# SHRI VENKATESHWARA UNIVERSITY

# Syllabus

## DIPLOMA

## Mechanical Engineering (Production)

**(Three Years Programme)**

**(w.e.f. 2019-20)**

## SCHOOL OF ENGINEERING & TECHNOLOGY

Evaluation Scheme

| **MechanicalEngineering (Production)** SEMESTER-I | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sl. No.** | **Subject Codes** | **Subject** | **Periods** | | | **Evaluation Scheme** | | | | **End Semester** | | Total | Credit |
| | | | L | T | P | CT | TA | Total | PS | TE | PE | | |
| 1 | PBS-101 | APPLIED MATHEMATICS-I | 4 | 1 | 0 | 20 | 10 | 30 | | 70 | | 100 | 5 |
| 2 | PBS-102 | APPLIED PHYSICS | 3 | 1 | 0 | 20 | 10 | 30 | | 70 | | 100 | 4 |
| 3 | PBS-103 | APPLIED CHEMISTY | 3 | 1 | 0 | 20 | 10 | 30 | | 70 | | 100 | 4 |
| 4 | PHS-104 | COMMUNICATION SKILLS | 4 | 0 | 0 | 20 | 10 | 30 | | 70 | | 100 | 4 |
| 5 | PBS-112 | APPLIED PHYSICS-I LAB | 0 | 0 | 2 | | | | 10 | | 15 | 25 | 1 |
| 6 | PBS-113 | APPLIED CHEMISTRY LAB | 0 | 0 | 2 | | | | 10 | | 15 | 25 | 1 |
| 7 | PED-114 | ENGINEERING DRAWING LAB | 0 | 0 | 4 | | | | 25 | | 25 | 50 | 2 |
| 8 | PWP-115 | GENERAL WORKSHOP PRACTICE LAB | 0 | 0 | 4 | | | | 25 | | 25 | 50 | 2 |
| | | Total | | | | | | | | | | 550 | 23 |

## PBS-101: APPLIED MATHEMATICS - I

**L T P**
**4 0 0**

1. Algebra -I

Series : AP and GP; Sum, nth term, Mean Binomial theorem for positive, negative and fractional index (without proof). Application of Binomial theorem.

Determinants : Elementary properties of determinant of order 2 and 3, Multiplication system of algebraic equation, Consistency of equation, Crammer's rule

2. Algebra- II

Vector algebra : Dot and Cross product, Scaler and vector triple product.

Complex number.

Complex numbers, Representation, Modulus and amplitude Demoivre theorem, its application in solving algebraic equations, Mod. function and its properties..

3. Trigonometry

Relation between sides and angles of a triangle : Statement of various formulae showing relationship between sides and angle of a triangle.

Inverse circular functions : Simple case only

4. Differential Calculus - I

Functions, limits, continuity, - functions and their graphs, range and domain, elementary methods of finding limits (right and left), elementary test for continuity and differentiability.

Methods of finding derivative, Trigonometric functions, exponential function, Function of a function, Logaritimic differentiation, Differentiation of Inverse trigonometric function, Differentiation of implicit functions.

5. Differential Calculus - II

Higher order derivatives, Leibnitz theorem (without proof). Simple applications.

Application - Finding Tangents, Normal, Points of Maxima/Minima, Increasing/Decreasing functions, Rate, Measure, velocity, Acceleration, Errors and approximation.

**RECOMMENDED BOOKS**


1. Elementary Engineering Mathematics by BS Grewal, Khanna Publishers, New Delhi
2. Engineering Mathematics, Vol I & II by SS Sastry, Prentice Hall of India Pvt. Ltd.,
3. Applied Mathematics-I by Chauhan and Chauhan, Krishna Publications, Meerut.
4. Applied Mathematics-I (A) by Kailash Sinha and Varun Kumar; Aarti Publication, Meerut

## PBS-102: APPLIED PHYSICS

**L T P**
**4 0 0**

Unit 1. Units and Dimensions

Need of Measurement in engineering and science, unit of a physical quantities- fundamental and derived units, systems of units (FPS, CGS and SI units)
Dimensions and dimensional formulae of physical quantities.
Principle of homogeneity of dimensions
Dimensional equations and their applications, conversion of numerical values of physical quantities from one system of units into another, checking the correctness of physical equations and deriving relations among various physical quantities
Limitations of dimensional analysis
Error in measurement, accuracy and precision of instruments, random and systematic errors, absolute error, relative error, and percentage error, Estimation of probable errors in the results of measurement (combination of errors in addition, subtraction, multiplication, division and powers), rules for representing significant figures in calculation.
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).

Unit 2. Force and Motion

Scalar and vector quantities – examples, representation of vector, types of vectors Addition and Subtraction of Vectors, Triangle and Parallelogram law (Statement only), Scalar and Vector Product.
Resolution of Vectors and its application to lawn roller.
Force, Momentum, Statement and Derivation of Conservation of linear momentum, its applications such as recoil of gun.
Impulse and its Applications
Circular motion (Uniform and Non-uniform), definition of angular displacement, angular velocity, angular acceleration, frequency, time period.
Relation between linear and angular velocity, linear acceleration and angular acceleration (related numerical)
Central force, Expression and Applications of Centripetal and centrifugal forces with examples such as banking of roads and bending of cyclist, Principle of centrifuge.
Application of various forces in lifts, cranes, large steam engines and turbines

Unit 3. Work, Power and Energy

Work: and its units, examples of zero work, positive work and negative work, conservative and non-conservative force,
Friction: modern concept, types, laws of limiting friction, Coefficient of friction and its Engineering Applications.
Work done in moving an object on horizontal and inclined plane for rough and plane surfaces with its applications
Energy and its units: Kinetic energy and potential energy with examples and their derivation, work energy theorem.
Principle of conservation of Mechanical(PRODUCTION) energy for freely falling bodies, examples of transformation of energy.
Power and its units, calculation of power in numerical problems
Application of Friction in brake system of moving vehicles, bicycle, scooter, car trains etc.

Unit 4 Rotational Motion

Concept of translatory and rotatory motions with examples
Definition of torque with examples
Angular momentum, Conservation of angular momentum (quantitative) and its examples
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). Concept of Fly wheel.
Rotational kinetic energy, Rolling of sphere on the slant plane,
Comparison of linear motion and rotational motion.
Application of rotational motions in transport vehicles, and machines.

Unit 5 Motion of planets and satellites

Gravitational force, Kepler's law of planetary motion,
Acceleration due gravity and its variation,
Gravitational Potential and Gravitational potential energy,
Motion of satellite, orbital velocity and time period of satellite, Total energy and Binding energy of a satellite, Escape energy and escape velocity,
Types of satellites, Geo-stationarysatellite, semi-synchronous, polar satellite (concept only) and their uses in science and technology,
Concept of Black Holes

Unit 6. Properties of Matter

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

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

Surface tension: concept, its units, angle of contact, Capillary action and determination of surface tension from capillary rise method, applications of surface tension, effect of temperature and impurity on surface tension

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

Concept of fluid motion, stream line and turbulent flow, Reynold's number Equation of continuity, Bernoulli's Theorem and their applications.

Unit 7. Heat and Thermodynamics

Difference between heat and temperature

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

Different scales of temperature and their relationship

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

Heat conduction in a metal rod, Temperature gradient, Concept of Co-efficient of thermal conductivity, Uses and effects of Heat conduction in Daily life.

Isothermal and Adibatic process

Zeroth, First and second law of thermodynamics, Heat engine (concept Only), Carnot cycle.

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

RECOMMENDED BOOKS


1 Text Book of Physics for Class XI (Part-I, Part-II); N.C.E.R.T., Delhi

2 Concepts in Physics by HC Verma, Vol. I & II, Bharti Bhawan Ltd. New Delhi

3 Comprehensive Practical Physics, Vol, I & II, JN Jaiswal, Laxmi Publications (P) Ltd., New Delhi

4 B.Sc.Practical Physics by C L Arora, S. Chand Publication..

5 Engineering Physics by PV Naik, Pearson Education Pvt. Ltd, New Delhi

6 Engineering Physics by DK Bhhatacharya & Poonam Tandan; Oxford University Press, New Delhi

7 Modern Engineering Physics by SL Gupta, Sanjeev Gupta, Dhanpat Rai Publications

8 V. Rajendran,physics-I, Tata McGraw-Hill raw Hill publication, New Delhi

9 Arthur Beiser, Applied Physics, Tata McGraw-Hill raw Hill publication, New Delhi

10 Physics Volume 1, 5th edition, Haliday Resnick and Krane, Wiley publication

## PBS-103 : APPLIED CHEMISTRY

**L T P**
**4 0 0**

UNIT : 1 Atomic Structure, Periodic Table and Chemical Bonding

Fundamental particles- mass and charges of electrons, protons and neutrons with names of the scientists who discovered these fundamental particles.
Bohr's model of atom and successes and limitations of atomic theory (qualitative treatment only).
Atomic number, atomic mass number isotopes and isobars.
Definition of orbit and orbitals, shapes of s and p orbitals only, quantum numbers and their significance,
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).
Modern periodic law and periodic table, groups and periods, classification of elements into s, p, d and f blocks (periodicity in properties - excluded)
Chemical bonding and cause of bonding and types such as ionic bond in NaCl sigma ($\sigma$) and pi ($\pi$) covalent bonds in $H_2$, HCl, $Cl_2$, elementary idea of hybridization in $BeCl_2$, $BF_3$, $CH_4$, $NH_3$ and $H_2O$, VSEPR, Molecular orbital Theory
States of Matter: Solid, Liquid & Gas, Metallic bonding- explanation with the help of electron gas (sea) model.

UNIT : 2 Fuelsand Lubricants

Definition of fuel, classification of fuels, characteristics of good fuel, relative merits of gaseous, liquid and solid fuels
Calorific value-higher calorific value, lower calorific value, determination of calorific value of solid or liquid fuel using Bomb calorimeter and numerical examples.
Coal - types of coal and proximate analysis of coal
Fuel rating – Octane number and Cetane number, fuel-structural influence on Octane and Cetane numbers
Gaseous fuels – chemical composition, calorific value and applications of natural gas (CNG), LPG, producer gas, water gas and biogas.
Elementary ideal on – hydrogen as future fuels, nuclear fuels.
Lubricants: Definition and properties, mechanism, industrial application and its function in bearings.
Synthetic lubricants and cutting fluids.

UNIT : 3 Water

Demonstration of water resources on Earth using pie chart.
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 numerical, pH and buffer solutions and their applications.
Disadvantages caused by the use of hard water in domestic and boiler feed water. Primming and foaming and caustic embrittlement in boilers.
Removal of hardness -Permutit process and Ion-exchange process.
Physico-Chemical methods for Water Quality Testing
Determination of pH using pH meter, total dissolved solids (TDS)
Testing and Estimation of- alkalinity, indicator their types and application total hardness by EDTA method and O'Hener's Method. (chemical reaction of EDTA method are excluded).
Understanding of Indian Water Quality standards as per WHO
Natural water sterilization by chlorine and UV radiation and reverse osmosis.
Municipality waste water treatment. Definition of B.O.D and C.O.D.

Electrochemistry

Redox Reaction, Electrode Potential, Nernst equation, Electrochemical cell (Galvanic and Electrobytes); Nernst equation.

UNIT : 4 Corrosion and its Control

Definition of corrosion and factors affecting corrosion rate.
Theories of Dry (chemical) corrosion- Pilling Bedworth rule, Wet corrosion in acidic atmosphere by hydrogen evolution mechanism
Definition of passivity and galvanic series, Corrosion control:
Metal coatings – Cathodic protection, Cementation on Base Metal Steel –Application of Metal Zn (Sheradizing),Cr (Chromozing) and Al (Calorizing), Sacrificial protection and impressed current voltage
Inorganic coatings – Anodizing and phosphating, Organic coatings - use of paints varnishes and enamels
Internal corrosion preventive measures- alloying (with reference to passivating, neutralizing and inhibition) and heat treatment (quenching, annealing)

UNIT : 5 Organic compounds, Polymers and Plastics

Classification of organic compounds and IUPAC Nomenclature, Definition of polymer, monomer and degree of polymerization, Brief introduction to addition and condensation

polymers with suitable examples (PE, PS, PVC, Teflon, Nylon -66 and Bakelite), Definition of plastics, thermo plastics and thermo setting plastics with suitable examples, distinctions between thermo and thermo setting plastics Applications of polymers in industry and daily life

**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

## PHS-104 : COMMUNICATION SKILLS – I

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Unit 1 Basics of Communication

Definition and process of communication
Types of communication - formal and informal, oral and written, verbal and non-verbal
Communications barriers and how to overcome them
Barriers to Communication, Tools of Communication

Unit 2 Application of Grammer

Parts of Speech (Noun, verb, adjective, adverb) and modals
Sentences and its types
Tenses
Active and Passive Voice
Punctuation
Direct and Indirect Speech

Unit 3 Reading Skill

Unseen passage for comprehension (one word substitution, prefixes, suffixes, antonyms, synonyms etc. based upon the passage to be covered under this topic)

Unit 4 Writing Skill

Picture composition
Writing paragraph
Notice writing

RECOMMENDED BOOKS


1. Communicating Effectively in English, Book-I by RevathiSrinivas; Abhishek Publications, Chandigarh.
2. Communication Techniques and Skills by R. K. Chadha; DhanpatRai Publications, New Delhi.
3. High School English Grammar and Composition by Wren & Martin; S. Chand & Company Ltd., Delhi.
4. Excellent General English-R.B.Varshnay, R.K. Bansal, Mittal Book Depot, Malhotra
5. The Functional aspects of Communication Skills – Dr. P. Prsad, S.K. Katria & Sons, New Delhi
6. Q. Skills for success – Level & Margaret Books, Oxford University Press.
7. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR.

## PBS-112 : APPLIED PHYSICS LAB

**L T P**
**0 0 2**

LIST OF PRACTICALS (to perform minimum six experiments)

1 To find radius of wire and its volume and the maximum permissible error in these quantities by using both vernier calipers and screw gauge.
2 To find the value of acceleration due to gravity on the surface of earth by using a simple pendulum.
3 To determine the Radius of curvature of (i) convex mirror, (ii) concave mirror by spherometer
4 To verify parallelogram law of forces
5 To study conservation of energy of a ball or cylinder rolling down an inclined plane.
6 To find the Moment of Inertia of a flywheel about its axis of rotation
7 To determine the atmospheric pressure at a place using Fortin's Barometer
8 To determine the viscosity of glycerin by Stoke's method
9 To determine the coefficient of linear expansion of a metal rod
10 To determine force constant of spring using Hooks law

## PBS-113 : APPLIED CHEMISTRY LAB

**L T P**
**0 0 2**

### LIST OF PRACTICALS

1. Estimation of total hardness of water using standard EDTA solution
2. Estimation of total alkalinity of given water sample by titrating it against standard sulfuric acid solution
3. Proximate analysis of solid fuel)
4. Estimation of temporary hardness of water sample by O' Hener's Method.
5. Determination of flash and fire point of given lubricating oil using Able's flash point apparatus

## PED-114 : ENGINEERING DRAWING – I

| L | T | P |
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1. Introduction to Engineering Drawing (03 sheets)

Introduction to drawing instruments, materials, layout and sizes of drawing sheets and drawing boards.

Different types of lines in Engineering drawing as per BIS specifications

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.

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)

Necessity of dimensioning, method and principles of dimensioning (mainly theoretical instructions)

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)

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

Drawing of plain and diagonal scales

4. Orthographic Projections (06 sheets)

Theory of orthographic projections (Elaborate theoretical instructions)

Projection of Points in different quadrant

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

Line parallel to both the planes

Line perpendicular to any one of the reference plane

Line inclined to any one of the reference plane.

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

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

Identification of surfaces

5 Projection of Solid (02 sheets)

Definition and salient features of Solid

Types of Solid (Polyhedron and Solid of revolution)
To make projections, sources, Top view, Front view and Side view of various types of Solid.

6. Sections (02 sheets)

Importance and salient features
Drawing of full section, half section, partial or broken out sections, Offset sections, revolved sections and removed sections.
Convention sectional representation of various materials, conventional breaks for shafts, pipes, rectangular, square, angle, channel, rolled sections
Orthographic sectional views of different objects.

7. Isometric Views (02 sheets)

Fundamentals of isometric projections and isometric scale.
Isometric views of combination of regular solids like cylinder, cone, cube and prism.

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.

## PWP-115: GENERAL WORKSHOP PRACTICE – I

**L T P**

**- - 4**

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. Carpentry Shop
2. Painting and Polishing Shop
3. Electrical Shop
4. Welding Shop
5. Plumbing Shop

### 1. CARPENTRY SHOP

General Shop Talk
Name and use of raw materials used in carpentry shop : wood & alternative materials
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.
Specification of tools used in carpentry shop.
Different types of Timbers, their properties, uses & defects.
Seasoning of wood.

Practice
Practices for Basic Carpentry Work
Sawing practice using different types of saws
Assembling jack plane — Planning practice including sharpening of jack plane cutter
Chiselling practice using different types of chisels including sharpening of chisel
Making of different types of wooden pin and fixing methods. Marking measuring and inspection of jobs.

### 1.3 Job Practice

Job 1 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)

1.4. Demonstration of job showing use of Rip Saw, Bow saw and Tenon saw, method of sharpening various saws.

## 2. PAINTING AND POLISHING SHOP

Introduction of paints, varnishes, Reason for surface preparation, Advantages of Painting, other method of surface coating ie. Electroplating etc.

Job Practice
Job 1: To prepare a wooden surface for painting apply primer on one side and to paint the same side. To prepare french polish for wooden surface and polish the other side.
Job II: To prepare metal surface for painting, apply primer and paint the same.
Job III: To prepare a metal surface for spray painting, first spray primer and paint the same by spray painting gun and compressor system.

The sequence of polishing will be as follows:
i) Abrasive cutting by leather wheel
ii) Polishing with hard cotton wheel and with polishing material
iii) Buffing with cotton wheel or buff wheel.

## 3. ELECTRICAL SHOP

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.
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.
Study of common electrical appliances such as auto electric iron, electric kettle, ceiling/table fan, desert cooler etc.
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.
Introduction to battery charger and its functioning.
Job IV Charging a battery and testing with hydrometer and cell tester

4. WELDING SHOP

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.

Job Practice

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 T-joint using gas welding or arc welding on 100 mm x 6 mm MS Flat

5. PLUMBING SHOP

Use of personal protective equipments, safety precautions while working and cleaning of shop. Introduction and demonstration of tools, equipment and machines used in plumbing shop. Introduction of various pipes and pipe fittings of elbow, nipple, socket, union etc.

Job Practice

Job 1 : Preparation of job using elbow, bend and nipple

Job II: Preparation of job using Union, Tap, Plug and Socket. Job III: Threading practice on pipe with die

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.