Estate	सम्पदा
11.	Self-Sufficient	आत्मनिर्भर
12.	Emergency	आपात्तकाल
13.	General Body	आम सभा
14.	Exemption	छूट
15.	Daily wages	दिहाडीदार
16.	Death-Cum Retirement	मृत्यु और निवृत्ती
17.	Despatch Register	रवानगी रजिस्टर
18.	Despatch	रवानगी
19.	Stenography	आशुलिपिक
20.	Assurance	दिलासा
21.	Justify	सही साबित करना
22.	Superior	बढिया
23.	High Commission	उच्चयुक्त
24.	Simultaneous	साथ - साथ
25.	Precautionary	एहतिहासी
26.	Commanding Office	कमांडिंग अफसर
27.	Negligence	लापरवाही
28.	Performance	पुरा करना
29.	Proof Reader	पुफ रीडर
30.	Take Over	काम सभालना
31.	Timely Compliance	समय दौरान पुरा करना
32.	Responsibility	जिमेदारी
33.	Chief Justice	मुख्य न्यायधिश
34.	Disciplinary Action	अनुशासनिक कारवाई
35.	Efficiency Bar	दक्षता रोक
36.	Flying Squad	उड़न दस्ता
37.	Regret	खेद
38.	Inconvenience	असुविधा
39.	Ambiguous	अस्पष्ट
40.	Part Time	अधकालीन
41.	Academy	अकादमी
42.	Disparity	असमानता
43.	Extraordinary	असाधारण
44.	Provisional	अस्थायी
45.	Income Tax	आयकर
46.	Bonafide	असली
47.	Acting in Official Capacity	बतौर अधिकारिक हैसियत
48.	Contractor	ठेकेदार
49.	On probation	परिवीक्षाधीन
50.	State	राज्य

51.	Administrator	प्रशासक
52.	Admission	प्रवेश
53.	Aforesaid	पूर्वोक्त, उपरोक्त
54.	Affidavit	शपथपत्र
55.	Agenda	कार्यसूची
56.	Alma Mater	विद्यालय जहाँ किसी व्यक्ति ने शिक्षा प्राप्त
57.	Appointing Authority	मनोनित अधिकारी
58.	Apprentice	शिल्पकार
59.	Additional	अतिरिक्त
60.	Advertisement	विज्ञापन
61.	Assistant	सहायक
62.	Assumption of Charge	अधिकार ग्रहण करना
63.	Attested Copy	सत्यापित प्रति
64.	Chief Minister	मुख्यमन्त्री
65.	Clerical Error	लेखन सम्बन्धी भ्रम
66.	Code	कानून की किताब, गुप्त भाषा
67.	Corruption	नैतिक भ्रष्टाचार, खोटापन
68.	Craftsman	कारीगर
69.	Compensation	हरजाना
70.	Compensatory Allowance	क्षतिपूरक भत्ता
71.	Compile	संकलन करना, संग्रह करना
72.	Confidential Letter	गुप्त पत्र
73.	Chief Engineer	मुख्य अभिन्यता
74.	Data	स्वीकृत तत्त्व (आंकड़े)
75.	Dearness Allowance	संहर्गाई भत्ता
76.	Department	विभाग
77.	Dictionary	शब्द कोष
78.	Director	निदेशक, संचालन
79.	Director of Tech.. Edu.	तकनीकी शिक्षा निदेशक
80.	Executive Engineer	अधिशायी अभियन्ता
81.	Employment Exchange	व्यवसाय केन्द्र
82.	Head Office	मुख्य कार्यालय
83.	Head Clerk	प्रधान लिपिक
84.	Indian Admn. Service	भारतीय प्रशासनिक सेवा
85.	Legislative Assembly	विधान सभा
86.	Officiating	स्थानापन्न
87.	Office Record	कार्यालय रिकार्ड
88.	Office Discipline	कार्यालय अनुशासन
89.	Polytechnic	बहुतकनीकी
90.	Temporary	अस्थायी
91.	Qualified	योग्यता प्राप्त
92.	Under Investigation	जांच अधीन
93.	Sub-treasury	उप-खजाना
94.	Target Date	लक्ष्य तिथि
95.	Technical Approval	तकनीकी मान्यता
96.	Verification	जांच पड़ताल
97.	Viva-voca	मौखिक परीक्षा
98.	Write off	बटटेखाते डालना
99.	Warning	चेतावनी
100.	Yours faithfully	भवदीय

1.2 APPLIED MATHEMATICS – I

L	P
5	-

RATIONALE

Applied Mathematics forms the backbone of engineering students. Basic elements of algebra, trigonometry, coordinate geometry have been included in the curriculum as foundation course. This course will develop analytical abilities to make exact calculations and will provide continuing educational base to the students.

DETAILED CONTENTS

1. Algebra (25 hrs)

- 1.1 Complex Numbers: Definition, real and imaginary parts of a Complex number, polar and Cartesian, representation of a complex number and its conversion from one form to other, conjugate of a complex number, modulus and amplitude of a complex number Addition, Subtraction, Multiplication and Division of a complex number. De-moivre's theorem, its application.
- 1.2 Partial fractions (linear factors, repeated and non-repeated linear factors)
- 1.3 Permutations and Combinations: Value of ${}^n P_r$ ${}^n C_r$.
- 1.4 Binomial theorem (without proof) for positive integral index (expansion and general form); binomial theorem for any index (expansion without proof) first and second binomial approximation with applications to engineering problems

2. Trigonometry (25 hrs)

- 2.1 Concept of angles, measurement of angles in degrees, grades and radians and their conversions.
- 2.2 T-Ratios of Allied angles (without proof), Sum, difference formulae and their applications (without proof). Product formulae (Transformation of product to sum, difference and vice versa). T-Ratios of multiple angles, sub-multiple angles ($2A$, $3A$, $A/2$).
- 2.3 Graphs of

Sin x, cos x, tan x and e^x

3. Differential Calculus

(30 hrs)

3.1 Definition of function; Concept of limits.

Four standard limits

$$\lim_{x \rightarrow a} \frac{x^n - a^n}{x - a}, \quad \lim_{x \rightarrow 0} \frac{\sin x}{x},$$
$$\lim_{x \rightarrow 0} \left(\frac{a^x - 1}{x} \right), \quad \lim_{x \rightarrow 0} (1 + x)^{1/x},$$

3.2 Differentiation by definition of $x^n, \sin x, \cos x, \tan x, e^x, \log_e x$

3.3 Differentiation of sum, product and quotient of functions. Differentiation of function of a function.

3.4 Differentiation of trigonometric and inverse trigonometric functions, Logarithmic differentiation, Exponential functions.

3.5 Applications:

(a) Maxima and minima

(b) Equations of tangent and normal to a curve (for explicit functions only)

(c) Calculations of small errors and rate measures

RECOMMENDED BOOKS

1. *Elementary Engineering Mathematics* by BSGrewal, Khanna Publishers, New Delhi
2. *Engineering Mathematics* by Vol. I & II by SKohli, IPH, Jalandhar
3. *Applied Mathematics* by Dr. RD Sharma
4. *Applied Mathematics, Vol. I & II* by SSSabharwal & Sunita Jain, Eagle Parkashan, Jalandhar.
5. *Applied Mathematics, Vol. I & II* by B.D. Moudgil & BC Chopra, Eagle Parkashan, Jalandhar.
6. *Comprehensive Mathematics, Vol. I & II* by Laxmi Publications
7. *Engineering Mathematics* by Dass Gupta
8. *Engineering Mathematics* by CDass Chawla, Asian Publishers, New Delhi
9. *Comprehensive Mathematics, Vol. I & II* by Laxmi Publications
10. *Engineering Mathematics, Vol. I, II & III* by VSundaram et al, Vikas Publishing House (P) Ltd., New Delhi
11. *Engineering Mathematics* by N. Ch. S. Niyengaret. al, Vikas Publishing House (P) Ltd., New Delhi
12. *Engineering Mathematics, Vol. I & II* by SSSastry, Prentice Hall of India Pvt. Ltd.,
13. *Engineering Mathematics, Vol. I & II* by AKGupta, MacMillan India Ltd., New Delhi
14. *Applied Mathematics Vol-1 & II* by Hiteshi Publication.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	25	30
2	25	30
3	30	40
Total	80	100

1.3 APPLIED PHYSICS – I

L	P
4	2

RATIONALE

Applied physics includes the study of a large number of diverse topics all related to things that go on in the world around us. It aims to give an understanding of this world both by observation and by prediction of the way in which objects will behave. Concrete use of physical principles and analysis in various fields of engineering and technology are given prominence in the course content.

Note: Teachers should give examples of engineering/technology applications of various concepts and principles in each topic so that students are able to appreciate learning of these concepts and principles. In all contents, SI units should be followed.

DETAILED CONTENTS

1. Units and Dimensions (10 hrs)
 - 1.1 Physical quantities Units - fundamental and derived units, systems of units (FPS, CGS and SI units)
 - 1.2 Dimensions and dimensional formulae of physical quantities (area, volume, velocity, acceleration, momentum, force, impulse, work, power, energy, surface tension, coefficient of viscosity, stress, strain, moment of inertia, gravitational constant.)
 - 1.3 Principle of homogeneity of dimensions
 - 1.4 Dimensional equations and their applications, conversion from one system of units to other, checking of dimensional equations and derivation of simple equations)
 - 1.5 Limitations of dimensional analysis
 - 1.6 Error in measurement, absolute error, relative error, rules for representing significant figures in calculation.
 - 1.7 Application of units and dimensions in measuring length, diameter, circumference, volume, surface area etc. of metallic and non metallic blocks, wires, pipes etc (at least two each).

2. Force and Motion (12 hrs)
- 2.1 Scalar and vector quantities – examples, representation of vector, types of vectors
 - 2.2 Addition and Subtraction of Vectors, Triangle and Parallelogram law (Statement only), Scalar and Vector Product.
 - 2.3 Resolution of Vectors and its application to lawn roller.
 - 2.4 Force, Momentum, Statement and Derivation of Conservation of linear momentum, its applications such as recoil of gun.
 - 2.5 Impulse and its Applications
 - 2.6 Circular motion, definition of angular displacement, angular velocity, angular acceleration, frequency, time period.
 - 2.7 Relation between linear and angular velocity, linear acceleration and angular acceleration (related numerical)
 - 2.8 Expression and Applications of Centripetal and centrifugal forces with examples such as banking of roads and bending of cyclist
 - 2.9 Application of various forces in lifts, cranes, large steam engines and turbines
3. Work, Power and Energy (10 hrs)
- 3.1 Work: and its units, examples of zero work, positive work and negative work
 - 3.2 Friction: modern concept, types, laws of limiting friction, Coefficient of friction and its Engineering Applications.
 - 3.3 Work done in moving an object on horizontal and inclined plane for rough and plane surfaces with its applications
 - 3.4 Energy and its units: Kinetic energy and gravitational potential energy with examples and their derivation
 - 3.5 Principle of conservation of mechanical energy for freely falling bodies, examples of transformation of energy.
 - 3.6 Power and its units, calculation of power in numerical problems
 - 3.7 Application of Friction in brake system of moving vehicles, bicycle, scooter, car trains etc.
- 4 Rotational Motion (10 hrs)
- 4.1 Concept of translatory and rotatory motions with examples
 - 4.2 Definition of torque and angular momentum and their examples
 - 4.3 Conservation of angular momentum (quantitative) and its examples

4.4 Moment of inertia and its physical significance, radius of gyration for rigid body, Theorems of parallel and perpendicular axes (statements only), Moment of inertia of rod, disc, ring and sphere (hollow and solid) (Formulae Only no derivation).

4.5 Application of rotational motions in transport vehicles, and machines.

5. Properties of Matter (12 hrs)

5.1 Elasticity: definition of stress and strain, different types of moduli of elasticity, Hooke's law, significance of stress strain curve

5.2 Pressure: definition, its units, atmospheric pressure, gauge pressure, absolute pressure, Fortin's Barometer and its applications

5.3 Surface tension: concept, its units, angle of contact, Ascent Formula (No derivation), applications of surface tension, effect of temperature and impurity on surface tension

5.4 Viscosity and coefficient of viscosity: Terminal velocity, Stoke's law and effect of temperature on viscosity, application in hydraulic systems.

5.5 Concept of fluid motion, stream line and turbulent flow, Reynold's number Equation of continuity, Bernoulli's Theorem and their applications (no derivation and numerical).

6. Thermometry (10 hrs)

6.1 Difference between heat and temperature

6.2 Modes of transfer of heat (Conduction, convection and radiation with examples)

6.3 Different scales of temperature and their relationship

6.4 Types of Thermometer (Mercury Thermometer, Bimetallic Thermometer, Platinum resistance Thermometer, Pyrometer)

6.5 Expansion of solids, liquids and gases, coefficient of linear, surface and cubical expansions and relation amongst them

6.6 Concept of Co-efficient of thermal conductivity

6.7 Application of various systems of thermometry in refrigeration and air-conditioning etc.

LIST OF PRACTICALS (to perform minimum eight experiments)

1. To find volume of solid sphere using a vernier calipers
2. To find internal diameter and depth of a beaker using a vernier calipers and hence find its volume.
3. To find the diameter of wire using a screw gauge
4. To determine the thickness of glass strip using a spherometer
5. To verify parallelogram law of forces
6. To study conservation of energy of a ball or cylinder rolling down an inclined plane.
7. To find the Moment of Inertia of a flywheel about its axis of rotation
8. To determine the atmospheric pressure at a place using Fortin's Barometer
9. To determine the viscosity of glycerin by Stoke's method

10. To determine the coefficient of linear expansion of a metal rod
11. To determine force constant of spring using Hooks law

INSTRUCTIONAL STATREGY

Teacher may use various teaching aids like models, charts, graphs and experimental kits etc. for imparting effective instructions in the subject. The teacher should explain about field applications before teaching the basics of mechanics, work power and energy, rotational motion, properties of matter etc. to develop proper understanding of the physical phenomenon. Use of demonstration can make the subject interesting and develop scientific temper in the students.

RECOMMENDED BOOKS

1. Text Book of Physics for Class XI (Part-I, Part-II); N.C.E.R.T., Delhi
2. Applied Physics, Vol. I and Vol. II, TTTI Publications, Tata McGraw Hill, Delhi
3. Concepts in Physics by HC Verma, Vol. I & II, Bharti Bhawan Ltd. New Delhi
4. A Text Book of Optics, Subramanian and Brij Lal, S Chand & Co., New Delhi
5. Comprehensive Practical Physics, Vol, I & II, JN Jaiswal, Laxmi Publications (P) Ltd., New Delhi
6. Engineering Physics by PV Naik, Pearson Education Pvt. Ltd, New Delhi
7. Applied Physics I & II by RA Banwait & R Dogra, Eagle Parkashan, Jalandhar
8. Engineering Physics by DK Bhattacharya & Poonam Tandan; Oxford University Press, New Delhi

SUGGESTED DISTRIBUTION OF MARKS		
Topic	Time Allotted (Hrs)	Marks Allotted (%)
1.	10	15
2.	12	20
3.	10	15
4.	10	15
5.	12	20
6.	10	15
Total	64	100

1.4 APPLIED CHEMISTRY – I

L	P
4	2

RATIONALE

The use of various chemicals and chemical products in diverse technical and engineering fields have repeatedly proved the importance of Applied Chemistry, which enhances its role to a new peak. On the other hand, ever increasing use of such materials will compel engineers, technocrats to acquire essential applied chemistry knowledge in order to select engineering materials, which not only suit them but also provide more environmental compatibility. This situation demands principles of Applied Chemistry in diploma-engineering courses. Principles of Applied Chemistry will enable budding engineers and technocrats to develop scientific temper and appreciate physical, chemical and engineering properties of materials. Hence the subject of Applied Chemistry.

DETAILED CONTENTS

1. Basic Concept of Chemistry (08 hrs)
 - 1.1 Physical Classification of matter –solids, liquids, gases.
 - 1.2 Chemical Classification of matter – element, compounds and mixtures
 - 1.3 Symbols of elements and valency, writing of chemical formulae of simple compounds.
 - 1.4 Calculation of percentage of elements in the following compounds using atomic and molecular masses CaCO_3 , NaCl , CuSO_4 , NaOH , Ca(OH)_2 , H_2SO_4 , $\text{C}_2\text{H}_2\text{O}_4$. (Atomic mass of elements should be provided)
 - 1.5 Chemical equations, thermo-chemical equations, balancing of chemical equations (hit and trial method)
2. Atomic Structure, Periodic Table and Chemical Bonding (14 hrs)
 - 2.1 Fundamental particles- mass and charges of electrons, protons and neutrons with names of the scientists who discovered these fundamental particles.
 - 2.2 Bohr's model of atom and successes and limitations of atomic theory (qualitative treatment only).
 - 2.3 Atomic number, atomic mass number isotopes and isobars.
 - 2.4 Definition of orbit and orbitals, shapes of s and p orbitals only, quantum numbers and their significance,
 - 2.5 Aufbau's principle, Pauli's exclusion principle and Hund's rule electronic configuration of elements with atomic number (Z) = 30 only. (Electronic configurations of elements with atomic number greater than 30 are excluded).
 - 2.6 Modern periodic law and periodic table, groups and periods, classification of elements into s, p, d and f blocks (periodicity in properties - excluded)

2.7 Chemical bonding and cause of bonding and types such as ionic bond in NaCl sigma (σ) and pi (π) covalent bonds in H_2 , HCl, Cl_2 , elementary idea of hybridization in $BeCl_2$, BF_3 , CH_4 , NH_3 and H_2O .

2.8 Metallic bonding- explanation with the help of electron gas (sea) model.

3. Solutions (08 hrs)

3.1 Definition of solution, solute and solvent with examples

3.2 Methods to express the concentration of solution- molarity (M), molality (m) and normality (N) and numericals based on calculation of M , m and N

3.3 Introduction to pH of solution, simple numericals on pH and industrial applications of pH.

3.4 Definition of buffer solution and industrial applications of buffers solutions.

4. Water (14 hrs)

4.1 Demonstration of water resources on Earth using pie chart.

4.2 Classification of water – soft water and hard water, action of soap on hard water, types of hardness, causes of hardness, units of hardness – mg per liter (mgL^{-1}) and part per million (ppm) and simple numericals.

4.3 Disadvantages caused by the use of hard water in domestic and boiler feed water.

4.4 Removal of hardness -Permutit process and Ion-exchange process.

4.5 Physico-Chemical methods for Water Quality Testing

a) Determination of pH using pH meter, total dissolved solids (TDS)

b) Testing and Estimation of- alkalinity, total hardness by EDTA method (chemical reaction of EDTA method are excluded).

c) Understanding of Indian Water Quality standards as per WHO

4.6 Natural water sterilization by chlorine and UV radiation and reverse osmosis.

5. Electro Chemistry (14 hrs)

5.1 Electronic concept of oxidation, reduction and redox reactions

5.2 Definition of terms: electrolytes, non-electrolytes with suitable examples

5.3 Faradays laws of electrolysis and simple numerical problems.

5.4 Industrial Application of Electrolysis – Electroplating, electrolytic refining and electrometallurgy.

5.5 Application of redox reactions in electrochemical cells – commercial dry cell (Primary), commercially used lead storage battery, mercury cell, nickel-cadmium rechargeable cell and lithium ion battery (Secondary cell).

6. Organic Chemistry (06 hrs)

6.1 Tetra valency and catenation property of carbon to produce huge organic compounds.

6.2 Classification of organic compounds on the bases of functional groups

- 6.3 Nomenclature of simple organic compounds in accordance with I.U.P.A.C. (compounds having two carbon atoms in a molecule belongs to alkanes, alkenes, alkynes, alkyl halides, alcohols, ethers, aldehydes, ketones, carboxylic acids, esters, amines) (compounds containing more than one functional groups are excluded) and their common names (if any)

LIST OF PRACTICALS

1. Volumetric analysis and apparatus used in volumetric analysis
2. Preparation of standard solution of oxalic acid or potassium permanganate
3. To determine strength of given sodium hydroxide solution by titrating against standard oxalic acid solution using phenolphthalein indicator.
4. Volumetric estimation of ferrous ammonium sulfate solution by titrating it against standard potassium permanganate solution in acidic medium
5. Experimental verification of Faraday's first law of electrolysis using copper sulfate solution and copper electrode
6. To prepare Mohr's salt from ferrous sulfate and ammonium sulfate
7. Determination of pH of given solution using pH meter
8. Estimation of total hardness of water using standard EDTA solution and using eriochrome black-T (solochrome black-T) indicator and approximately neutral buffer solution (pH range 7-11)
9. Estimation of total alkalinity of given water sample by titrating it against standard sulfuric acid solution

INSTRUCTIONAL STRATEGY

Teachers may take help of various models and charts while imparting instructions to make the concept clear. More emphasis should be laid on discussing and explaining practical applications of various chemical process and reactions. In addition, students should be encouraged or motivated to study those processes in more details, which may find practical application in their future professional career.

RECOMMENDED BOOKS

1. Chemistry in Engineering by J.C. Kuricose & J. Rajaram, Tata McGraw Hill, Publishing Company Limited, New Delhi.
2. Engineering Chemistry by P.C. Jain & Monika Jain, Dhanapat Rai Publishing Company, New Delhi.
3. Eagle's Applied Chemistry - I by S. C. Ahuja & G. H. Hugar, Eagle Prakashan, Jalandhar.
4. Engineering Chemistry – A Text Book by H. K. Chopra & A. Parmar, Narosa Publishing House, New Delhi.

5. Applied Chemistry - I by Dr. P. K Vij & Shiksha Vij, Lords Publications, Jalandhar.
6. Engineering Chemistry by Dr. Himanshu Pandey, Goel Publishing House, Meerut, India.

SUGGESTED DISTRIBUTION OF MARKS		
Topics	Time Allotted (hrs)	Marks Allotted (%)
1.	08	12
2.	14	22
3.	08	12
4.	14	22
5.	14	22
6.	06	10
Total	64	100

1.5 BASICS OF INFORMATION TECHNOLOGY

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-	3

RATIONALE

Information technology has great influence on all aspects of life. Primary purpose of using computer is to make the life easier. Almost all work places and living environment are being computerized. The subject introduces the fundamentals of computer system for using various hardware and software components. In order to prepare diploma holders to work in these environments, it is essential that they are exposed to various aspects of information technology such as understanding the concept of information technology and its scope; operating a computer; use of various tools using MS Office/Open Office/Libre Office using internet etc., form the broad competency profile of diploma holders. This exposure will enable the students to enter their professions with confidence, live in a harmonious way and contribute to the productivity.

Note:

Explanation of Introductory part should be demonstrated with practical work. Following topics may be explained in the laboratory along with the practical exercises. There will not be any theory examination.

TOPICS TO BE EXPLAINED THROUGH DEMONSTRATION

1. Basic Concepts of IT and Its Application

Information Technology concept and scope, applications of IT. in office, Air and Railway Ticket reservation, Banks financial transactions, E-Commerce and E-Governance applications etc., Ethics of IT, concept of online frauds, threats of IT crimes.

2. Computer Hardware:

Block diagram of a computer, components of computer system, CPU, Memory, Input devices; keyboard, Scanner, mouse etc; Output devices; VDU, LCD, Printers etc. Primary and Secondary Memory: RAM, ROM, magnetic disks – tracks and sectors, optical disk (CD , DVD & Blue Ray Disk.), USB/Flash Drive.

3. Software Concepts:

System software, Application software, Virtualization software and Utility software, Introduction of Operating System, Installation of Window / linux, Features of OPEN OFFICE/MS_OFFICE(MS word, Excel, PowerPoint) .

4. Internet Concepts:

Basics of Networking – LAN, WAN, Wi-Fi technologies and sharing of printers and other resources, Concept of IP addresses, DNS, introduction of internet, applications of internet like: e-mail and browsing, concept of search engine and safe searching. Various browsers like Internet explorer/Microsoft Edge, Mozilla Firefox, use of cookies and history, WWW (World Wide Web), hyperlinks, introduction to Anti-virus.

LIST OF PRACTICAL EXERCISES

1. Given a PC, name its various components and peripherals. List their functions .
2. Installing various components of computer system and installing system software and application software
- 3 Installation of I/O devices, printers and installation of operating system viz. Windows/BOSS/ LINUX
4. Features of Windows as an operating system
 - Start
 - Shut down and restore
 - Creating and operating on the icons
 - Opening, closing and sizing the windows and working with windows interfacing elements (option buttons, checkbox, scroll etc.)
 - Using elementary job commands like – creating, saving, modifying, renaming, finding and deleting a file and folders
 - Changing settings like, date, time, colour (back ground and fore ground etc.)
 - Using short cuts
 - Using on line help
5. Word Processing (MS Office/Open Office)
 - a) File Management:
 - Opening, creating and saving a document, locating files, copying contents in some different file(s), protecting files, giving password protection for a file
 - b) Page set up:
 - Setting margins, tab setting, ruler, indenting
 - c) Editing a document:
 - Entering text, cut, copy, paste using tool- bars
 - d) Formatting a document:
 - Using different fonts, changing font size and colour, changing the appearance through bold/italic/underlined, highlighting a text, changing case, using subscript and superscript, using different underline methods
 - Aligning of text in a document, justification of document, inserting bullets and numbering

- Formatting paragraph, inserting page breaks and column breaks, line spacing
- Use of headers, footers: Inserting footnote, end note, use of comments, autotext
- Inserting date, time, special symbols, importing graphic images, drawing tools

e) Tables and Borders:

- Creating a table, formatting cells, use of different border styles, shading in tables, merging of cells, partition of cells, inserting and deleting a row in a table
- Print preview, zoom, page set up, printing options
- Using find, replace options

f) Using Tools like:

- Spell checker, help, use of macros, mail merge, thesaurus word content and statistics, printing envelopes and labels
- Using shapes and drawing toolbar,
- Working with more than one window .

6. Spread Sheet Processing (MS Office/Open Office)

a) Starting excel, open worksheet, enter, edit, data, formulae to calculate values, format data, save worksheet, switching between different spread sheets

b) Menu commands:

Create, format charts, organise, manage data, solving problem by analyzing data. Programming with Excel Work Sheet, getting information while working

c) Work books:

Managing workbooks (create, open, close, save), working in work books, selecting the cells, choosing commands, data entry techniques, formula creation and links, controlling calculations

Editing a worksheet, copying, moving cells, pasting, inserting, deletion cells, rows, columns, find and replace text, numbers of cells, formatting worksheet, conditional formatting

d) Creating a chart:

Working with chart types, changing data in chart, formatting a chart, use chart to analyze data

Using a list to organize data, sorting and filtering data in list

e) Retrieve data with query:

Create a pivot table, customizing a pivot table. Statistical analysis of data

f) Exchange data with other application:

Embedding objects, linking to other applications, import, export document.

7. PowerPoint Presentation (MS Office/Open Office)

a) Introduction to PowerPoint

- How to start PowerPoint
- Working environment: concept of toolbars, slide layout & templates.
- Opening a new/existing presentation
- Different views for viewing slides in a presentation: normal, slide sorter.

b) Addition, deletion and saving of slides

c) Insertion of multimedia elements

- Adding text boxes
- Adding/importing pictures
- Adding movies and sound
- Adding tables and charts etc.
- Adding organizational chart
- Editing objects
- Working with Clip Art

d) Formatting slides

- Using slide master
- Text formatting
- Changing slide layout
- Changing slide colour scheme
- Changing background
- Applying design template

e) How to view the slide show?

- Viewing the presentation using slide navigator
- Slide transition
- Animation effects, timing, order etc.

f) Use of Pack and Go Options.

8. Internet and its Applications

a) Establishing an internet connection.

b) Browsing and down loading of information from internet.

c) Sending and receiving e-mail

- Creating a message
- Creating an address book
- Attaching a file with e-mail message
- Receiving a message
- Deleting a message

d) Assigning IP Addresses to computers and use of domain names.

9. Functioning of Antivirus
 - a) Installation and updation of an antivirus.
 - b) How to scan and remove the virus.

INSTRUCTIONAL STRATEGY

Since this subject is practice oriented, the teacher should demonstrate the capabilities of computers to students while doing practical exercises. The students should be made familiar with computer parts, peripherals, connections and proficient in making use of MS Office/Open Office in addition to working on internet. The student should be made capable of working on computers independently.

RECOMMENDED BOOKS

1. Fundamentals of Computer by V Rajaraman; Prentice Hall of India Pvt. Ltd., New Delhi
2. Information Technology for Management by Henery Lucas, Tata McGraw Hills, New Delhi
3. Computers Fundamentals Architecture and Organisation by B Ram, revised Edition, New Age International Publishers, New Delhi
4. Computers Today by SK Basandara, Galgotia publication Pvt Ltd. Daryaganj, New Delhi.
5. Internet for Every One by Alexis Leon and Mathews Leon; Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi
6. A First Course in Computer by Sanjay Saxena; Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi
7. Computer Fundamentals by PK Sinha; BPB Publication, New Delhi
8. Fundamentals of Information Technology by Leon and Leon; Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi
9. On Your Marks - Net...Set...Go... Surviving in an e-world by Anushka Wirasinha, Prentice Hall of India Pvt. Ltd., New Delhi
10. Fundamentals of Information Technology by Vipin Arora, Eagle Parkashan, Jalandhar

1.6 ENGINEERING DRAWING - I

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RATIONALE

Drawing is the language of engineers and technicians. Reading and interpreting engineering drawing is their day to day responsibility. The subject is aimed at developing basic graphic skills in the students so as to enable them to use these skills in preparation of engineering drawings, their reading and interpretation. The emphasis, while imparting instructions, should be to develop conceptual skills in the students following BIS SP 46 – 1988.

Note:

- i) First angle projection is to be followed
- ii) Minimum of 16 sheets to be prepared and atleast 2 sheets on AutoCAD
- iii) Instructions relevant to various drawings may be given along with appropriate demonstrations, before assigning drawing practice to students

DETAILED CONTENTS

1. Introduction to Engineering Drawing (03 sheets)
 - 1.1 Introduction to drawing instruments, materials, layout and sizes of drawing sheets and drawing boards.
 - 1.2 Different types of lines in Engineering drawing as per BIS specifications
 - 1.3 Practice of vertical, horizontal and inclined lines, geometrical figures such as triangles, rectangles, circles, ellipses and curves, hexagonal, pentagon with the help of drawing instruments.
 - 1.4 Free hand and instrumental lettering (Alphabet and numerals) – upper case (Capital Letter), single stroke, vertical and inclined at 75 degree, series of 5,8,12 mm of free hand and instrumental lettering of height 25 to 35 mm in the ratio of 7:4
2. Dimensioning Technique (01 sheet)
 - 2.1 Necessity of dimensioning, method and principles of dimensioning (mainly theoretical instructions)
 - 2.2 Dimensioning of overall sizes, circles, threaded holes, chamfered surfaces, angles, tapered surfaces, holes, equally spaced on P.C.D., counter sunk holes, counter bored holes, cylindrical parts, narrow spaces and gaps, radii, curves and arches

3. Scales (02 sheets)

3.1 Scales –their needs and importance (theoretical instructions), type of scales, definition of R.F. and length of scale

3.2 Drawing of plain and diagonal scales

4. Orthographic Projections (06 sheets)

4.1 Theory of orthographic projections (Elaborate theoretical instructions)

4.2 Projection of Points in different quadrant

4.3 Projection of Straight Line (1st and 3rd angle)

4.3.1. Line parallel to both the planes

4.3.2. Line perpendicular to any one of the reference plane

4.3.3. Line inclined to any one of the reference plane.

4.4 Projection of Plane – Different lamina like square, rectangular, triangular and circle inclined to one plane, parallel and perpendicular to another plane in 1st angle only

4.5 Three views of orthographic projection of different objects. (At least one sheet in 3rd angle)

4.6 Identification of surfaces

5. Sections (02 sheets)

5.1 Importance and salient features

5.2 Drawing of full section, half section, partial or broken out sections, Offset sections, revolved sections and removed sections.

5.3 Convention sectional representation of various materials, conventional breaks for shafts, pipes, rectangular, square, angle, channel, rolled sections

5.4 Orthographic sectional views of different objects.

6. Isometric Views (02 sheets)

6.1 Fundamentals of isometric projections and isometric scale.

6.2 Isometric views of combination of regular solids like cylinder, cone, cube and prism.

7. Common Symbols and Conventions used in Engineering (02 sheets)
- 7.1 Civil Engineering sanitary fitting symbols
- 7.2 Electrical fitting symbols for domestic interior installations

- *8. Introduction to AutoCAD (02 sheets)

Basic introduction and operational instructions of various commands in AutoCAD. At least two sheets on AutoCAD of cube, cuboid, cone, pyramid, truncated cone and pyramid, sphere and combination of above solids.

- * **Auto CAD drawing will be evaluated internally for sessional assessment.**

INSTRUCTIONAL STRATEGY

Teacher should show model of realia of the component/part whose drawing is to be made. Emphasis should be given on cleanliness, dimensioning and layout of sheet. Focus should be on proper selection of drawing instruments and their proper use. The institute should procure AutoCAD or other engineering graphics software for practice in engineering drawings. Teachers should undergo training in AutoCAD/Engineering Graphic. Separate labs for practice on AutoCAD should be established.

RECOMMENDED BOOKS

1. A Text Book of Engineering Drawing by Surjit Singh; Dhanpat Rai & Co., Delhi
2. Engineering Drawing by PS Gill; SK Kataria & Sons, New Delhi
3. Elementary Engineering Drawing in First Angle Projection by ND Bhatt; Charotar Publishing House Pvt. Ltd., Anand
4. Engineering Drawing I & II by JS Layall; Eagle Parkashan, Jalandhar
5. Engineering Drawing I by DK Goel, GBD Publication.

1.7 GENERAL WORKSHOP PRACTICE – I

(Common for all branches)

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-	6

RATIONALE

In order to have a balanced overall development of diploma engineers, it is necessary to integrate theory with practice. General workshop practices are included in the curriculum in order to provide hands-on experience about use of different tools and basic manufacturing practices. This subject aims at developing general manual and machining skills in the students. In addition, the development of dignity of labour, safety at work place, team working and development of right attitude are the other objectives.

DETAILED CONTENTS (PRACTICAL EXERCISES)

Note: The students are supposed to come in proper workshop dress prescribed by the institute. Wearing shoes in the workshop(s) is compulsory. Importance of safety and cleanliness, safety measures and upkeep of tools, equipment and environment in each of the following shops should be explained and practiced. The students should prepare sketches of various tools/jobs in their practical Notebook.

The following shops are included in the syllabus:

1. Welding Shop – I
2. Fitting Shop – I
3. Sheet Metal Shop – I
4. Electric Shop-I
5. Carpentry Shop – I
6. Smithy Shop – I

1. WELDING SHOP – I

1.1 Introduction and importance of welding as compared to other material joining processes. Specifications and type of welding machines, classification and coding of electrodes, welding parameters, welding joints and welding positions. Materials to be welded, safety precautions.

1.2 Jobs to be prepared

Job I Practice of striking arc (Minimum 4 beads on 100 mm long M.S. flat).

Job II Practice of depositing beads on plate at different current levels. (Minimum 4 beads on M.S. plate at four setting of current level).

Job III Preparation of lap joint using arc welding process.

Job IV Preparation of butt joint using arc welding process. (100 mm long).

Job V Preparation of T Joint using gas or arc welding (100mm x 6 mm M.S. Flat).

2. FITTING SHOP – I

- 2.1 Use of personal protective equipment and safety precautions while working.
- 2.2 Basic deburring processes.
- 2.3 Introduction to fitting shop tools, marking and measuring devices/equipment.
- 2.4 Identification of materials. (Iron, Copper, Stainless Steel, Aluminium etc.)
- 2.5 Identification of various steel sections (flat, angle, channel, bar etc.).
- 2.6 Introduction to various fitting shop operations/processes (Hacksawing, Drilling, Chipping and Filing).

Job I Marking of job, use of marking tools, filing and use of measuring instruments. (Vernier calliper, Micrometer and Vernier height gauge).

Job II Filing a rectangular/square piece to maintain dimensions within an accuracy of ± 0.25 mm.

Job III Making a cut-out from a square piece of MS flat using hand hacksaw and chipping.

3. SHEET METAL SHOP – I

3.1. Introduction to sheet metal shop, use of hand tools and accessories e.g. different types of hammers, hard and soft mallet, sheet and wire gauge, necessary allowance required during job fabrication, selection of material.

3.2 Introduction and demonstration of hand tools used in sheet metal shop.

3.3 Introduction and demonstration of various machines and equipment used in sheet metal shop e.g. Shearing Machine, Bar Folder, Burring Machine, Turning Machine, Wiring Machine, Setting Down Machine, Forming Machine, Brake etc.

3.4 Introduction and demonstration of various raw materials used in sheet metal shop e.g. black-plain sheet, galvanized-iron plain sheet, galvanised corrugated sheet, aluminium sheet etc.

3.5 Study of various types of nuts, bolts, rivets, screws etc.

Job I Shearing practice on a sheet using hand shears.

Job II Practice on making Single riveted lap joint/Double riveted lap Joint.

Job III Practice on making Single cover plate chain type, zig-zag type and single riveted Butt Joint.

4. ELECTRIC SHOP - I

4.1 Study, demonstration and identification of common electrical materials with standard ratings and specifications such as wires, cables, switches, fuses, cleats, clamps and allied items, tools and accessories.

4.2 Study of electrical safety measures and protective devices.

Job I Identification of phase, Neutral and Earth wires for connection to domestic electrical appliances and their connections to three pin plugs.

Job II Carrying out house wiring circuits using fuse, switches, sockets, ceiling rose etc. in batten or P.V.C. casing-caping.

4.3 Study of common electrical appliances such as auto electric iron, electric kettle, ceiling/table fan, desert cooler etc.

4.4 Introduction to the construction of lead acid battery and its working.

Job III Installation of battery and connecting two or three batteries in series and parallel.

- 4.5 Introduction to battery charger and its functioning.
Job IV Charging a battery and testing with hydrometer and cell tester

5. CARPENTRY SHOP - I

5.1 General Shop Talk

5.1.1 Name and use of raw materials used in carpentry shop : wood & alternative materials

5.1.2 Names, uses, care and maintenance of hand tools such as different types of Saws, C-Clamp, Chisels, Mallets, Carpenter's vices, Marking gauges, Try-squares, Rulers and other commonly used tools and materials used in carpentry shop by segregating as cutting tools, supporting tools, holding tools , measuring tools etc.

5.1.3 Specification of tools used in carpentry shop.

5.1.4 Different types of Timbers, their properties, uses & defects.

5.1.5 Seasoning of wood.

5.1.6 Estimation.

5.2 Practice

5.2.1 Practices for Basic Carpentry Work

5.2.2 Sawing practice using different types of saws

5.2.3 Assembling jack plane — Planning practice including sharpening of jack plane cutter

5.2.4 Chiselling practice using different types of chisels including sharpening of chisel

5.2.5 Making of different types of wooden pin and fixing methods. Marking measuring and inspection of jobs.

5.3 Job Practice

Job I Marking, sawing, planning and chiselling and their practice

Job II Half Lap Joint (cross, L or T – any one)

Job III Mortise and Tenon joint (T-Joint)

Job IV Dove tail Joint (Lap or Bridle Joint)

6. SMITHY SHOP - I

6.1 General Shop Talk

6.1.1 Purpose of Smithy shop

6.1.2 Different types of Hearths used in Smithy shop

6.1.3 Purpose, specifications, uses, care and maintenance of various tools and equipments used in hand forging by segregating as cutting tools, supporting tools, holding tools, measuring tools etc.

6.1.4 Types of fuel used and maximum temperature obtained

6.1.5 Types of raw materials used in Smithy shop

6.1.6 Uses of Fire Bricks & Clays in Forging workshop.

6.2 Practice

6.2.1 Practice of firing of hearth/Furnace, Cleaning of Clinkers and Temperature Control of Fire.

6.2.2 Practice on different basic Smithy/Forging operations such as Cutting, Upsetting, Drawing down, Setting down, Necking, Bending, Fullering, Swaging, Punching and Drifting

a) Demonstration — Making cube, hexagonal cube, hexagonal bar from round bar

6.2.3 Practice of Simple Heat treatment processes like Tempering, Normalizing Hardening etc

Job Practice: Job Preparation

Job I Making a cold / hot, hexagonal / octagonal flat chisel including tempering of edges.

Job II Production of utility goods e.g. hexagonal bolt / square shank boring tool, fan hook (long S-type) [Two jobs are to be done by the students].

Job III To prepare a cube from a M.S. round by forging method.

RECOMMENDED BOOKS

1. Workshop Technology I,II,III, by SK Hajra, Choudhary and AK Choudhary; Media Promoters and Publishers Pvt. Ltd. Mumbai.
2. Workshop Technology Vol. I, II, III by Manchanda; India Publishing House, Jalandhar.
3. Workshop Training Manual Vol. I, II by S.S. Ubhi; Katson Publishers, Ludhiana.
4. Manual on Workshop Practice by K Venkata Reddy; MacMillan India Ltd., New Delhi
5. Basic Workshop Practice Manual by T Jeyapoovan; Vikas Publishing House (P) Ltd., New Delhi
6. Workshop Technology by B.S. Raghuwanshi; Dhanpat Rai and Co., New Delhi
7. Workshop Technology by HS Bawa; Tata McGraw Hill Publishers, New Delhi.