CERTIFICATE

OF

VOCATIONAL EDUCATION

EXAMINATION (YEAR 12)

SYLLABUS FOR

MECHANICAL ENGINEERING TECHNICIAN

Correspondence should be addressed to

THE CHIEF EXECUTIVE & SECRETARY
COUNCIL FOR THE INDIAN SCHOOL CERTIFICATE EXAMINATIONS
P-35,36 Sector VI
Pushp Vihar
Saket
New Delhi – 110017

The certificate course in **MECHANICAL ENGINEERING TECHNICIAN (MET)** is equivalent to Class XII, with the added advantage of acquiring a basic knowledge of Mechanical Engineering.

A successful candidate has two options open to him:

1. To become a small-scale entrepreneur and execute Mechanical Engineering Contracts.
2. To find suitable employment in the Manufacturing Industry.

A successful candidate, if interested, has a third option of taking up higher studies in Mechanical Engineering by joining the Institution of Engineers (India) as a student member.

Eligibility Criteria:

The eligibility criteria for taking admission in CVE 12 Examination are as follows:

1. Age: 16 to 25 years
2. Must have passed Class X Examination from any recognized Board with English, Science and Mathematics as compulsory subjects

CONTENTS

CLASS XI – SUBJECT STRUCTURE & MARKING SCHEME

Sl. No.	NAME OF THE SUBJECT	Internal Assessment	External Assessment	Total Marks	Pass Criteria (%)
1	English	30	70	100	35
2	General Foundation, Industrial Sociology & Entrepreneurship	30	70	100	35
3	Engineering Physics	30	70	100	35
4	Engineering Chemistry	30	70	100	35
5	Applied Mathematics	30	70	100	35
6	Engineering Graphics	30	70	100	35
7	Fundamentals of Computer	30	30 + 40	100	35
8	Production Technology - Paper I	30	70	100	35
9	Production Technology - Paper II	30	70	100	50

Note:

FUNDAMENTALS OF COMPUTER - There will a project of 30 marks and examination of 40 marks to be conducted by the Council.

CLASS XII – SUBJECT STRUCTURE & MARKING SCHEME

Sl. No.	NAME OF THE SUBJECT	Internal Assessment	External Assessment	Total Marks	Pass Criteria (%)
1	English	30	70	100	35
2	General Foundation, Industrial Sociology & Entrepreneurship	30	70	100	35
3	Engineering Graphics	30	70	100	35
4	Engineering Science	30	70	100	35
5	Technician Mathematics	30	70	100	35
6	Production Technology – Paper I	30	70	100	35
7	Production Technology - Paper II	30	70	100	50

MECHANICAL ENGINEERING TECHNICIAN

Aims:

On successful completion of the course, the technician should:

1. Be aware of safety precautions to be taken to ensure safe working conditions.
2. Be able to select common hand tools and powered hand tools for specific use.
3. Be aware of the forms of supply and properties of materials - metallic and non-metallic.
4. Know the process involved in fabrication of components using both fusion and non-fusion methods of joining.
5. Be able to layout and mark jobs for production.
6. Know the difference between measuring and gauging with corresponding advantages and disadvantages.
7. Handle precision measuring instruments for assessment.
8. Have knowledge of the following machines in relation to its mechanics, types, ranges, uses, attachments and safety:
   i) Lathes ii) Shaping machines iii) Drilling machines iv) Milling machines v) Grinding Machines vi) Slotting machines.
9. Be familiar with single, multiple point cutting tools and cutting tool materials.
10. Have knowledge in sand casting, gravity and pressure die casting, compression transfer and injection moulding.

MECHANICAL ENGINEERING

TECHNICIAN

SYLLABUS FOR CLASS XI

English
Class XI

Examination Duration: 3 Hours

S.No.	Name of the Topic	No. of Hours
	GRAMMAR	
T1	Sentences	6
2	Subject & Predicate	6
3	Parts of Speech	20
4	Phrases & Clauses	9
5	Simple, Compound & Complex Sentences	10
6	Tenses	12
7	Formal Letter Writing	12
	LITERATURE	
1	The Eyes Have It	6
2	Job Hunting	6
3	Benjamin Franklin	6
4	The Martyr's Corner	6
5	Life History of Abdul Kalam	6
TOTAL NUMBER OF HOURS		105

General Foundation, Industrial Sociology and Entrepreneurship
Class XI

Examination Duration: 3 Hours

S.No.	Name of the Topic	No. of Hours
1	**Personality Development**	13
2	**Human and Industrial Relationship**	15
3	**Developing Coping Mechanism**	15
4	**Motivation**	10
5	**Professional Ethics**	12
6	**Developing Fitness for a Job**	15
TOTAL NUMBER OF HOURS		80

1. **Personality Development:**
   - **1.1** Self-esteem
   - **1.2** Self-concept
   - **1.3** Self-acceptance

2. **Human and Industrial Relations:**
   - **2.1** Human relations and performance in organisation
   - **2.2** Understand self and others for effective behaviour
   - **2.3** Behaviour modification techniques
   - **2.4** Industrial relations and disputes
   - **2.5** Relations with subordinates, peers & superiors
   - **2.6** Characteristics of group behaviour and trade unions

3. **Developing Coping Mechanism:**
   - **3.1** Coping with loneliness
   - **3.2** Coping with depression
   - **3.3** Coping with fear
   - **3.4** Coping with shyness
   - **3.5** Coping with anger
   - **3.6** Coping with failure
   - **3.7** Coping with criticism

- **3.8** Coping with conflicts
- **3.9** Coping with change
- **3.10** Coping with study
- **3.11** Substance abuse
- **3.12** Mass media

4. **Motivation:**
   - **4.1** Factors determining motivation
   - **4.2** Characteristics of motivation
   - **4.3** Methods of improving motivation

5. **Professional Ethics:**
   - **5.1** Concept of ethics
   - **5.2** Concept of professionalism
   - **5.3** Need for professional ethics

6. **Developing fitness for a job:**
   - **6.1** Leadership
   - **6.2** Team work
   - **6.3** Career guidance
   - **6.4** Work environment

Engineering Physics

Class XI

Examination Duration: 3 Hours

S. No.	Name of the Topic	No. of Hours
1	**Units**	5
2	**Mass, Weight & Density**	15
3	**Rest & Motion**	20
4	**Work, Power & Energy**	18
5	**Moments, Lever and Centre of Gravity**	18
6	**Heat & Temperature**	24
7	**Friction**	15
TOTAL NUMBER OF HOURS		115

1. **Units:**
   - **1.1** Introduction
   - **1.2** Definition of Unit
   - **1.3** System of Units (CGS, MKS & FPS)
   - **1.4** Physical Quantity
   - **1.5** Fundamental Units
   - **1.6** SI Derived units
   - **1.7** Inter relation between Metric & British System of Units

2. **Mass, Weight & Density:**
   - **2.1** Mass
   - **2.2** Weight
   - **2.3** Differences between mass & weight of substances
   - **2.4** Density
   - **2.5** Relative Density
   - **2.6** Differences between Density & Relative Density
   - **2.7** Archimedes Principle
   - **2.8** Finding out the relative density of the substances using Archimedes' Principle
   - **2.9** Buoyancy, Law of Floatation & Centre of Floatation
   - **2.10** Hydrometer, Nicholson's Hydrometer and related numerical

3. **Rest & Motion:**
    - **3.1** Rest & Motion
    - **3.2** Laws of Inertia
    - **3.3** First Law of Motion
    - **3.4** Momentum
    - **3.5** Second Law of Motion
    - **3.6** Third Law of Motion
    - **3.7** Vector Quantity
    - **3.8** Scalar Quantity
    - **3.9** Speed &Velocity
    - **3.10** Differences between speed & velocity
    - **3.11** Acceleration
    - **3.12** Equation of motion
    - **3.13** Motion under the force of gravity

4. **Work, Power & Energy:**
    - **4.1** Work
    - **4.2** Work represented by an area or diagram of force
    - **4.3** Work done by an oblique force
    - **4.4** Torque
    - **4.5** Power
    - **4.6** Horse power of engines
    - **4.7** Power required for rotation & determination of the output power of a machine by means of a brake system
    - **4.8** Efficiency of a machine
    - **4.9** Energy – Its uses & application
    - **4.10** Types of energy – Potential & Kinetic with their applications
    - **4.11** Principle of conservation of energy
    - **4.12** Other forms of energy
    - **4.13** Transmission of power by belt pulley drive
    - **4.14** IHP of steam and petrol engine
    - **4.15** Electrical Power & Energy

5. **Moments, Lever and Centre of Gravity:**
    - **5.1** Moments – Its definition
    - **5.2** Arm of Couple
    - **5.3** Moment of Couple
    - **5.4** Lever – Its definition, types, application & order
    - **5.5** Bell Crank Lever
    - **5.6** Application of the principle of moments

5.7 Centre of Gravity

5.8 Stable, Unstable and Neutral Equilibrium

6. Heat & Temperature:

6.1 Heat – Its definition

6.2 Temperature – Its definition

6.3 Differences between heat and temperature

6.4 Temperature scale (Celsius, Fahrenheit & Kelvin)

6.5 Relationship between Celsius, Fahrenheit & Kelvin Scales

6.6 Boiling point, melting point and specific heat

6.7 Transmission of heat, conduction, convection and radiation

6.8 Heat transfer in mixture, Calorimeter and latent heat of fusion and vapour

6.9 Thermos flask, Pyrometer, Thermocouple, thermoelectric pyrometer

6.10 Calorific values of fuel

7. Friction:

7.1 Definition

7.2 Advantages and disadvantages of friction

7.3 Normal Reaction, Limiting Friction and Laws of limiting friction

7.4 Co-efficient of friction

7.5 Angle of Friction & Angle of Repose and its relationship

7.6 Force of Friction when the force is horizontal and when the force is inclined

7.7 Lubrication for the control of friction

Engineering Chemistry
Class XI

Examination Duration: 3 Hours

S. No.	Name of the Topic	No. of Hours
1	**Introduction to Periodic Table**	14
2	**States of matter**	10
3	**Physical and Chemical changes**	14
4	**Air**	6
5	**Water**	10
6	**Acid, Base & Salt**	18
7	**Metals & Non-metals**	8
TOTAL NUMBER OF HOURS		80

1. Introduction to Periodic Table:

- **1.1** General Symbols, Atomic Numbers and Atomic Structure
- **1.2** Introduction to the different elements
- **1.3** General Plan for Periodic Table
- **1.4** Modern Periodic Table
- **1.5** Periodic trend in physical properties
- **1.6** Valence Electron, Valency, Variation of Atomic Size

2. States of matter:

- **2.1** Detailed study of substance
- **2.2** Molecular, atoms, solids- liquids- gases
- **2.3** Inter- conversion
- **2.4** Elements, compounds, mixture - separation, boiling, freezing, melting, condensation, evaporation, chromatography, distillation and uses

3. Physical and Chemical changes:

- **3.1** Different types of reactions- (exothermic, endothermic, combination, decomposition, displacement, oxidation and reduction)
- **3.2** Temporary and Permanent changes
- **3.3** Illustration & examples

4. Air:

- **4.1** Composition & Properties
- **4.2** Uses of components & its separation
- **4.3** Pollution & preventive measures

5. Water:

- **5.1** Pure & Impure water
- **5.2** Natural and Potable water
- **5.3** Distilled water
- **5.4** Soft and Hard water
- **5.5** Techniques of removing hardness
- **5.6** Uses of Water
- **5.7** Pollution
- **5.8** Contract measure & conservation

6. Acid, Base & Salt:

- **6.1** Introduction
- **6.2** Acids – Classification depending on different factors like source, chemical compound
- **6.3** General properties of an acid
- **6.4** Bases – Classification depending on different factors like acidity of bases and concentration
- **6.5** General properties of bases
- **6.6** Neutralisation
- **6.7** Some basic uses of acid and bases
- **6.8** Salts – Classification depending on different factors
- **6.9** Solubility of salts
- **6.10** Properties of Salts

7. Metals & Non-metals:

- **7.1** Introduction to the topic
- **7.2** Physical Properties of Metals and Non-metals
- **7.3** Chemical Properties of Metals & Non- metals
- **7.4** Occurrence of metals
- **7.5** Activity Series of metals
- **7.6** Extraction of metals
- **7.7** Iron & Steel – Introduction, Occurrence & Properties
- **7.8** Product from the Blast Furnace – Pig Iron
- **7.9** Cast iron and its occurrence
- **7.10** Alloy Steel
- **7.11** Different types of metals (Ferrous & Non-Ferrous) and its properties and household applications

7.12 Other Alloys – Composition & Uses

7.13 Some properties and uses of non-metals

Applied Mathematics
Class XI

Examination Duration: 3 Hours

S. No.	Name of the Topic	No. of Hours
1	**Units**	4
2	**General Simplification**	6
3	**Ratio & Proportion**	4
4	**Percentage**	5
5	**Algebra**	12
6	**Logarithm**	6
7	**Indices**	8
8	**Equations**	14
9	**Factorization**	10
10	**Properties of Triangle, Circle & Polygons**	6
11	**Mensuration**	20
12	**Trigonometry (Ratio & Identities)**	10
TOTAL NUMBER OF HOURS		**105**

1. **Units:**
   - **1.1** Introduction
   - **1.2** Definitions
   - **1.3** Classification of units
   - **1.4** Conversion of the basic mechanical units

2. **General Simplification:**
   - **2.1** Introduction
   - **2.2** Fractions & Decimal Fractions
   - **2.3** LCM & HCF
   - **2.4** Multiplication and division of decimals
   - **2.5** Conversion of fraction from one to another
   - **2.6** Multiplication of fraction with numbers like 10, 100, 1000

2.7 Some more methods of converting fractions

3. Ratio & Proportion:

3.1 Ratio

3.2 Proportion

3.3 Relationship between Ratio & Proportion

4. Percentage:

4.1 Introduction

4.2 Conversion of decimal to percentage and vice versa

4.3 Profit & Loss

5. Algebra:

5.1 Introduction

5.2 Careful consideration of subject items

5.3 Addition and Subtraction

5.4 Multiplication and Division

5.5 Algebraic formulae

5.6 Proofs

6. Logarithm:

6.1 Introduction

6.2 Definition of different terms used in logarithms

6.3 Laws of Logarithm

6.4 How to refer to a log table

6.5 Negative characteristic

6.6 Relationship between log and antilog

6.7 How to refer to Antilog table

6.8 Rules while using logarithms

6.9 Addition, subtraction, multiplication & division using indices

7. Indices:

7.1 Exponent and multiplication

7.2 The laws of indices

7.3 Zero and negative integral indices

7.4 Fractional Indices

7.5 Exponential Equations

8. Equations:

8.1 Equations & Root

8.2 Solving linear equation with one variable
8.3 Solving problems using equations
8.4 Number Problems, Age Problems, Mensuration Problems
8.5 Solving simultaneous linear equation
8.6 Method of elimination by addition and subtraction
8.7 Word problem involving simultaneous equation
8.8 Quadratic Equations – Problems on Quadratic Equation

9. Factorization:

9.1 Factorizing polynomials
9.2 Factorization of a perfect square trinomial – e.g. $(4x^4 + 12x^2 + 9)$
9.3 Factorizing the difference of two squares
9.4 Trinomials
9.5 Factorization using the middle term factor
9.6 Problem solving based on factorization

10. Properties of Angle, Triangle, Circle and Polygons:

10.1 Introduction
10.2 Different properties related to the angular properties of the triangle
10.3 Different types of triangles
10.4 Median and Altitudes
10.5 Mid-Point theorem of the triangle
10.6 Circle - Elements
10.7 Properties of the circle – Arc, Sector, Segment, Chord and Tangent
10.8 Polygons – Types and Features
10.9 Method of finding the internal and external angle of polygons

11. Mensuration:

11.1 Introduction to the topic
11.2 Formulae for various Plane and irregular figures (Area, perimeter and volume)
11.3 Area and Perimeter of Plane Figures like Rectangle, Square, Area of four walls, Triangle, Parallelograms, Rhombus, Trapezium, Circle
11.4 Surface area of different solid figures
11.5 Volume of different Solid figures
11.6 Volume of the metal that is removed from different machining process

12. Trigonometry:

12.1 Introduction to Trigonometry
12.2 Notation for angle
12.3 Trigonometrical Ratio
12.4 Reciprocal ratios

12.5 Understanding of the different sides of the triangle based on the angle given

12.6 Understanding the use of Trigonometrical table for finding different angles

Engineering Graphics

Class XI

Examination Duration: 3 Hours

S. No.	Name of the Topic	No. of Hours
1	Engineering Drawing: Introduction and its importance	2
2	Drawing Instrument: Its Standard and Uses	4
3	Sheet Layout and Sketching	2
4	Lines, Lettering and Numbering	14
5	Dimensioning	4
6	Drawing of Geometrical Figures	30
7	Curves	12
8	Method of presentation of Engineering Drawing	6
9	Symbolic Representation	6
10	Scale	10
11	Drawing of Solid Figures	12
12	Orthographic Projection	32
13	Free Hand Drawing of Tools & Equipment	6
TOTAL NUMBER OF HOURS		140

1. **Engineering Drawing: Introduction and its importance:**
   - **1.1** Introduction
   - **1.2** Definition of Drawing
   - **1.3** Classification of Drawing
   - **1.4** Viewing of engineering drawing sheets
   - **1.5** Method of folding printed drawings

2. **Drawing Instrument: Its Standard and Uses:**
   - **2.1** Drawing Board
   - **2.2** Drafters & Set Squares
   - **2.3** Drawing instruments box
   - **2.4** Scales, Protractor and French curve
   - **2.5** Drawing pencils and different grades

3. **Sheet Layout and Sketching:**
    - **3.1** Standard Sheet Layout
    - **3.2** Standard Sheet Sizes
    - **3.3** Margin Spacing
    - **3.4** Border Lines
    - **3.5** Designing of standard title block with details

4. **Lines, Lettering and Numbering:**
    - **4.1** **Lines –** Introduction, its type, definition, uses and practical application
    - **4.2** **Lettering & Numbering – a** Single Stroke Capital letters (Vertical and Inclined)
      b Gothic Letters
      c Numbering using the same style as stated above
      d Characteristics of different types of lettering

5. **Dimensioning:**
    - **5.1** Dimensioning terms and notation
    - **5.2** Types of Arrow heads
    - **5.3** Placing of the dimensions – Aligned &Uni-Directional System
    - **5.4** Arrangement of Dimensioning
    - **5.5** General rules and practical hints for dimensioning
    - **5.6** Practical representation of the dimensions with examples

6. **Drawing of Geometrical Figures:**
    - **6.1** Bisecting a line
    - **6.2** To draw perpendicular lines
    - **6.3** To draw parallel lines
    - **6.4** To divide a line into equal number of even and odd parts
    - **6.5** To bisect and trisect an angle
    - **6.6** To form different types of angles – Acute, Obtuse, Reflex
    - **6.7** To construct different types of triangle – Scalene, Isosceles, Equilateral and Right Angle
    - **6.8** To draw an arc of a given radius, touching a given arc and a given straight line
    - **6.9** To draw a continuous curve of circular arcs passing through any number of given points
    - **6.10** To construct different types of quadrilaterals
    - **6.11** To construct different types of polygons using various methods
    - **6.12** To construct different types of polygons using the same base
    - **6.13** To draw a circle and understand all its elements
    - **6.14** To inscribe different polygons in a circle
    - **6.15** To describe different polygons about a circle
    - **6.16** To draw a tangent on two same size circles and two different sizes of circles
    - **6.17** To determine the length of a given arc
    - **6.18** To draw a circle touching two converging lines

7. **Curves:**
    - **7.1** Conic Section
    - **7.2** Cycloid
    - **7.3** Epi-Cycloid

8. Method of presentation of Engineering Drawing:

- **8.1** Different methods of representing engineering drawing
- **8.2** Understanding of isometric views with suitable examples
- **8.3** Understanding of oblique views with examples

9. Symbolic Representation:

- **9.1** Representation of basic Electronic & Mechanical symbols
- **9.2** Conventions (Materials, Bar & Profile Section, Welded Joint)

10. Scale:

- **10.1** Introduction and types of scales
- **10.2** Construction of a Plain Scale
- **10.3** Construction of a Vernier Scale
- **10.4** Construction of a Diagonal Scale

11. Drawing of Solid Figures:

- **11.1** Cube, Cuboids, Pyramid, Prism, Cone & Frustum of a Cone

12. Orthographic Projection:

- **12.1** Introduction & principle of projection
- **12.2** Methods of projection
- **12.3** Plane of projection
- **12.4** Four quadrants
- **12.5** First angle of projection – Introduction and symbols used
- **12.6** Examples related to first angle of projection
- **12.7** Constructing a view in first angle from an isometric view
- **12.8** Third angle of projection - Introduction and symbols used
- **12.9** Examples related to third angle of projection
- **12.10** Constructing a view in third angle from an isometric view
- **12.11** To construct isometric views from an orthographic projection
- **13.** Free Hand Drawing of different tools used in the machine shop

Fundamentals of Computer
Class XI

Examination Duration: 2 Hours

S. No.	Name of the Topic	No. of Hours
1	**Introduction to Computer**	5
2	**Number System**	8
3	**Operating System**	4
4	**Introduction to MS Office**	2
5	**Microsoft Word**	10
6	**Microsoft Excel**	16
7	**Microsoft Power Point**	4
8	**Internet & Security**	8
9	**Project Work**	8
TOTAL NUMBER OF HOURS		65

1. Introduction to Computer:

- **1.1** Introduction & application of computers
- **1.2** History of the Computer – Evolution and generation of computers
- **1.3** Hardware & Software
- **1.4** Different Hardware devices with physical demonstration
- **1.5** Different types of software used with their areas of application
- **1.6** Storage devices – Evolution and its application in modern technology
- **1.7** Characteristics of the computer
- **1.8** Organization of the computer
- **1.9** Basic operation carried out by the computer
- **1.10** Understanding the day to day application of the computer

2. Number System:

- **2.1** Introduction to the number system
- **2.2** Types of number systems used – Decimal, Binary, Octal and Hexadecimal
- **2.3** Conversion from Decimal to Binary and vice-versa
- **2.4** Conversion of Decimal to Octal and Vice-Versa
- **2.5** Conversion of Decimal to Hexadecimal and Vice-Versa
- **2.6** Conversion of Fractional Decimal to Binary, Octal and Hexadecimal

2.7 Logic Gate – Not, Or, And

3. Operating System:

3.1 Introduction about Operating System and its uses
3.2 Types of Operating System
3.3 Application of Operating System in our computer
3.4 Method of Installing the Operating System
3.5 Method of partitioning the Hard Disk during the installation of the Operating System
3.6 Advantages & Comparisons of different types of Operating Systems

4. Introduction to MS Office:

4.1 Introduction to Microsoft Office Package
4.2 Different applications available in the package
4.3 Advantages and application of different applications
4.4 An overview on the available applications – MS Word, Excel, PowerPoint, Access, Outlook
4.5 Process of Opening the Microsoft Office Package from the START BUTTON

5. Microsoft Word:

5.1 Introduction
5.2 Procedure of opening the Microsoft Word application
5.3 Introduction to the Microsoft Word Screen/Page
5.4 Understanding different options available
5.5 Understanding different context menus available on the page with their application
5.6 Understanding the **OFFICE BUTTON** – New, Open, Save, Save As, Print, Prepare, Publish, Close, Word Options, Recent Documents
5.7 Understanding the **HOME** Menu – Clipboard Option, Font Options, Paragraph, Styles
5.8 Understanding the **INSERT** Menu – Pages, Tables, different methods of inserting pictures, Links, Header& Footer, Text Formatting, Symbols
5.9 Understanding the **PAGE LAYOUT** Menu – Different themes, Page Setup, Page Background, Paragraph Indentation, Alignment
5.10 Understanding the complete process of Mail Merge (Letter)
5.11 Understanding the Concept of viewing the pages in different styles, New windows, Split page option
5.12 Practical work on the above content

6. Microsoft Excel:

6.1 Introduction
6.2 Procedure of opening the Microsoft Excel Application
6.3 Introduction to the Microsoft Excel Screen/Page
6.4 Understanding different options available

6.5 Understanding the method of renaming, adding and removing the sheet

6.6 Understanding the method of copying and moving the sheet

6.7 Understanding different short cuts used on the application

6.8 Understanding the **HOME** menu – Clipboard Options, Font Options, Paragraphs, Styles, etc.

6.9 Understanding the **INSERT** Menu – Table Creation, different methods of inserting pictures & shapes, charts, links and method of formatting the text

6.10 Understanding the **PAGE LAYOUT** Menu – Themes, Page setup, Scale, Sheet Options, Alignment, etc.

6.11 Understanding the **FORMULAS** Menu – Insert function, Function Library (Auto Sum, Logical, Text, Lookup, Date & time)

6.12 Conditional Formatting

6.13 Basic Menu options like View, Data and Review

6.14 Practical work on the above content

7. Microsoft PowerPoint:

7.1 Introduction

7.2 Procedure of opening the Microsoft Power Point Application

7.3 Introduction to the Microsoft Power Point Screen/Page

7.4 Understanding different options available

7.5 Understanding different shortcuts used for the application

7.6 Understanding the **HOME** Menu – Clipboard, Slides, Font, Paragraph indentation, drawing tools, find & replace

7.7 Understanding the **INSERT** Menu - Table Creation, Different methods of inserting pictures & shapes, Charts, Link, method of formatting the text & methods of inserting movie clip & audio in the slide

7.8 Understanding the **DESIGN** Menu – Page Setup, different themes to be used as the background of the slides, colours, fonts, effects, background styles

7.9 Understanding the **ANIMATION** Menu – Custom Animation, different transition options for the slides, background music, transition speed, slideshow option (on mouse click or after time interval that is set)

7.10 Understanding the **SLIDE SHOW** Menu – Start & End of the slide show, slide show setup, monitoring the resolution and other factors

7.11 Understanding various options like Review and View

7.12 A presentation to understand the working of different options available in the application

8. Internet & Security:

8.1 Introduction to Internet & Security

8.2 Different types of connections that can be established in the system

8.3 Uses, advantages and disadvantages of the Internet

8.4 Security – Definition & Goals

8.5 Basic ISP (Internet Service Providers) Infrastructure

8.6 Virus – Definition and its different types

8.7 Firewall – Definition and applications

8.8 Understanding the basic security measures

9. Project Work

The students will prepare a project work using the concepts taught in the 'Fundamentals of Computer'.

Production Technology – Paper I
Class XI

Examination Duration: 3 Hours

S. No.	Name of the Topic	No. of Hours
1	**Safety Precautions and House Keeping**	8
2	**Commonly Used Hand Tools & Cutting Tools**	24
3	**Drilling Machine**	15
4	**Forging**	6
5	**Heat Treatment of Steel**	18
6	**Lubricants & Lubrication**	3
7	**Preventive Maintenance**	2
8	**Lathe Machine**	38
9	**Shaping Machine**	30
10	**Slotting Machine**	12
11	**Introduction to Milling Machine**	40
12	**Surface Finish**	3
13	**Industry 40**	6
14	**Metrology**	25
TOTAL NUMBER OF HOURS		**230**

1. Safety Precautions and House Keeping:

- **1.1** General Safety
- **1.2** Machine Safety
- **1.3** PPE (Personal Protective Equipment)
- **1.4** Types of Fire
- **1.5** Fire Extinguishers
- **1.6** Housekeeping
- **1.7** 5S Concept & Waste Disposal
- **1.8** First Aid
- **1.9** Safety Signs

2. Commonly Used Hand Tools & Cutting Tools:

2.1 Files:

- **2.1.1** Elements & Material
- **2.1.2** Specification - Size, Cuts, Shapes and Grades of File

2.1.3 Types of filing process
2.1.4 Pining of file
2.1.5 Convexity of file
2.1.6 Pitch of file

2.2 Vice:

2.2.1 Introduction to the topic
2.2.2 Different Types of vices used in the shop floor
2.2.3 Specification of bench vice as per standard

2.3 Hacksaw:

2.3.1 Hacksaw Frame - Definition & Parts
2.3.2 Types of Hacksaw frames
2.3.3 Hacksaw Blade –Definition & Parts
2.3.4 Types of hacksaw blades
2.3.5 Classification & Selection of hacksaw blade
2.3.6 Setting of saw-teeth (Staggered & Wave Set)
2.3.7 Specification of Frame & Blade

2.4 Hammer:

2.4.1 Hammer – Definition & Parts
2.4.2 Types of Pein
2.4.3 Types of hammer
2.4.4 Specification of hammer

2.5 Chisel:

2.5.1 Introduction and its parts
2.5.2 Types of chisels and its uses
2.5.3 Different angles grounded on a chisel and its functions
2.5.4 Method of Holding the chisel for cutting different types of metals
2.5.5 Specification of chisel

2.6 Marking & Layout:

2.6.1 Introduction to the topic
2.6.2 Calipers – Types (Outside, Inside and Odd Leg Calipers) and its uses
2.6.3 Try Square – Parts, types, uses and their specification as per standard
2.6.4 Surface Gauge – Parts, Types and application
2.6.5 Straight Edge – Parts & Uses
2.6.6 Scriber & Divider – Uses and application
2.6.7 Datum
2.6.8 V-Block – Parts, types and their application as per the shape of the work
2.6.9 Parallel Block and uses
2.6.10 Punches – parts, types and uses as per the type of operation to be carried out

2.6.11 Marking off Table & Surface Plate – types and uses
2.6.12 Marking media used like Prussian blue
2.6.13 Angle Plate – Introduction, types and its uses with specification

3. **Drilling Machine:**
   - **3.1** Introduction to the topic
   - **3.2** Types of drilling machines used in the shop floor
   - **3.3** Drill Bit & its parts
   - **3.4** Types of drill bits used in the shop floor with their uses
   - **3.5** Different operations performed on the machine – Drilling, Tapping, Reaming, Counter Boring, Counter Sinking & Spot Facing
   - **3.6** Cutting speed & RPM with relevant calculation
   - **3.7** Feed – introduction, factors that governs the feed and standard chart for feed selection
   - **3.8** Drilling defects and remedies
   - **3.9** Tap drill Size – Calculation based on the standard tap drill sizes with their functions
   - **3.10** Tap & Tap wrench – Introduction, types and application as per standard
   - **3.11** Die & Die Stock
   - **3.12** Calculation of the material to be used for die

4. **Forging:**
   - **4.1** Introduction to the topic and the safety rules to be followed while working in blacksmith shop
   - **4.2** Forge & its parts with specific uses
   - **4.3** Heating temperature for the forge
   - **4.4** Preparation of the forge
   - **4.5** Types of forging tools used – Anvil, Rake, Shovel, Sprinkler, Punches, Upsetting Block, and Swage Block etc.

5. **Heat Treatment of Steel:**
   - **5.1** Introduction to Heat Treatment of Steel
   - **5.2** Carbon Equilibrium Graph for understanding of different stages of heat treatment
   - **5.3** Structure of metals
   - **5.4** Ferrous (Plain Carbon Steel) and Non-ferrous Metals
   - **5.5** Ferrous & Non-ferrous Alloys
   - **5.6** Blast Furnace – Pig Iron& its applications
   - **5.7** Cupola – Cast Iron& its applications
   - **5.8** Wrought Iron – Puddling Furnace & its applications
   - **5.9** Heat Treatment procedure – Heating, Soaking, Preheating and Quenching
   - **5.10** Basic heat treatment Process – Normalizing, Annealing, Hardening, Tempering, Surface Hardening (Case Hardening, Nitriding, Flame Hardening & Induction hardening)

6. **Lubricants & Lubrication:**
   - **6.1** Lubricant & Lubrication – Introduction

6.2 Properties of a good lubricant
6.3 Classification of Lubricants
6.4 Qualities of a good lubricant
6.5 Coolant – Properties and classification
6.6 Methods of lubrication and equipment used – Gravity Feed, Force Feed and Splash Feed
6.7 Different types of lubricants used in the shop floor with standard specification (E.g.- Servomesh, Servospin)

7. Preventive Maintenance:

7.1 Preventive Maintenance – Introduction
7.2 Need for Preventive Maintenance
7.3 Advantages and functions of Preventive Maintenance
7.4 Periodic inspection of machines & equipment as per check List
7.5 Maintenance Record list

8. Lathe Machine:

8.1 Introduction to the machine and its parts
8.2 Safety precautions to be followed on the lathe machine
8.3 Definition, Parts and types of – Lathe Bed, Headstock, spindle nose, Tailstock, Tool post
8.4 Specification of lathe machine as per standard
8.5 Different work holding and supporting devices like 3 and 4 jaw chuck, face plate, steady rest, catch plate, lathe dogs, dead centre and live centre
8.6 Properties and types of cutting tool materials used in the shop floor
8.7 Cutting tools – Nomenclature, types & angles grounded on them
8.8 Cutting speed & RPM related to the lathe operation
8.9 Basic Lathe Operation – Centre drilling, Facing, Turning, Step Turning, Chamfering (Angular and radius), Shoulder Turning, etc.
8.10 Knurling – Introduction, Types of knurls, Types of knurling tools, Grades of knurls, etc.
8.11 Drilling & Boring – Operations based on the lathe machine with standard tools used and the process of using boring bar
8.12 Taper turning – Introduction and elements, calculations involved in taper turning work, types of tapers, taper turning operation
8.13 Screw Thread – Introduction, elements with its definitions
8.14 Screw Thread – Types of threads used in the shop floor and its basic dimensions like depth of cut, minor diameter, etc.
8.15 Screw Thread – Gear Train (Simple and Compound) with their uses and the method of calculating the driver and driven gears for different types of thread cut on the machine
8.16 Screw Thread – Cutting of thread on the machine using different methods

9. Shaping Machine:

9.1 Introduction to the machine and its parts
9.2 Safety precautions to be followed on the Shaping Machine
9.3 Specifications of a Shaping Machine

9.4 Length of stroke & Position of stroke
9.5 Different types of shaping machines with their specification
9.6 Work holding and supporting devices used on the Shaping machine
9.7 Tools used on the Shaping machine
9.8 Working of crank and slotted link mechanism
9.9 Feed Mechanism
9.10 Tool head & Clapper box

10. Slotting Machine:

10.1 Introduction to the machine and its parts
10.2 Different types of slotting machine used
10.3 Specification of the slotting machine
10.4 Stroke length selection and position of stroke
10.5 Different work holding and supporting devices used on the machine
10.6 Quick return mechanism of the slotting machine
10.7 Feed mechanism of the slotting machine
10.8 Different types of tools used on the slotting machine
10.9 Different operations performed on the slotting machine
10.10 Indexing by Rotary Table

11. Introduction to Milling Machine:

11.1 Introduction to the machine and its parts
11.2 Safety precautions to be followed on the milling machine
11.3 Types of milling machines used in the shop floor and their specifications
11.4 Arbor – Long & Stub arbor with its parts, types and uses
11.5 Work holding and supporting devices used on the milling machine
11.6 Cutter Nomenclature, its uses and angles grounded like primary &secondary clearance angle
11.7 Different types of milling Cutters used – Slab Milling cutter, Side & Face cutter, End mill cutter, Angle Cutter, T-Slot cutter with their uses and types as per standard
11.8 Milling Procedure – Up Milling &Down Milling – Introduction, application, advantages and disadvantages
11.9 Milling Process – Side milling, End milling, Face milling
11.10 Simple Indexing – Introduction, Indexing Device and its parts, Formulae used for calculating the crank movement with some basic examples

12. Surface Finish:

12.1 Introduction
12.2 Terminology used for surface roughness – Lay, Ra Value, Texture, Waviness, etc.
12.3 Ra value specification
12.4 Method of representing the surface texture in the diagram with different specifications
12.5 Symbol chart

12.6 Grades of surface quality with some basic examples related to the content
12.7 Templates used for Surface Roughness Value Determination
12.8 Super Finishing Process - Honing, Lapping, Burnishing

13. Industry 40:

13.1 Introduction and Design Principle for Industry 40
13.2 Effects & Challenges of Industry 40
13.3 Impact of Industry 40
13.4 Role of Big data and analytics

14. Metrology:

14.1 Steel Rule:

14.1.1 Introduction
14.1.2 Different types of reading – Direct and Indirect
14.1.3 Units of scale i.e. inches and millimeter and its conversions
14.1.4 Types of Steel rule used in the shop floor
14.1.5 Readings related to steel rule in inches and millimeter

14.2 Vernier caliper:

14.2.1 Introduction and its parts
14.2.2 Working Principle of Vernier Caliper
14.2.3 Zero Errors – Positive Error & Negative Error
14.2.4 Least Count – Definition and formulae for calculating the least count
14.2.5 Derivation of least count for 002mm and 005mm Vernier caliper
14.2.6 Reading related to 002 & 005mm Vernier caliper
14.2.7 Practical Demonstration of Vernier caliper
14.2.8 Derivation for non-standard least count of Vernier caliper
14.2.9 Derivation of the least count for 0001" Vernier Caliper
14.2.10 Readings related to 0001" Vernier Caliper
14.2.11 Specification and standard sizes available in the market

14.3 Outside Micrometer:

14.3.1 Introduction and parts of Outside Micrometer
14.3.2 Working Principle of Outside Micrometer
14.3.3 Derivation of the least count
14.3.4 Readings related to 001mm of Outside Micrometer
14.3.5 Derivation of the least count for inch Outside Micrometer – 0001"
14.3.6 Understanding of the range available for the inch Micrometer
14.3.7 Readings related to Inch Outside Micrometer
14.3.8 Derivation of the least count – Vernier Outside Micrometer (Metric – 0001mm & Inch – 00001")
14.3.9 Understanding the method of reading the micrometer
14.3.10 Readings related to Vernier Outside Micrometer (Metric – 0001mm & Inch – 00001")

14.4 Vernier Height Gauge:

14.4.1 Introduction & Understanding the parts of height gauge

14.4.2 Different types of scribers used

14.4.3 Derivation of the least count and practical demonstration of height gauge – Metric & Inch

14.4.4 Readings related to height gauge

14.5 Measuring tape:

14.5.1 Introduction and different types of measuring tapes available

14.5.2 Method of reading the measuring tape

14.5.3 Practical demonstration of measuring tapes

Production Technology – Paper II
Class XI

Examination Duration: 8 Hours

S.No.	Name of the Topic	No. of Hours
1	**Fitting Shop Work**	**55**
2	**Lathe Machine**	**145**
3	**Shaping Machine**	**40**
4	**Slotting Machine**	**30**
5	**Milling Machine**	**190**
TOTAL NUMBER OF HOURS		**460**

1. **Fitting Shop Work:**
   - **1.1** Identification of tools & equipment for fitting shop work
   - **1.2** General Safety Methods to be followed while working
   - **1.3** Filing Flat surfaces
   - **1.4** Uses of marking tools, punch, try square & basic measuring tools, caliper & steel rule
   - **1.5** Hacksawing the work piece to understand its operation
   - **1.6** Marking, drilling and tapping holes on flat pieces
   - **1.7** Filing Tee shape job
   - **1.8** Making of relief grooves
   - **1.9** Hand reaming, counter sinking and counter boring
   - **1.10** Fitting male and female square piece to close limit

2. **Basic Lathe Machine Operation:**
   - **2.1** Introduction of the machine and its parts
   - **2.2** Introduction to different work holding and supporting devices
   - **2.3** Demonstration on the setting of the work and tool
   - **2.4** Grinding of different tool profile by maintaining angles (RH Turning tools, LH Turning Tool, V-Tool, Radius Tool, Square Tool etc.)
   - **2.5** Centering of the work piece on 4-Jaw chuck
   - **2.6** Facing and centre drilling
   - **2.7** Plain turning in between centers
   - **2.8** Step Turning
   - **2.9** Chamfering and fillet on the edges
   - **2.10** Taper turning
   - **2.11** Knurling

2.12 Drilling and Boring on the work piece

2.13 Step Boring

3. Shaping Machine:

3.1 Introduction of the machine and parts

3.2 Basic settings – length of stroke, job setting and alignment of the vice

3.3 Shaping of square block to close limits

3.4 Shaping of square and triangular slots to close limits

3.5 Shaping of T-slot by using forged tool

3.6 Shaping of V-groove to form a V-Block

3.7 Shaping vertical and angular surfaces using the vertical head

4. Slotting Machine:

4.1 Introduction of the machine and parts

4.2 Basic settings – length of stroke, speed adjustment and job setting

4.3 Machining the sides of the plate and maintaining squareness

4.4 Slotting internal slots with semicircular ends

4.5 Slotting internal polygons

5. Milling Machine:

5.1 Introduction to the machine and its parts

5.2 Demonstration on the setting of work piece

5.3 Physical demonstration of arbors, cutters used on the machine along with methods of setting arbors and cutters on horizontal and vertical milling machines

5.4 Machining of square blocks within limits

5.5 Step machining using side and face milling cutter

5.6 Machining of Angular surface

5.7 Machining of T-slot fitting work pieces

5.8 Simple Indexing

5.9 Machining of different polygons by using simple indexing and angular indexing method

5.10 Machining of Ratchet, Dog clutch and similar jobs

MECHANICAL ENGINEERING

TECHNICIAN

SYLLABUS FOR CLASS XII

English
Class XII

Examination Duration: 3 Hours

S.No.	Name of the Topic	No. of Hours
	GRAMMAR	
1	Direct & Indirect Speech	18
2	Phrases & Idioms	8
3	Letter Writing (Informal)	11
4	Report Writing, Essay Writing & Precis Writing	15
5	Comprehension & Story Writing	13
	LITERATURE	
1	Wright Brothers	8
2	Jamshedji Tata	8
3	Solar Energy	8
4	Thomas Edison	8
5	Henry Ford	8
TOTAL NUMBER OF HOURS		105

General Foundation, Industrial Sociology and Entrepreneurship
Class XII

Examination Duration: 3 Hours

S.No.	Name of the Topic	No. of Hours
1	**The Constitution of India**	**5**
2	**An Ideal Supervisor**	**5**
3	**Industrial Safety, First Aid and Hygiene**	**10**
4	**Entrepreneurship**	**10**
5	**Labour Laws**	**16**
6	**Environmental Science**	**10**
7	**Estimation & Costing**	**12**
8	**Project Plan**	**12**
TOTAL NUMBER OF HOURS		**80**

1. **The Constitution of India:**
   - **1.1.** Salient Features
   - **1.2.** Preamble to the Constitution
   - **1.3.** Fundamental Duties
   - **1.4.** Directive Principles of State Policy
   - **1.5.** Difference between Fundamental Rights and Directive Principles

2. **An Ideal Supervisor:**
   - **2.1** Qualities of an ideal supervisor

3. **Industrial Safety, First Aid and Hygiene:**
   - **3.1.** Concept of Safety
   - **3.2.** Safety Consciousness
   - **3.3.** Necessity of safety
   - **3.4.** Safety Measures

4. **Entrepreneurship:**
   - **4.1.** Introduction
   - **4.2.** Definition of Entrepreneurship
   - **4.3.** Need for Self-Employment
   - **4.4.** Advantages of Entrepreneurship
   - **4.5.** Roles and responsibilities of an Entrepreneur
   - **4.6.** Qualities of a good Entrepreneur

5. **Labour Laws:**
    - **5.1.** Factories Act 1948
    - **5.2.** Apprentices Act
    - **5.3.** Employees State Insurance (ESI) Act
    - **5.4.** Payment of Wage Act 1936
    - **5.5.** Minimum Wages Act & Rules
    - **5.6.** Employees Provident Fund Act (EPF)
    - **5.7.** Workmen's Compensation Act

6. **Environmental Science:**
    - **6.1** Effect of pollution on Human Health
    - **6.2** Impact of technology on Environment
    - **6.3** Impact of pollution on Environment
    - **6.4** Waste Management

7. **Estimation & Costing:**
    - **7.1** Introduction to Estimation and Costing
    - **7.2** Importance and Aims of Estimation & Costing
    - **7.3** Functions of Estimating Department
    - **7.4** Qualities of an Estimator
    - **7.5** Estimating Procedures and Errors in Estimation
    - **7.6** Constituents of Estimation
    - **7.7** Advantages of Standard Costing
    - **7.8** Differences between Estimation and Costing
    - **7.9** Procedures of Costing & Costing methods
    - **7.10** Cost Control and Advantages of Efficient Costing
    - **7.11** Elements of Cost
    - **7.12** Components of Cost and the process of calculating material cost & labour cost
    - **7.13** Block diagram of Components of Cost
    - **7.14** Methods of calculating indirect expenses and depreciation cost
    - **7.15** Repairs and Maintenance Costing
    - **7.16** Basic numerical on Estimation and Costing

8. **Project Plan:**
    - **8.1** Introduction
    - **8.2** Definitions of Working Capital, Fixed Capital, Budget
    - **8.3** Market Survey
    - **8.4** Project Planning
    - **8.5** Project Capacity
    - **8.6** Selection of Site and Plant Layout
    - **8.7** Product design and development

8.8 Factors considered while designing a product
8.9 Product drawings and design specification
8.10 Product Development
8.11 Material Requirement
8.12 Operation Planning
8.13 Equipment Requirement
8.14 Material Handling
8.15 Break-Even Point
8.16 Preparation of Project

Engineering Graphics
Class XII

Examination Duration: 3 Hours

S.No.	Name of the Topic	No. of Hours
1	**Sectioning of views**	17
2	**Development of Surface**	18
3	**Screw Thread & Fastener**	10
4	**Riveted Joints**	8
5	**Couplings**	10
6	**Working & Assembly drawing**	44
7	**Revision on the orthographic projection, Oblique projection & Isometric drawing**	8
8	**Auto CAD**	45
TOTAL NUMBER OF HOURS		**160**

1. **Sectioning of views:**
   - **1.1** Introduction
   - **1.2** Types of section views – Full Section, Half Section, Offset Section, local section
   - **1.3** Different conventional representation of material in sectioned views
   - **1.4** Construction of sectional views from the isometric in both First & Third Angle

2. **Development of Surface:**
   - **2.1** Introduction and methods of development
   - **2.2** Development of lateral surface of solids like cube, prisms, polygons, truncated prism / pyramid and cones
   - **2.3** Development of transition pieces
   - **2.4** Practical based drawing related to the topic

3. **Screw Thread & fastener:**
   - **3.1** Different types of standard thread profile with their features
   - **3.2** Conventional representation of different types of thread (External & Internal)
   - **3.3** Types of bolt and calculation related to bolt designs
   - **3.4** Different heads of the bolt
   - **3.5** Different types of nuts used in the shop floor
   - **3.6** Different forms of grub screws, set screws and studs used

3.7 Different types of Locking Devices

3.8 Forms of foundation bolts used in the shop floor

4. Riveted joints:

4.1 Different types of rivet head used in the shop floor

4.2 Calculations involved in the rivet joint of the sheet metals

4.3 Different types of riveted joint used – Lap Joint, Butt Joint

5. Couplings:

5.1 Introduction about the couplings and its application in the mechanical industry

5.2 Naming different types of coupling that are used in the shop floor

5.3 Drawing of Muff Coupling, Flanged Coupling, Universal Coupling

5.4 Calculation involved in coupling assembly

6. Working & Assembly drawing:

6.1 Understanding of the assembly drawing and the rules involved in it

6.2 Demonstration of the assembly drawing with suitable examples

6.3 Simple assembly of components i.e. Shaft & Hole assembly, Nut & Bolt assembly

6.4 Assembly of Machine parts that are frequently used in the work shop

7. Revision of orthographic projection, oblique projection & isometric drawing

8. Auto CAD:

8.1 Basic Tools & Figures:

8.1.1. Introduction to Auto CAD Software, its uses and application with some practical examples/demo models

8.1.2. Benefits and limitation of Auto CAD

8.1.3. Understanding of the Cad Screen environment– different settings, workspaces, menus

8.1.4. Understanding of the different drawing tools used for the Auto CAD drawings

8.2 2D Designing:

8.2.1 Understanding the basic concept of 2D drafting/drawing

8.2.2 Application of Draw menu – lines, multi-line, circle, rectangle, ellipse, polygons, etc.

8.2.3 Methods of using different tools available in the MODIFY Menu – Erase, Trim, Hatch, Join, Explode, Scale, Expand, Mirror, Copy, Offset, Array (Rectangular, Polar)

8.2.4 Drawing of different types of 2D drawings that involve the use of all tools available in the Auto CAD's Draw & Modify Menu

8.2.5 Understanding the method of providing different dimensions on the drawing – linear, aligned, angular, radial, diameter, multi leader, etc.

8.2.6 Method of printing the drawing using viewport options and other page set up options available

8.3 3D Designing:

8.3.1 Introduction to 3D modelling

8.3.2 Understanding the workspace environment for 3D modeling

8.3.3 Understanding the concept of WCS (World Co-ordinate System) & UCS (User Co-ordinate System)

8.3.4 Method of selecting different coordinate for constructing different profiles

8.3.5 Selection of X, Y, Z coordinates as per the drawing area of the profile

8.3.6 Understanding the tools used for drawing different 3D models – Extrude, Subtract, Revolve, Loft, Press pull, Union, Intersection

8.3.7 Method of using the Sweep command

8.3.8 Drawing of threaded bolt with standard dimensions

8.3.9 Modelling of different tools used in the shop floor using different tools available in the Auto CAD 3D modelling work space

8.3.10 Construction of different isometric to understand the method of using the tools

8.3.11 Construction of some simple assembly component to understand the 3D method

Engineering Science
Class XII

Examination Duration: 3 Hours

S.No.	Name of the Topic	No. of Hours
1	**Expansion of Solid, Liquid & Gases**	15
2	**Triangles & Polygon of Forces**	15
3	**Simple Stress & Strain**	22
4	**Angular Motion**	10
5	**Pressure**	16
6	**Simple Machine**	18
7	**Electricity**	24
TOTAL NUMBER OF HOURS		120

1. **Expansion of Solid, Liquid & Gases:**
   - **1.1** Expansion of Solids
   - **1.2** Coefficient of Linear Expansion
   - **1.3** Superficial expansion of solid
   - **1.4** Cubic expansion of solid and liquid
   - **1.5** Cubic expansion of gases
   - **1.6** Ideal Gases

2. **Triangles & Polygon of Forces:**
   - **2.1** Forces and reactions
   - **2.2** Representation of a force by a vector
   - **2.3** Equilibrium
   - **2.4** Three inclined forces – triangle of forces
   - **2.5** Bow's notation
   - **2.6** Resultant
   - **2.7** Parallelogram of Forces
   - **2.8** Equilibrium of three inclined forces- Concurrency
   - **2.9** Resolution of force into two components
   - **2.10** Polygon of forces
   - **2.11** Pin Jointed Frameworks – Nature of forces in a member

3. **Simple Stress & Strain:**
   - **3.1** Introduction – Stress & Strain with application and units

3.2 Different types of stress
3.3 Hooke's Law
3.4 Young's Modulus or Modulus of Elasticity
3.5 Tensile strength, Yield Point, Ultimate Stress and Working Stress
3.6 Factor of safety and its application
3.7 Stress-Strain Graph, Modulus of Rigidity, Poisson's Ratio, Proof Stress and Bulk Modulus
3.8 Relationship between three moduli for a given material

4. Angular Motion:

4.1 Angular Displacement
4.2 Angular Velocity
4.3 Angular acceleration
4.4 Relationship between linear and angular motion
4.5 Equations of angular motion
4.6 Torque & Angular motion
4.7 Moment of inertia

5. Pressure:

5.1 Atmosphere
5.2 Atmospheric pressure
5.3 Pressure - its definition
5.4 Pressure in liquid
5.5 Absolute pressure
5.6 Gauge Pressure and Vacuum pressure
5.7 Measurement of atmospheric pressure and pressure inside the boiler
5.8 Simple Barometer
5.9 Different Laws and its applications

6. Simple Machine:

6.1 Machines – Definition and its types
6.2 Effort and Load
6.3 Mechanical Advantage & Velocity Ratio – its definition and unit
6.4 Efficiency of machine
6.5 Relationship between Efficiency, Mechanical Advantage and Velocity Ratio
6.6 The lever
6.7 Pulley Block
6.8 Wheel & Axle
6.9 The Screw and Screw jack
6.10 Belt and chain drive
6.11 Gear Wheel

7. Electricity:

- **7.1** Introduction: Uses of Electricity
- **7.2** Molecule, Atom and Particles in Atoms
- **7.3** How to produce electricity
- **7.4** Electric Current – Ampere
- **7.5** Ohm's Law - Resistance, Voltage and Current
- **7.6** Electromotive forces
- **7.7** Potential Difference
- **7.8** Conductor, Insulator and Switch Fuse
- **7.9** Electrical Circuits
- **7.10** Electromotive Forces (EMF)
- **7.11** Types of connection – Series and parallel
- **7.12** Electrical Power & Horse Power
- **7.13** Types of current – AC & DC
- **7.14** Electrical Energy

Technician Mathematics
Class XII

Examination Duration: 3 Hours

S.No.	Name of the Topic	No. of Hours
1	**Trigonometry (Height & Distance)**	10
2	**Spur Gear**	18
3	**Cutting Speed, Feed & Depth of cut**	8
4	**Machining time for all machines**	18
5	**Taper Calculations involved in the workshop**	10
6	**Belt Drive calculations**	10
7	**Graph**	12
8	**Statistics (Mean, Median & Mode)**	14
9	**Mathematical Reasoning**	20
TOTAL NUMBER OF HOURS		120

1. **Trigonometry (Height & Distance):**
   - **1.1** Introduction to the content
   - **1.2** Angle of Elevation and Angle of Depression
   - **1.3** Solution of triangle using Sine Rule & Cosine Rule

2. **Spur Gear:**
   - **2.1** Introduction & elements of the spur gear
   - **2.2** Gearing System – DP System & Module System
   - **2.3** Formulae related to gearing system
   - **2.4** Stub Tooth Gears

3. **Cutting Speed, Feed & Depth of cut:**
   - **3.1** Introduction to the topic
   - **3.2** Cutting speed – Formulae, Calculation using the standard chart of cutting speed specification
   - **3.3** Feed – Types, Definition and formulae
   - **3.4** Depth of Cut – Definition and method of calculating the depth of different machining processes

4. **Machining time for all machines:**
   - **4.1** Introduction to machining time

4.2 Basic formulae to find the machining time of cutting different materials

4.3 Drilling Machine & Lathe Machine – Factors required for calculating the machining time like total travel of table, feed per revolution

4.4 Slotting & Shaping Machine – Factors required for calculating the machining time like length of stroke, number of stroke, cutting and return time

4.5 Milling Machine – Factors required for calculating the machining time like Approach length, Overrun Length, Feed per tooth, Feed per minute

5. Taper Calculations involved in the workshop:

5.1 Introduction to the topic

5.2 Elements of taper

5.3 Formula for finding different elements

5.4 Calculation involved in taper turning

5.5 Calculation related to external & internal dovetails

5.6 Calculation related to the taper job using Slip Gauge & Precision Rollers

6. Belt Drive calculations:

6.1 Introduction to the belt drive system used in the machine shop

6.2 Factors that affect the selection of a belt drive

6.3 Open Belt System – Definition and the basic formula used for finding the length of the belt needed

6.4 Calculation of open belt length using trigonometry method

6.5 Cross Belt system – Definition and the basic formula used for finding the length of the belt needed

6.6 Calculation of Cross belt length using trigonometry method

7. Graph:

7.1 Definition and rules for drawing a graph

7.2 Drawing and reading of simple graphs

7.3 Graph of simple equations

7.4 Graph of compound equations

7.5 Solution of Expression

8. Statistics (Mean, Median & Mode):

8.1 Introduction to Statistics

8.2 Basic Concepts used in statistics

8.3 Mean – Introduction and method of finding mean with different sets of data available

8.4 Median - Introduction and method of finding median with different sets of data available

8.5 Mode - Introduction and method of finding mode with different sets of data available

9. Mathematical Reasoning:

- **9.1** Introduction to mathematical reasoning – Importance and necessity
- **9.2** Reasoning related to numbers
- **9.3** Reasoning related to series of occurrence
- **9.4** Reasoning related to logical existence of objects
- **9.5** Reasoning related to missing figures

Production Technology – Paper I
Class XII

Examination Duration: 3 Hours

S.No.	Name of the Topic	No. of Hours
1	Grinding	20
2	Jigs & Fixtures	4
3	Lathe Machine	22
4	Capstan & Turret Lathe	4
5	Limit, Fit & Tolerance	12
6	Advanced Milling Machine	30
7	Power Transmission	20
8	Reamers	5
9	Planning Machine	12
10	Welding	30
11	Hydraulics	24
12	Metrology	32
13	Metallurgy	30
14	CNC Lathe	40
15	CNC Milling	35
TOTAL NUMBER OF HOURS		320

1. **Grinding:**
   - **1.1** Grinding – Introduction and its various applications
   - **1.2** Grinding Wheel (Natural and Artificial Abrasives)
   - **1.3** Properties of Artificial Abrasive (Silicon Carbide & Aluminum Oxide)
   - **1.4** Constructional Features of Grinding Wheel – Abrasive, Grit Size, Grade, Structure & Bond
   - **1.5** Size of Grinding Wheel
   - **1.6** Wheel marking
   - **1.7** Selection of Grinding Wheel
   - **1.8** Mounting of Wheel and Balancing
   - **1.9** Defects of Grinding Wheel
   - **1.10** Dressing of grinding wheel using different types of dressers
   - **1.11** Identification of different shapes of grinding wheels
   - **1.12** Surface Speed Calculation

1.13 Parts of different types of grinding machines available in the shop floor (Cylindrical, Surface, Centre less, Portable & Pedestal)

1.14 Diamond Wheel and its construction with their specifications

1.15 Different types of grinding operation – Cylindrical (External and Internal), Surface and Tool & Cutter Grinding

1.16 Tool & Cutter Grinding Machine – Parts and its uses with various types of operations done on the machine

1.17 Tooth Rest – Types and its applications

2. Jigs & Fixtures:

2.1 Introduction and its applications

2.2 Types of drill jigs and its uses

2.3 Constructional Features of a jig and fixture

2.4 Types of fixtures and its uses

3. Lathe Machine:

3.1 Multi-Start thread – its application with different methods of cutting a thread on a lathe

3.2 Change wheel calculation for multi start threads

3.3 Screw Thread Measurement – Introduction and different methods of measuring different elements of a screw thread

3.4 Steady Rest – Introduction and its application with demonstration

3.5 Form Turning – Introduction and its uses as per requirements

3.6 Methods of form turning on the lathe using templates

3.7 Machine taps and its applications

3.8 Methods of removing broken taps

3.9 Quality Control and its application for the zero-defect concept

4. Production Lathes:

4.1 Copying Lathe

4.2 Capstan & Turret Lathe

5. Limit, Fit & Tolerance:

5.1 Mass Production and interchangeability

5.2 Assembly (Selective & Non-Selective)

5.3 The Indian standard system of limits & fits – Terminology

5.4 Fundamental Grade & Tolerance

5.5 Fits and its Classification as per the Indian Standard

5.6 Allowance

5.7 Hole Basis & Shaft Basis System

5.8 The BIS system of limit & fit – reading the standard chart (Escart Superior & Escart Inferior)

5.9 Calculation based on types of fit

6. **Milling Machine:**
   - **6.1** Different types of milling machines used
   - **6.2** Boring head & method of boring in vertical milling machine
   - **6.3** Helix & Spiral – Introduction and their calculation for the helix elements and gear setting calculations
   - **6.4** Linear Indexing – Introduction, Derivation and numerical on the content
   - **6.5** Rack – Its elements and calculation for finding different elements
   - **6.6** Differential indexing – Introduction and calculation involved in cutting odd teeth gears on the milling machine
   - **6.7** Cam – Introduction, elements, its various types and method of calculating the lobbed distance
   - **6.8** Broaching – Introduction, Specification and Application of broaching operations
   - **6.9** Broaching – Broach tools & its elements
   - **6.10** Broaching – Broaching methods & procedures
   - **6.11** Broaching Machine and its uses
   - **6.12** Hexagonal Socket head screw and its different types with application
   - **6.13** Bolts & Studs – Types and its uses
   - **6.14** Machine Screw – Types and uses

7. **Power Transmission:**
   - **7.1** Keys & Spline – Introduction & its application with different specifications
   - **7.2** Different types of Key and their applications
   - **7.3** Calculation and measurement of key seat size
   - **7.4** Clutches – Introduction and their various types with applications
   - **7.5** Gears – Introduction, Types and its various applications
   - **7.6** Bearings – Frictional & Anti Frictional
   - **7.7** Types and applications of Frictional & Anti Frictional bearings
   - **7.8** Bearing Materials
   - **7.9** Belt & Belt drives
   - **7.10** Pulleys – Types, Uses and Maintenance features of V belt
   - **7.11** Chains & Sprockets
   - **7.12** Internal Gear – Introduction with advantages and disadvantages

8. **Reamers:**
   - **8.1** Introduction
   - **8.2** Reamers – Nomenclature
   - **8.3** Hand Reamers & Machine reamers
   - **8.4** Calculation involved in the selection of a reamer including the oversized hole and undersized hole theory
   - **8.5** Reamers – Number of teeth & Unequal spacing

9. Planning Machine:

- **9.1** Introduction to the machine
- **9.2** Parts of the machine and its functions
- **9.3** Loose & fast pulley mechanism used
- **9.4** Feed Mechanism of Planer
- **9.5** Tool Slide/Head design and parts with its function
- **9.6** Work Holding & Supporting devices used
- **9.7** Attachment used on the Planning machine
- **9.8** Different operations performed on the Planning machine
- **9.9** Practical based examples to understand the working of the machine

10. Welding:

10.1 Arc Welding:

- **10.1.1** Introduction
- **10.1.2** Types of Welding
- **10.1.3** Safety Precautions
- **10.1.4** Arc Welding – Tools & Accessories
- **10.1.5** Arc Welding Machines (AC & DC)
- **10.1.6** Polarity in Arc Welding
- **10.1.7** Arc length and its effects
- **10.1.8** Faults in Welding
- **10.1.9** Electrodes (Flux Coated)
- **10.1.10** Function of Flux Coating
- **10.1.11** Welding Joints and edge preparation
- **10.1.12** Causes of common welding faults
- **10.1.13** Selection and storage of electrodes
- **10.1.14** Welding symbols
- **10.1.15** Inspection and testing of welds

10.2 Gas Welding:

- **10.2.1** Introduction (Oxy-Acetylene gas welding)
- **10.2.2** Features of oxygen and acetylene welding (Cylinder, Regulator, Hose-pipe, Blow-pipe)
- **10.2.3** Safety Precautions
- **10.2.4** Systems of Oxy-Acetylene Welding
- **10.2.5** Gases used in welding
- **10.2.6** Types of Oxy-Acetylene Flames
- **10.2.7** Methods of cleaning before welding
- **10.2.8** Welding Nozzles (Size & Selection)
- **10.2.9** Welding terms (Fusion, Molten Pool, Penetration, Flashback& Backfire)
- **10.2.10** Filler rod for gas welding/melting point
- **10.2.11** Leftward and Rightward welding techniques

10.2.12 Root gap
10.2.13 Welding Joints/Positions
10.2.14 Distortion in welding – Causes and Control
10.2.15 Common Welding defects (Gas Welding)
10.2.16 Inspection of Welds

10.3 Gas Cutting:

10.3.1 Introduction
10.3.2 Principle of Gas Cutting
10.3.3 Terms used in Gas Cutting
10.3.4 Faults and rectification in Gas Cutting

10.4 Soldering & Brazing:

10.4.1 Introduction
10.4.2 Fundamentals of Soldering & Brazing
10.4.3 Advantages and limitations
10.4.4 Filler rods & Fluxes
10.4.5 Method of Cleaning
10.4.6 Primary Joints employed
10.4.7 Brazing & Soldering method
10.4.8 Difference between Fusion Welding, Braze Welding and Soldering

11. Hydraulics:

11.1 Basic Principles of Hydraulics and various symbols used
11.2 Basic Hydraulics Circuits
11.3 USASI (United States of America Standards Institute) Standards
11.4 Reservoirs, Strainers & Filters
11.5 Hydraulic Fluid
11.6 Hydraulic Pumps
11.7 Piston Pump & Pump Rating Methods
11.8 Hydraulics Pressure & Directional control
11.9 Directional Control Valves
11.10 Method of how an actuator converts hydraulic energy into mechanical energy
11.11 Electrohydraulic servo systems and its applications
11.12 Practical Demonstration on the hydraulic panel and system
11.13 Some practical examples

12. Metrology:

12.1 Gauges:

12.1.1 Care & Maintenance of gauges
12.1.2 Limit Gauge – Introduction & its different types with application

12.1.3 Slip Gauge - Introduction and specification as per the grade

12.1.4 Slip Gauge – Selection of slip gauge as per the reading

12.1.5 Slip Gauge – Use of Sine bar & Slip Gauge

12.1.6 Slip Gauge – Determining taper angle using Rollers & slip gauge

12.1.7 Slip Gauge – Care & Maintenance of slip gauge & sine bar

12.1.8 Slip Gauge Accessories with its uses

12.1.9 Determining Internal & External Dovetail elements using slip gauge & rollers

12.1.10 Angle Gauge – Introduction, uses and method of calculating the readings

12.1.11 Comparator gauge – Introduction, Types and uses in the practical field

12.1.12 Dial Test Indicator – Plunger & Lever type

12.1.13 Geometrical Tolerance

12.1.14 Measuring Errors

12.2 Depth Micrometer:

12.2.1 Introduction and parts of a Depth Micrometer

12.2.2 Derivation of the least count and understanding the range available

12.2.3 Understanding on the Extension rods available and the method of fixing them

12.2.4 Reading related to the Depth Micrometer

12.3 Dial Vernier Caliper:

12.3.1 Introduction and working principle of the dial with the least count

12.3.2 Method of taking reading on the dial vernier caliper

12.3.3 Practical reading of the components in the workshop

12.3.4 Practical demonstration of the Dial Vernier Caliper

12.4 Gear Tooth Vernier Caliper:

12.4.1 Constructional Features

12.4.2 Uses and application

12.4.3 Chordal Addendum & Chordal Thickness Calculation

12.5 Inside Micrometer:

12.5.1 Introduction and parts of an Inside Micrometer

12.5.2 Derivation of the least count and understanding the range available

12.5.3 Understanding the extension rods available and the method of fixing them

12.5.4 Reading related to the Inside Micrometer

12.5.5 Practical demonstration of the Inside Micrometer with some practical exposure

12.5.6 Two Point self-centering bore dial gauge & telescopic gauge– Introduction & application

13. Metallurgy:

13.1 Manufacturing of Steel – Bessemer Process & Open Hearth Process

13.2 Destructive and Non-Destructive Test

13.3 Hardness Testing – Brinell, Vickers, Rockwell and Shore
13.4 Impact testing (Izod & Charpy)
13.5 Tensile Test
13.6 Tensile Test Machine and specimen
13.7 Load & extension graph of Plain Carbon Steel
13.8 Carbide Tool – Types and Application
13.9 Specification of Carbide Inserts
13.10 Plastics & Polymers– Thermosetting & Thermoforming
13.11 Plastics – Different types and composition

14. CNC Lathe:

14.1 Introduction and understanding of the machine parts and features
14.2 Understanding of different types of switches and console available on the machine
14.3 Demonstration of the controller and the various functional switches available on it
14.4 Demonstration on the setting of the work piece
14.5 Work offset and tool length settings
14.6 Understanding of the different modes available on the machine i.e. JOGS, MDI, SINGLE BLOCK
14.7 Understanding of the different G Codes & M codes used for the machine
14.8 Demonstration on the simulation system
14.9 Selection of material and cutting tips as per the specification
14.10 Programming and operating the stock removal cycle
14.11 Programming and operating - Grooving, Threading, Parting and different cycles available on the machine
14.12 Programming the work using contour turning method
14.13 Programming the internal operation like centre drilling, deep hole drilling, boring
14.14 Part programming for different operations
14.15 Method of writing the sub program and calling
14.16 Turning of work piece with maximum operation stated above and related work

15. CNC Milling:

15.1 Introduction and understanding of the machine parts and features
15.2 Understanding of different types of switches and console available on the machine
15.3 Demonstration of the controller and the various functional switches available on it
15.4 Demonstration on the setting of the work piece
15.5 Demonstration on the setting of different tools on the tool palette
15.6 Work offset and tool length settings
15.7 Understanding of the different modes available on the machine i.e. JOGS, MDI, SINGLE BLOCK
15.8 Understanding of the different G Codes & M codes used for the machine
15.9 Demonstration on the simulation system
15.10 Selection of material and cutting tips as per specification

15.11 Programming & operating for the machining of block

15.12 Programming & operating for the edge cutting and face milling operation

15.13 Programming & operating for the slot cutting and pocket milling

15.14 Programming & operating for centre drilling, deep hole drilling, tapping operation

15.15 Programming & operating using the contour machining process

15.16 Machining work involving maximum operation that can be done on a milling machine

15.17 Practical observation on the machining centre

Production Technology – Paper II
Class XII

Examination Duration: 8 Hours

S.No.	Name of the Topic	No. of Hours
1	**Lathe Machine Operation**	**140**
2	**Milling Machine**	**200**
3	**CNC Lathe**	**40**
4	**CNC Milling**	**30**
5	**Grinding**	**15**
6	**Project work**	**35**
TOTAL NUMBER OF HOURS		**460**

1. **Lathe Machine Operation:**
   - **1.1** Thread cutting on lathe (Single Start) – V-Thread, Square Thread & Acme Thread
   - **1.2** Eccentric Turning
   - **1.3** Cube-In-Cube machining
   - **1.4** Multi Throw Crank Shaft to understand the concept of eccentric turning
   - **1.5** Thread fitting with standard dimensions (V-thread- BSW, Metric and Square thread)
   - **1.6** Multi start thread Cutting (V-Thread and Square Thread)
   - **1.7** Form turning to understand the methods of creating profiles on the lathe machine
   - **1.8** Turning of blanks for gear cutting
   - **1.9** Turning cast iron work pieces on the lathe
   - **1.10** Working in the production department to gain knowledge of different operations

2. **Milling Machine:**
   - **2.1** Cutting of Spur gear and Bevel gear
   - **2.2** Cutting of Steel Rule using Linear Indexing method
   - **2.3** Machining on the rotary table
   - **2.4** Practical production work to be observed
   - **2.5** Machining of the complete set of strap clamp used on the milling machine

3. **CNC Lathe:**
   - **3.1** Introduction and understanding of machine parts and features
   - **3.2** Understanding of different types of switches and console available on the machine
   - **3.3** Demonstration of the controller and the various functional switches available on it
   - **3.4** Demonstration on the setting of the work piece

3.5 Work offset and tool length settings

3.6 Understanding of the different modes available on the machine i.e. JOGS, MDI, SINGLE BLOCK

3.7 Understanding of the different G Codes & M codes used for the machine

3.8 Demonstration on the simulation system

3.9 Selection of material and cutting tips as per specifications

3.10 Programming and operating the stock removal cycle

3.11 Programming and operating - Grooving, Threading, Parting and different cycles available on the machine

3.12 Programming the work using contour turning method

3.13 Programming the internal operation like centre drilling, deep hole drilling, boring

3.14 Part programming for different operations

3.15 Method of writing the sub program and calling

3.16 Turning of work piece with maximum operation stated above and related work

4. CNC Milling:

4.1 Introduction and understanding of the machine parts and features

4.2 Understanding of different types of switches and consoles available on the machine

4.3 Demonstration of the controller and the various functional switches available on it

4.4 Demonstration on the setting of the work piece

4.5 Demonstration on the setting of different tools on the tool palette

4.6 Work offset and tool length settings

4.7 Understanding of the different modes available on the machine i.e. JOGS, MDI, SINGLE BLOCK

4.8 Understanding of the different G Codes & M codes used for the machine

4.9 Demonstration on the simulation system

4.10 Selection of material and cutting tips as per specifications

4.11 Programming & operating for the machining of a block

4.12 Programming & operating for the edge cutting and face milling operation

4.13 Programming & operating for slot cutting and pocket milling

4.14 Programming & operating for centre drilling, deep hole drilling, tapping operation

4.15 Programming & operating using the contour machining process

4.16 Machining work involving maximum operation that can be done on a milling machine

4.17 Practical observation on the machining centre

5. Grinding:

5.1 Introduction to the machine parts and different holding devices

5.2 Demonstration on the setting of the work and grinding wheel on the machine

5.3 Grinding of the outer diameter of a cylindrical job

5.4 Step grinding the cylindrical job within limits

5.5 Grinding of Tapered surface on a cylindrical job

5.6 Internal grinding of the work within limits

5.7 Surface Grinding - Different parts and holding devices used in the machine

5.8 Demonstration on the setting of the work pieces on the magnetic chuck using different holding devices

5.9 Grinding of the face of the plate within limits and measuring with outside micrometer

5.10 Grinding of machine parts within tolerance by adjusting the stroke length on the machine

6. Project work:

Project work includes manufacturing of the component which can be used in the shop floor. It needs to be assembled and should involve all operations taught the training period.

Note:

- **THE FOLLOWING TOPICS WILL NOT BE EXAMINED AT THE BOARD EXAMINATION LEVEL DUE TO TIME CONSTRAINT AND NON-AVAILABILITY OF SUFFICIENT MACHINES:**
  - Grinding
  - CNC Lathe
  - CNC Milling
  - Machining of bevel gears, cutters, helical grooves and spiral gears

List of Tools &Equipment

For 'Mechanical Engineering Technician' Trainees

General Tools & Instruments

1.	Steel rule 300 mm graduated both in English & Metric Units	25 nos
2.	Outside caliper 150 mm (Spring & Firm joint)	25 nos
3.	Inside caliper 150 mm (Spring & Firm joint)	25 nos
4.	Odd-leg / Jenny caliper 150 mm	25 nos
5.	Divider 150 mm (Spring & Firm joint)	25 nos
6.	Centre punch 100 mm (Prick, Dot & Centre Punch)	25 nos
7.	Hammer Ball Pein	25 nos
8.	Try square 150 mm	25 nos
9.	Scriber 150 mm (double point)	25 nos
10.	Combination pliers 150 mm	25 nos
11.	Safety glasses	25 nos
12.	Flat bastard file 300 mm	25 nos
13.	Flat 2nd cut file 250 mm	25 nos
14.	Flat smooth file 200 mm	25 nos
15.	File half round 2nd cut 250 mm	4 nos
16.	File triangular smooth 200 mm	4 nos
17.	File round 2nd cut 250 mm	4 nos
18.	File square 2nd cut 250 mm	4 nos
19.	Rasp cut file	10 nos
20.	Curve cut file	10 nos
21.	Hand file 300mm	25 nos
22.	Needle file set	1 set
23.	Engineers screw driver 300 mm (Flat & Philips)	25 nos
24.	Flat cold chisel 25 mm X 150 mm	25 nos
25.	File Card / Brush	25 nos
26.	Soft jaws	As Required
27.	Ratchet Screw Drive	As Required
28.	Adjustable screw wrench	As Required
29.	Surface plate 400 mm x 400 mm	1 no
30.	Table for surface plate 900 x 900 x 1200 mm	1 no
31.	Marking off table 1200 x 1200 x 900 mm	1 no
32.	Scribing block universal 300 mm	2 nos
33.	V-Block 100 / 7 – 80 - A	2 nos
34.	Straight edge steel 100 mm	1 no
35.	Steel tape 8 meter in case	1 no
36.	Steed rule 600 mm graduated both in English and Metric units	2 nos
37.	Sprit level 005m – 200mm	1 no
38.	Hammer BP 800 grams with handle	12 nos
39.	Screw driver heavy duty 300 mm with handle	4 nos
40.	Mallet Hammer (Wooden & Lead 1 kg)	6 nos
41.	Anvil 50 kg	1 no

42.	Anvil stand	1 no
43.	Combination set 300 mm	4 nos
44.	Allen hexagonal keys 25 – 12mm & Allen Key set (English)	2 set
45.	Spanner DEGP series 2 (sets of 7 pieces – Box & Ring)	6 sets
46.	Adjustable spanner 300 mm	2 nos
47.	Reduction sleeve morse taper 1-1, 3-1, 4-1, 4-2, 5-1, 5-2, 6-1	2 set
48.	Angle plate size 150 X 100mm	2 nos
49.	Angle plate adjustable 250 x 150 x 175mm	2 nos
50.	Solid parallels in pairs (Different sizes) in Metric	25 pairs
51.	Oil can pressure feed 500 mm	25 nos
52.	Oil stone 150 x 50 x 25 mm	2 nos
53.	Oil stone 100 x 12 mm square	2 nos
54.	Number drills HSS (Parallel shank)	1 set
55.	Twist drills 3 mm to 13 mm in a step of 05mm (parallel shank)	2 sets
56.	Drill chuck 020 with taper shank with key	1 no
57.	Drill angle gauge	2 nos
58.	Centre drill A1 to 5	2 sets
59.	Grinding Wheel dresser (Diamond, Star & Abrasive stick)	1 no
60.	Clamps 'C' 150 mm	2 nos
61.	Clamp toolmaker 5 cm and 75 cm set of 2	2 nos
62.	Scraper flat 15 cm	2 nos
63.	Scraper triangular 15 cm	2 nos
64.	Scraper half round 15cm	2 nos
65.	Wing compass 254 cm or 30 cm	5 nos
66.	Tap and die set in box metric pitch (6 – 12 mm)	1 set each
67.	Tap wrench (Adjustable)	5 nos
68.	Tap and die set in box inch pitch (Standard sizes)	1 set each
69.	Drill HSS taper shank (6 – 12 mm in a step of 05mm)	2 set
70.	Hand & Machine Reamer 6 mm to 25 mm by 1 mm	1 set
71.	Reamer adjustable 10 mm to 15 mm by 75 mm	1 set
72.	Tools bit HSS 6 mm square	1 doz
73.	Tools bit HSS 10 mm square	1 doz
74.	Tools bit holder (Armstrong) LH	4 nos
75.	Tools bit holder (Armstrong) RH	4 nos
76.	Assorted tools for lathe, shaper, slotter and planner of different shapes and sizes	As required
77.	Hacksaw frame adjustable & fixed 250 – 300 mm with blades	2 nos
78.	Table chuck 75 mm jaw swivel base	1 no
79.	Machine vice 200 mm swivel base	3 nos
80.	Machine vice 160 mm swivel base	3 nos
81.	Hand vice 50 mm jaw	4 nos
82.	Bench Vice	25 Nos
83.	Universal table angle plate	1 no
84.	Taper shank twist drill set 6-30 mm x 15 mm to suit Radial drilling machine	1 set
85.	Shaper tool holder turret type	2 nos
86.	Base chuck for Slotting machine	1 no
87.	Shaper indexing centre	1 no

88.	Knurling tools (set of 3) straight & diamond set	1set
89.	Angle plate with slots 300 x 300 & 400 x 400 mm	1 no
90.	Pliers 200 mm	2 nos
91.	Magnifying glass 75 mm	2 nos
92.	Letter Punch set 3 mm	1 no
93.	Number Punch set 3 mm	1 no
94.	Carbide tipped tools of different sizes & shapes (Throw away tips)	2 sets
95.	Hand hammers 1 kg with handle	2 nos
96.	Steel lockers for 25 trainees	1 no
97.	Steel chair for instructor	1 no
98.	Steel table for instructor	1 no
99.	Steel cupboard 180 x 90 x 45 mm	1 no
100.	Steel cupboard 120 x 60 x 45 cm	1 no
101.	Black board with easel	1 no
102.	First Aid box	1 no
103.	Fire extinguisher for Class A, B & C fire	4 nos
104.	Fire Bucket	4 nos

Milling Cutters

1.	Cylindrical cutter 63 x 32 bore dia	2 nos
2.	Cylindrical cutter 80 x 32 bore dia	2 nos
3.	Side and face cutter B 80 x 8 x 32	2 nos
4.	Side and face cutter B 160 x 10x 32	2 nos
5.	Side and face cutter B 100 x 12 x 32	2 nos
6.	Side and face cutter B 160 x 16 x 32	2 nos
7.	Side and face cutter A 100 x 20 x 32	2 nos
8.	Side and face cutter A 100 x 10 x 32	2 nos
9.	Equal angle cutter 100 X45°	2 nos
10.	Equal angle cutter 100 X60°	2 nos
11.	Equal angle cutter 100 X90°	2 nos
12.	Double unequal angle cutter 50 x 12 x 55°	2 nos
13.	Double unequal angle cutter 63 x 18 x 60°	2 nos
14.	Double unequal angle cutter 80 x 32 x 70°	2 nos
15.	Double unequal angle cutter 100 x 36 x 75°	2 nos
16.	Single angle cutter 63 x 18 x 45° RH	2 nos
17.	Single angle cutter 63 x 18 x 45° LH	2 nos
18.	Single angle cutter 63 x 18 x 60° RH	2 nos
19.	Single angle cutter 63 x 18 x 60° LH	2 nos
20.	Single angle cutter 63 x 28 x 70° RH	2 nos
21.	Single angle cutter 63 x 28 x 70° LH	2 nos
22.	Single angle cutter 63 x 28 x 80° LH	2 nos
23.	Slitting saw 80 x 3 x 32A	2 nos
24.	Slitting saw 125 x 3 x 32A	2 nos
25.	Slitting saw 100 x 4 x 32A	2 nos
26.	Slitting saw 100 x 5 x 32 B	2 nos
27.	Slitting saw 200 x 6 x 32 B	2 nos

28.	Slot drill (key seating) 3 mm	2 nos
29.	Slot drill (key seating) 4 mm	2 nos
30.	Slot drill (key seating) 6 mm	2 nos
31.	Slot drill (key seating) 8 mm	2 nos
32.	Slot drill (key seating) 12 mm	2 nos
33.	T-Slot cutters to suit T-headed bolts of 10, 12 mm straight-shank	2 each
34.	T-Slot cutter to suit T-headed bolts of 14, 18, 22 taper shank	2 each
35.	Drill fluting cutters nos8 to 16	1 set
36.	Reamer fluting cutters nos 1 to 8	1 set
37.	Milling cutter (involute gear tooth) 8, 10, 12, 164 20 DP No 1 to 8	1 set
38.	Milling cutters (involute gear tooth) 1, 2, 2 ½, 3& 4 module	1 set
39.	Convex milling cutter 25 mm	2 nos
40.	Convex mulling cutter 4 mm	2 nos
41.	Convex milling cutter 10 mm	2 nos
42.	Convex milling cutter 20 mm	2 nos
43.	Concave milling cutter 25 mm	2 nos
44.	Concave milling cutter 4 mm	2 nos
45.	Concave milling cutter 10 mm	2 nos
46.	Concave milling cutter 20 mm	2 nos
47.	Milling cutter corner rounding 25 mm	2 nos
48.	Milling cutter corner rounding 4 mm	2 nos
49.	Milling cutter corner rounding 10 mm	2 nos
50.	Milling cutter corner rounding 16 mm	2 nos
51.	Milling cutter face mill inserted type 150 x 50 bore	2 nos
52.	Milling cutter face mill inserted type 150 x 50 bore	2 nos
53.	Shell end mill 63 mm x 32 bore	2 nos
54.	Shell end mill 40 x 32 bore	2 nos
55.	Wood ruff key seating cutter A 135 x 3, A 165 x 4, A 195 x 5 & A 195 x 60	2 each
56.	End mill cutter (parallel shank) 3, 6, 10, 16, 18, 22 mm	2 each
57.	Dovetail cutter 60° and 55°	2 each
58.	Bevel gear cutter, cutter, 14 D P or equivalent module	1 set
59.	Counter boring & counter sinking cutter (standard size)	2 each

Measuring Instruments

1.	Micrometer outside 0 - 25 mm & 0 – 1”	4 nos
2.	Micrometer outside 25 - 50 & 1 – 2”	2 nos
3.	Micrometer outside 50 - 75 & 2 – 3”	1no
4.	Micrometer outside 75 - 100 & 2 – 3”	1no
5.	Inside Micrometer 25 mm to 150 mm with extension rod	2 nos
6.	Micrometer depth gauge 0 - 200 mm	2 nos
7.	Digital Outside Micrometer 0 – 25mm	2nos
8.	Dial Vernier Caliper 0 – 300mm (Direct reading with dial)	1 no
9.	Vernier height gauge 250 mm	1 no
10.	Vernier gear tooth caliper	1 no
11.	Vernier bevel protractor with 150 mm blade	1 no

12.	Bevel gauge 200 mm	1 no
13.	Telescope gauge 13 mm to 300 mm	1 no
14.	Sine bar 200 mm & 250mm	1 no each
15.	Compound dial gauge with stand	1 no
16.	Dial test indicator with magnetic gauge type 1 grade A with magnetic base (Plunger & Lever type)	1 no
17.	Centre gauge 60^0, 55^0, 29^0 & 475^0	1 no each
18.	Slip gauge set (Normal set) metric – M112 set	1 set
19.	Screw pitch gauge for metric pitches (025 - 6 mm)	2 sets
20.	Screw pitch gauge for BSW thread	2 sets
21.	Radius gauge metric set (1 - 6 mm)	1 set
22.	Wire gauge	1 no
23.	Limit plug gauge 5 mm to 25 mm by 25 mm	1 set
24.	Ring gauges 5 mm to 25 mm by 25 (Go & No Go)	1 set
25.	Taper gauge MTNo 1, 2, 3, 4 & 5	1 set
26.	Feeler gauge	1 no
27.	Planer gauge standard size	1 no
28.	Tubular Inside micrometer (minimum size 50mm)	1no
29.	Vernier depth gauge	2 nos
30.	Bore dial gauge	2 nos

General Installation

1.	Shaping machine 450 mm stroke (Motorized) with all attachments	2 no
2.	Shaping machine 315 mm stroke (Hydraulic) with all attachments	2 no
3.	Double column planer 1500 x 1000 x 1000 (Motorized) with all attachments	1 no
4.	Stotter 180 mm stroke (Motorized) with all attachments	2 nos
5.	Lathe general purpose all geared-height of centers 150 mm to below between centre 150 mm supplied with 3 jaw & 4 jaw chuck faceplate turner turning attachments steadies, etc and set of lathe tools	10 nos
6.	Tool and cutter grinder 250 mm to admit 450 mm between centre fully motorized work head supplied with tool rest ofdifferent types table clamps & other attachments	1 no
7.	Drilling machine pillar 20 mm capacity	3 no
8.	Radial drill 1200 mm are motorized with tapping attachment	2 no
9.	Silicon carbide grinder for carbide tipped tools	1 no
10.	Milling machine universal horizontal (Motorized) with all attachment such as: a Universal head b Vertical head c Slotting attachment d Rack cutting attachment e Rotary table f Diving head g Adaptors, arbors & collects etc for shank and mill from 3 mm to 30 mm	2 no
11.	Milling machine universal horizontal no 0 with all attachments	2 no
12.	Milling machine plain type horizontal (Motorized) No2 with all attachments	2 no
13.	Milling machine vertical No 1 (Motorized) with all attachments	2 no
14.	Surface grinding machine wheel dia 180mm (or near) reciprocating table,	

Longitudinal table traverse 200 mm (or near) fitted with adjustable traverse stop
Full motorized supplied with magnetic chuck 250 mm x 120 mm diamond tool holder
set of spanner grease gun 1 no

15. CNC TURNING CENTRE WITH ALL ACCESSORIES 1 no

16. CNC MACHINING/CENTRE WITH ALL ATTACHMENTS 1 no

17. Multimedia based simulator for CNC technology and interactive CNC part programming software for turning & milling with virtual machine operation and simulation using popular operation control system such as Fanuc, Siemens (Web based or Licensed based) 20 nos

18. Desktop with MS-Windows 7 or latest to run the above software networked on LAN