B.E. DEGREE
IN
CIVIL ENGINEERING

Year : I

Part : I

Teaching Schedule							Examination Scheme							
							Theory			Practical				
								Final			Final			
S. N.	Course Code	Course Title	L	T	P	Total	Assesment Marks	Duaration hours	Marks	Assesment Marks	Duaration hours	Marks	Total	Remark
1	SH 401	Engineering Mathematics - I	3	2		5	20	3	80				100	
2	CT 401	Computer Programing	3		3	6	20	3	80	50			150	
3	ME 401	Engineering Drawing I	1		3	4				60	3	40	100	
4	SH 403	Engineering Chemistry	3	1	3	7	20	3	80	20	3	30	150	
5	ME 402	Funadmental of Thermodynamics & Heat Transfer	3	1	1.5	5.5	20	3	80	25			125	
6	ME 403	Workshop Technology	1		3	4	10			40			50	
		Total	**14**	**4**	**13.5**	**31.5**	**90**	**12**	**320**	**195**	**6**	**70**	**675**	

ENGINEERING MATHEMATICS I

SH 401

Lecture : 3 **Year : I**
Tutorial : 2 **Part : I**
Practical : 0

Course Objective:

To provide students a sound knowledge of calculus and analytic geometry to apply them in their relevant fields.

1. Derivatives and their Applications **(14 hours)**

1.1 Introduction
1.2 Higher order derivatives
1.3 Mean value theorem
  1.3.1 Rolle's Theorem
  1.3.2 Lagrange's mean value theorem
  1.3.3 Cauchy's mean value theorem
1.4 Power series of single valued function
  1.4.1 Taylor's series
  1.4.2 Maclaurin's series
1.5 Indeterminate forms; L'Hospital rule
1.6 Asymptotes to Cartesian and polar curves
1.7 Pedal equations to Cartesian and polar curves; curvature and radius of curvature

2. Integration and its Applications **(11 hours)**

2.1 Introduction
2.2 Definite integrals and their properties
2.3 Improper integrals
2.4 Differentiation under integral sign
2.5 Reduction formula; Beta Gama functions
2.6 Application of integrals for finding areas, arc length, surface and solid of revolution in the plane for Cartesian and polar curves

3. Plane Analytic Geometry **(8 hours)**

3.1 Transformation of coordinates: Translation and rotation
3.2 Ellipse and hyperbola; Standard forms, tangent, and normal
3.3 General equation of conics in Cartesian and polar forms

4. Ordinary Differential Equations and their Applications **(12 hours)**

4.1 First order and first degree differential equations
4.2 Homogenous differential equations
4.3 Linear differential equations

4.4 Equations reducible to linear differential equations; Bernoulli's equation
4.5 First order and higher degree differential equation; Clairaut's equation
4.6 Second order and first degree linear differential equations with constant coefficients.
4.7 Second order and first degree linear differential equations with variable coefficients; Cauchy's equations
4.8 Applications in engineering field

References:

1. Erwin Kreyszig, "Advance Engineering Mathematics" , John Wiley and Sons Inc
2. Thomas,Finney, "Calculus and Analytical Geometry" Addison- Wesley
3. M. B. Singh, B. C. Bajrachrya, "Differential Calculus", Sukunda Pustak Bhandar,Nepal
4. M. B. Singh, S. P. Shrestha, "Applied Mathematics", RTU, Department of Engineering Science and Humanities.
5. G.D. Pant, G. S. Shrestha, "Integral Calculus and Differential Equations", Sunila Prakashan, Nepal
6. M. R. Joshi, "Analytical Geometry", SukundaPustak Bhandar,Nepal
7. S. P. Shrestha, H. D. Chaudhary, P. R. Pokharel, "A Textbook of Engineering Mathematics - Vol I", Vidyarthi Pustak Bhandar.
8. Santosh Man Maskey, "Calculus", Ratna Pustak Bhandar, Nepal

COMPUTER PROGRAMMING
CT 401

Lecture : 3 **Year : I**
Tutorial : 0 **Part : I**
Practical : 3

Course Objective:
To familiarize the student with computer software and high level programming languages and to develop the programming skill using C language

1. Overview of Computer Software & Programming Languages (3 hours)
- 1.1. System software
- 1.2. Application software
- 1.3. General software features and recent trends
- 1.4. Generation of programming languages
- 1.5. Categorization of high level languages

2. Problem Solving Using Computer (3 hours)
- 2.1. Problem analysis
- 2.2. Algorithm development and Flowchart
- 2.3. Compilation and Execution
- 2.4. Debugging and Testing
- 2.5. Programming Documentation

3. Introduction to 'C' Programming (4 hours)
- 3.1. Character set, Keywords, and Data types
- 3.2. Preprocessor Directives
- 3.3. Constants and Variables
- 3.4. Operators and statements

4. Input and Output (3 hours)
- 4.1. Formatted input/output
- 4.2. Character input/output
- 4.3. Programs using input/output statements

5. Control Statements (6 hours)
- 5.1. Introduction
- 5.2. The goto, if, if ... ... else, switch statements
- 5.3. The while, do ... while, for statements

6. User-Defined Functions (4 hours)
- 6.1. Introduction
- 6.2. Function definition and return statement
- 6.3. Function Prototypes

6.4. Function invocation, call by value and call by reference, Recursive Functions

7. Arrays and Strings **(5 hours)**

7.1. Defining an Array
7.2. One-dimensional Arrays
7.3. Multi-dimensional Arrays
7.4. Strings and string manipulation
7.5. Passing Array and String to function

8. Structures **(4 hours)**

8.1. Introduction
8.2. Processing a Structure
8.3. Arrays of Structures
8.4. Arrays within Structures
8.5. Structures and Function

9. Pointers **(4 hours)**

9.1. Introduction
9.2. Pointer declaration
9.3. Pointer arithmetic
9.4. Pointer and Array
9.5. Passing Pointers to a Function
9.6. Pointers and Structures

10. Data Files **(5 hours)**

10.1. Defining opening and closing a file
10.2. Input/Output operations on Files
10.3. Error handling during input/output operations

11. Programming Languages: FORTRAN **(4 hours)**

11.1 Character set
11.2 Data types, Constants and variables
11.3 Arithmetic operations, Library Functions
11.4 Structure of Fortran program
11.5 Formatted and Unformatted Input/Output Statements
11.6 Control Structures: Goto, Logical IF, Arithmetic IF, Do loops
11.7 Arrays: one dimensional and two dimensional

Practical

- Minimum 6 sets of computer programs in C (from Unit 4 to Unit 10) and 2 sets in FORTRAN (from Unit 11) should be done individually. (30 marks out of 50 marks)
- Student (maximum 4 persons in a group) should submit a mini project at the end of course. (20 marks out of 50 marks)

References:

1. Kelly & Pohl, "A Book on C", Benjamin/Cumming
2. Brian W. Keringhan & Dennis M. Ritchie, "The 'C' Programming Language", PHI
3. Daya Sagar Baral, Diwakar Baral and Sharad Kumar Ghimire "The Secrets of C Programming Language", Bhundipuran Publication
4. Bryons S. Gotterfried, "Programming with C", TMH
5. Yashavant Kanetkar, "Let Us C", BPB
6. Alexis Leon, Mathews Leon, "Fundamentals of Information Technology", Leon Press and Vikas Publishing House

ENGINEERING DRAWING I

ME 401

Lectures : 1 **Year : I**
Tutorial : 0 **Part : I**
Practical : 3

Course Objective:

To develop basic projection concepts with reference to points, lines, planes and geometrical solids. Also to develop sketching and drafting skills to facilitate communication.

1. Instrumental Drawing, Technical Lettering Practices and Techniques (2 hours)

1.1 Equipment and materials
1.2 Description of drawing instruments, auxiliary equipment and drawing materials
1.3 Techniques of instrumental drawing
1.4 Pencil sharpening, securing paper, proper use of T- squares, triangles, scales dividers, compasses, erasing shields, French curves, inking pens
1.5 Lettering strokes, letter proportions, use of pencils and pens, uniformity and appearance of letters, freehand techniques, inclined and vertical letters and numerals, upper and lower cases, standard English lettering forms

2. Dimensioning (2 hours)

2.1 Fundamentals and techniques
2.2 Size and location dimensioning, SI conversions
2.3 Use of scales, measurement units, reducing and enlarging drawings
2.4 Placement of dimensions: aligned and unidirectional

3. Applied Geometry (6 hours)

3.1 Plane geometrical construction: Proportional division of lines, arc & line tangents
3.2 Methods for drawing standard curves such as ellipses, parabolas, hyperbolas, involutes, spirals, cycloids and helices (cylindrical and conical)
3.3 Techniques to reproduce a given drawing (by construction)

4. Basic Descriptive Geometry (14 hours)

4.1 Introduction to Orthographic projection, Principal Planes, Four Quadrants or Angles
4.2 Projection of points on first, second, third and fourth quadrants
4.3 Projection of Lines: Parallel to one of the principal plane, Inclined to one of the principal plane and parallel to other, Inclined to both principal planes

4.4 Projection Planes: Perpendicular to both principal planes, Parallel to one of the principal planes and Inclined to one of the principal planes, perpendicular to other and Inclined to both principal planes
4.5 True length of lines: horizontal, inclined and oblique lines
4.6 Rules for parallel and perpendicular lines
4.7 Point view or end view of a line
4.8 Shortest distance from a point to a line
4.9 Edge View and True shape of an oblique plane
4.10 Angle between two intersecting lines
4.11 Intersection of a line and a plane
4.12 Angle between a line and a plane
4.13 Dihedral angle between two planes
4.14 Shortest distance between two skew lines
4.15 Angle between two non- intersecting (skew) lines

5. Multi view (orthographic) projections (18 hours)

5.1 Orthographic Projections
5.1.1 First and third angle projection
5.1.2 Principal views: methods for obtaining orthographic views, Projection of lines, angles and plane surfaces, analysis in three views, projection of curved lines and surfaces, object orientation and selection of views for best representation, full and hidden lines
5.1.3 Orthographic drawings: making an orthographic drawing, visualizing objects (pictorial view) from the given views
5.1.4 Interpretation of adjacent areas, true-length lines , representation of holes, conventional practices
5.2 Sectional Views: Full, half, broken revolved, removed (detail) sections, phantom of hidden section, Auxiliary sectional views, specifying cutting planes for sections, conventions for hidden lines, holes, ribs, spokes
5.3 Auxiliary views: Basic concept and use, drawing methods and types, symmetrical and unilateral auxiliary views. Projection of curved lines and boundaries, line of intersection between two planes, true size of dihedral angles, true size and shape of plane surfaces

6. Developments and Intersections (18 hours)

6.1 Introduction and Projection of Solids
6.2 Developments: general concepts and practical considerations, development of a right or oblique prism, cylinder, pyramid, and cone, development of truncated pyramid and cone, Triangulation method for approximately developed surfaces, transition pieces for connecting different shapes, development of a sphere
6.3 Intersections: lines of intersection of geometric surfaces, piercing point of a line and a geometric solid, intersection lines of two planes, intersections of -prisms and pyramids, cylinder and an oblique plane. Constructing a development using auxiliary views, intersection of - two cylinders, a cylinder & a cone

Practical:

1. Drawing Sheet Layout, Freehand Lettering, Sketching of parallel lines, circles, Dimensioning
2. Applied Geometry(Sketch and Instrumental Drawing)
3. Descriptive Geometry I: Projection of Point and Lines (4.1 to 4.3)(Sketch and Instrumental Drawing)
4. Descriptive Geometry II: Projection of Planes (4.4) (Sketch and Instrumental Drawing)
5. Descriptive Geometry III: Applications in Three dimensional Space (4.5 to 4.15) (Sketch and Instrumental Drawing)
6. Multiview Drawings (5.1) (Sketch and Instrumental Drawing)
7. Multiview, Sectional Drawings and Dimensioning I (5.2)(Sketch and Instrumental Drawing)
8. Multiview, Sectional Drawings and Dimensioning II (5.2) (Sketch and Instrumental Drawing)
9. Auxiliary View, Sectional Drawings and Dimensioning (5.3) (Sketch and Instrumental Drawing)
10. Projection of Regular Geometrical Solids (Sketch and Instrumental Drawing)
11. Development and Intersection I (6.1) (Sketch and Instrumental Drawing)
12. Development and Intersection II (6.2) (Sketch and Instrumental Drawing)
13. Development and Intersection III (6.3) (Sketch and Instrumental Drawing)

References:

1. M. C. Luintel, "Engineering Drawing (Vol.I)", Athrai Publication (P) Limited.
2. W. J. Luzadder, "Fundamentals of Engineering Drawing", Prentice Hall.
3. T. E. French, C. J. Vierck, and R. J. Foster, "Engineering Drawing and Graphic Technology", Mc Graw Hill Publshing Co.
4. A . Mitchell, H. C. Spencer and J. T. Dygdone, "Technical Drawing", F. E. Giescke, Macmillan Publshing Co.
5. N. D. Bhatt, "Elementary Engineering Drawing", Charotar Publshing House, India.
6. P. S. Gill, "A Text Book of Engineering Drawing", S. K. Kataria and Sons, India
7. R. K. Dhawan, "A Text Book of Engineering Drawing", S. Chand and Company Limited, India

ENGINEERING CHEMISTRY

SH 403

Lecture : 3 **Year : I**
Tutorial : 1 **Part : I**
Practical : 3

Course Objective:

To develop the basic concepts of Physical Chemistry, Inorganic Chemistry and Organic Chemistry relevant to problems in engineering.

1. Electro-chemistry and Buffer **(6 hours)**

1.1 Electro-chemical cells
1.2 Electrode Potential and Standard Electrode Potential
1.3 Measurement of Electrode Potential
1.4 Nernst equation
1.5 EMF of Cell
1.6 Application of Electrochemical and Electrolytic cells
1.7 Electrochemical Series and its Application
1.8 Buffer: its type and mechanism
1.9 Henderson's equation for pH of buffer and related problems
1.10 Corrosion and its type
1.11 Factors influencing corrosion
1.12 Prevention of corrosion

2. Catalyst **(4 hours)**

2.1 Introduction
2.2 Action of Catalyst (Catalytic Promoters and Catalytic Poisons)
2.3 Characteristics of Catalyst
2.4 Types of Catalyst
2.5 Theories of Catalysis
2.6 Industrial Applications of Catalysts

3. Environmental Chemistry **(5 hours)**

3.1 Air Pollution
3.2 Air Pollutants i) gases SO_x,NO_x,CO,CO_2,O_3 and hydrocarbons ii) particulates dust, smoke and fly ash
3.3 Effects of Air Pollutants on human beings and their possible remedies
3.4 Ozone depletion and its photochemistry
3.5 Water Pollution (Ref of surface water and pound water)
3.6 Water Pollutants (Ref of surface water) their adverse effect and remedies
3.7 Soil pollution
3.8 Pollutants of soil their adverse effects and possible remedies

4. Engineering Polymers **(6 hours)**

4.1 Inorganic polymers

4.2 General properties of inorganic polymers
4.3 Polyphosphazines
4.4 Sulpher Based Polymers
4.5 Chalcogenide Glasses
4.6 Silicones
4.7 Organic Polymers
4.8 Types of Organic Polymers
4.9 Preparation and application of
i) Polyurethane ii) Polystyrene iii) Polyvinylchloride iv) Teflon
v) Nylon 6,6 and vi) Bakelite vii) Epoxy Resin viii) Fiber Reinforced Polymer
4.10 Concept of bio-degradable, non-biodegradable and conducting polymers

5. 3-d Transition elements and their applications **(5 hours)**

5.1 Introduction
5.2 Electronic Configuration
5.3 Variable oxidation states
5.4 Complex formation tendency
5.5 Color formation
5.6 Magnetic properties
5.7 Alloy formation
5.8 Applications of 3-d transition elements

6. Coordination Complexes **(5 hours)**

6.1 Introduction
6.2 Terms used in Coordination Complexes
6.3 Werner's Theory Coordination Complexes
6.4 Sidgwick's model and Sidgwick's effective atomic number rule
6.5 Nomenclature of coordination compounds (Neutral type, simple cation and complex anion and complex cation and simple anion type)
6.6 Valence Bond Theory of Complexes
6.7 Application of valence bond theory in the formation of
i) Tetrahedral Complexes ii) Square planar Complexes and
iii) Octahedral Complexes
6.8 Limitations of Valence Bond Theory
6.9 Applications of Coordination Complexes

7. Explosives **(3 hours)**

7.1 Introduction
7.2 Types of explosives: Primary, Low and High explosives
7.3 Preparation and application of TNT, TNG, Nitrocellulose and Plastic explosives

8. Lubricants and Paints **(3 hours)**

8.1 Introduction

8.2 Function of Lubricants
8.3 Classification of Lubricants (Oils, Greases and Solid)
8.4 Paints
8.5 Types of Paint
8.6 Application of Paints

9. Stereochemistry **(4 hours)**

9.1 Introduction
9.2 Geometrical Isomerism (Cis Trans Isomerism) Z and E concept of Geometrical Isomerism
9.3 Optical Isomerism with reference to two asymmetrical carbon center molecules
9.4 Terms Optical activity, Enantiomers, Diastereomers, Meso structures, Racemic mixture and Resolution

10. Reaction Mechanism in Organic reactions **(4 hours)**

10.1 Substitution reaction
10.2 Types of substitution reaction SN^1 and SN^2
10.3 Elimination reaction
10.4 Types of elimination reaction El and E2
10.5 Factors governing SN^1, SN^2, El and E2 reaction mechanism path

References:

1. Jain and Jain, "Engineering Chemistry", Dhanpat Rai Publishing Co.
2. Shashi Chawala, "A Text Book of Engineering Chemistry", Dhanpat Rai Publishing Co.
3. J. D. Lee, "A New Concise Inorganic Chemistry", Wiley India Pvt. Limited.
4. Marron and Prutton, "Principles of Physical Chemistry", S. Macmillan and Co. Ltd.
5. Bahl and Tuli, "Essential of Physical Chemistry", S. Chand and Co. Ltd.
6. Satya Prakash and Tuli, "Advanced Inorganic Chemistry Vol 1 and 2", S. Chand and Co. Ltd
7. Morrison and Boyd, "Organic chemistry", ...
8. Moti Kaji Sthapit, "Selected Topics in Physical Chemistry", Taleju Prakashan, Kathmandu.
9. Peavy, Rowe and Tchobanoglous, "Environmental Engineering", McGraw-Hill, New York.
10. R. K. Sharma, B. Panthi and Y. Gotame, "Textbook of Engineering Chemistry", Athrai Publication.

Practical:

1. Compare the alkalinity of different water samples by double indicator method 6 Periods

2. Determine the temporary and permanent hardness of water by EDTA Complexo-metric method 3 Periods
3. Determine residual and combined chlorine present in the chlorinated sample of water by Iodometric method 6 Periods
4. Prepare organic polymer nylon 6,6/ Bakelite in the laboratory 3 Periods
5. Determine the pH of different sample of buffer solution by universal indicator method 6 Periods
6. Prepare inorganic complex in the laboratory 3 Periods
7. Determine surface tension of the given detergent solution and compare its cleansing power with other detergent solutions 6 Periods
8. Construct an electrochemical cell in the laboratory and measure the electrode potential of it 3 Periods
9. Estimate the amount of iron present in the supplied sample of ferrous salt using standard potassium permanganate solution (redox titration) 6 Periods

FUNDAMENTALS OF THERMODYNAMICS AND HEAT TRANSFER

ME 402

Lectures : 3 **Year : I**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objective:

To develop basic concepts, laws of thermodynamics and heat transfer and their applications.

1. Introduction **(3 hours)**

- 1.1 Definition and Scope of Engineering Thermodynamics
- 1.2 Value of energy to society
- 1.3 Microscopic versus Macroscopic Viewpoint
- 1.4 Concepts and Definitions
  - 1.4.1 System, Surroundings, Boundary and Universe; Closed Systems, Open Systems, and Isolated Systems
  - 1.4.2 Thermodynamic Properties: Intensive, Extensive and Specific Properties
  - 1.4.3 Thermodynamic Equilibrium
  - 1.4.4 Thermodynamic State
  - 1.4.5 Thermodynamic Process, Cyclic Process, Quasi-equilibrium Process, Reversible and Irreversible Process
- 1.5 Common Properties: Pressure, Specific Volume, Temperature
- 1.6 Zeroth Law of Thermodynamics, Equality of Temperature

2. Energy and Energy Transfer **(3 hours)**

- 2.1 Energy and its Meaning
- 2.2 Stored Energy and Transient Energy; Total Energy
- 2.3 Energy Transfer
  - 2.3.1 Heat Transfer
  - 2.3.2 Work Transfer
- 2.4 Expressions for displacement work transfer
- 2.5 Power

3. Properties of Common Substances **(6 hours)**

- 3.1 Pure Substance and State Postulate
- 3.2 Ideal Gas and Ideal Gas Relations
- 3.3 Two Phase (Liquid and Vapor) Systems: Phase Change; Subcooled Liquid, Saturated Liquid, Wet Mixture, Critical Point, Quality, Moisture Content, Saturated Vapor and Superheated Vapor
- 3.4 Properties of Two Phase Mixtures
- 3.5 Other Thermodynamic Properties: Internal Energy, Enthalpy, and Specific Heats

3.6 Development of Property Data: Graphical Data Presentation and Tabular Data Presentation

4. First Law of Thermodynamics **(9 hours)**

4.1 First Law of Thermodynamics for Control Mass; First Law of Thermodynamics for Control Mass Undergoing Cyclic Process
4.2 First Law of Thermodynamics for Control Volume
4.3 Control Volume Analysis: Steady State Analysis and Unsteady State Analysis
4.4 Control Volume Application: Steady and Unsteady Work Applications and Steady and Unsteady Flow Applications
4.5 Other Statements of the First Law

5. Second Law of Thermodynamics **(9 hours)**

5.1 Necessity of Formulation of Second Law
5.2 Entropy and Second Law of Thermodynamics for an Isolated System
5.3 Reversible and Irreversible Processes
5.4 Entropy and Process Relation for an Ideal Gases and Incompressible Substances
5.5 Control Mass Formulation of Second Law
5.6 Control Volume Formulation of Second Law
5.7 Isentropic Process for an Ideal Gas and for an Incompressible Substances
5.8 Carnot Cycle, Heat Engine, Heat Pump and Refrigerator
5.9 Kelvin-Planck and Clausius Statements of the Second Law of Thermodynamics and their Equivalence

6. Thermodynamic Cycles **(9 hours)**

6.1 Classification of Cycles
6.2 Air Standard Brayton Cycle
6.3 Rankine Cycle
6.4 Internal Combustion Cycles
  6.4.1 Air standard Analysis
  6.4.2 Air Standard Otto Cycle
  6.4.3 Air Standard Diesel Cycle
6.5 Vapor Compression Refrigeration Cycle

7. Introduction to Heat Transfer **(6 hours)**

7.1 Basic Concepts and Modes of Heat Transfer
7.2 One dimensional steady state heat conduction through a plane wall
7.3 Radial steady state heat conduction through a hollow cylinder
7.4 Heat flow through composite structures
  7.4.1 Composite Plane Wall
  7.4.2 Multilayer tubes
7.5 Electrical Analogy for thermal resistance
7.6 Combined Heat Transfer and Overall Heat Transfer Coefficient for Plane Wall and Tube

7.7 Nature of Convection; Free and Forced Convection
7.8 Heat Radiation, Stefan's Law, Absorptivity, Reflectivity and Transmissivity; Black Body, White Body and Gray Body

Practical:

1. Temperature Measurements
2. Experiment related to first law
3. Heat Pump
4. Heat Conduction
5. Heat Radiation

References:

1. M. C. Luintel, "Fundamentals of Thermodynamics and Heat Transfer", Athrai Publication (P) Limited.
2. R. Gurung, A. Kunwar & T. R. Bajracharya, "Fundamentals of Engineering Thermodynamics and Heat Transfer", Asmita Books Publishers and Distributors (P) Limited.
3. J. R. Howell & R. O. Buckius, "Fundamentals of Engineering Thermodynamics", McGraw Hill Publishers
4. V. Wylen, Sonntag & Borgnakke, "Fundamentals of Thermodynamics", John Wiley & Sons, Inc.
5. M. J. Moran & H. N. Shapiro, "Fundamentals of Engineering Thermodynamics", John Wiley & Sons, Inc.
6. Y. A. Cengel & M.A. Boles, "Thermodynamics: An Engineering Approach", McGraw-Hill.
7. J. P. Holman, "Heat Transfer", McGraw-Hill
8. Y. A. Cengel, "Heat Transfer: A Practical Approach", McGraw-Hill.

WORKSHOP TECHNOLOGY

ME 403

Lecture : 1 **Year : I**
Tutorial : 0 **Part : I**
Practical : 3

Course Objective:

To impart knowledge and skill components in the field of basic workshop technology. To be familiar with different hand and machine tools required for manufacturing simple metal components and articles.

1. General Safety Considerations **(2 hours)**

1.1 Bench Tools
1.2 Machinist's Hammers
1.3 Screw Drivers
1.4 Punches
1.5 Chisels
1.6 Scrapers
1.7 Scribers
1.8 Files
1.9 Pliers and Cutters
1.10 Wrenches
1.11 Hacksaw
1.12 Bench Vise
1.13 Hand drill
1.14 Taps and Dies
1.15 Hand Shears
1.16 Rules, Tapes and Squares
1.17 Soldering Iron
1.18 Rivets

2. Hand Working Operations **(1 hours)**

2.1 Sawing
2.2 Filing
2.3 Threading
2.4 Scribing
2.5 Shearing
2.6 Soldering
2.7 Riveting

3. Measuring and Gauging **(1hours)**

3.1 Introduction
3.2 Semi – Precision Tools – Calipers, depth Gauge, Feeler Gauge

3.3 3.3 Precision Tools – Micrometers, Vernier Calipers, Vernier Height Gauge, Telescopic Gauge, Hole Gauge, Bevel Protractor, Dial Indicator, Gauge Blocks and Surface Plate

4. Drills and Drilling Processes **(1 hours)**

4.1 Introduction
4.2 Types of Drill Presses
4.3 Work Holding Devices and Accessories
4.4 Cutting Tools
4.5 Geometry of Drill Bits
4.6 Grinding of Drill Bits
4.7 Operations – Drilling, Counter - boring, Counter - sinking, Reaming, Honning, Lapping
4.8 Cutting Speeds
4.9 Drilling Safety

5. Machine Tools **(4 hours)**

5.1 General Safety Considerations
5.2 Engine Lathes
- 5.2.1 Introduction
- 5.2.2 Physical Construction
- 5.2.3 Types of Lathe
- 5.2.4 Lathe Operations – Facing, Turning, Threading

5.3 Shapers
- 5.3.1 Introduction
- 5.3.2 Types of Shapers
- 5.3.3 Physical Construction
- 5.3.4 General Applications

5.4 Milling Machines
- 5.4.1 Introduction
- 5.4.2 Types of Milling Machines
- 5.4.3 Physical Construction
- 5.4.4 Milling Cutters – Plain, Side, Angle, End, Form
- 5.4.5 Milling Operations – Plain, Side, Angular, Gang, End, Form, Keyway
- 5.4.6 Work Holding Devices
- 5.4.7 Cutter Holding Devices

5.5 Grinding Machines
- 5.5.1 Abrasives, Bonds, Grinding Wheels
- 5.5.2 Rough Grinders – Portable Grinders, Bench Grinders, Swing Frame Grinders, Abrasive Belt Grinders
- 5.5.3 Precision Grinders – Cylindrical Grinders, Surface Grinders

6. Material Properties **(1 hours)**

6.1 Tool materials – Low, medium and high carbon steels; Hot and cold rolled steels; Alloy steels; Carbide and Ceramic materials

6.2 Heat treating methods for steels – Annealing, Tempering, Normalizing, Hardening and Quenching
6.3 Non – ferrous metals – Brass, Bronze, Aluminum – Comparative Properties

7. Sheet Metal Works **(1 hours)**

7.1 Introduction
7.2 Sheet Metal Tools
7.3 Marking and Layout
7.4 Operations – Bending, Cutting, Rolling

8. Foundry Practice **(1 hours)**

8.1 Introduction
8.2 Pattern Making
8.3 Foundry Tools
8.4 Core Making
8.5 Melting Furnace – Cupola
8.6 Sand Casting Process

9. Forging Practice **(1 hours)**

9.1 Introduction
9.2 Forging Tools
9.3 Operations – Upsetting, Drawing, Cutting, Bending, Punching
9.4 Forging Presses and Hammers
9.5 Advantages and Limitations

10. Metal Joining **(2 hours)**

10.1 Safety Considerations
10.2 Introduction
10.3 Soldering
10.4 Brazing
10.5 Welding – Gas Welding, Arc Welding, Resistance Welding, Tungsten Inert Gas Welding (TIG), Metal Inert Gas Welding (MIG)

Practical:

1. Bench Tools and hand operations: Measuring, Marking, Layout, Cutting, Filling, Drilling, Tapping, Assembly
2. Bench Tools and hand operations: (Contd.)
3. Drilling machines
4. Measuring and Gauging Instruments
5. Engine lathe: Basic operations such as Plain turning, facing, cutting off, knurling.
6. Engine lathe: Taper turning, drilling and boring
7. Basic Shaper Operations
8. Milling Machines
9. Grinding Machines

10. Sheet Metal works
11. Foundry Practice
12. Forging Practice
13. Electric Arc Welding
14. Gas Welding

References:

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