

ENGINEERING MATERIAL

Periods / Week : 4+1

Examination : 3Hrs

Total period : 60

End exams : 80 marks

I.A.: 20 marks

Topic wise distribution of periods

Sl.No.	Topic	Periods
1.	Material classification	03
2.	Imperfection in crystal	10
3.	Iron carbon system	10
4.	Heat treatment	10
5.	Nonferrous metal & alloys	10
6.	Bearing material	04
7.	Spring material	03
8.	Polymers	05
9.	Composites & Ceramic	05

RATIONAL:

Entire field of engineering deals with use of host of materials for making objects for human consumption. These materials include wide spectrum of element, metals, alloys and compounds with diverse properties. It is imperative that an engineer from any field should have a good knowledge of such materials and their properties.

COURSE CONTENTS (In terms of specific objectives):

1.0 Material classification

1.1 Classify material into ferrous and non-ferrous metals and alloys.

1.2 Understand factors affecting the selection of materials for engineering Purposes such as

- a) Properties of materials
- b) Performance requirements
- c) Materials reliability
- d) Safety
- e) Physical attributes
- f) Environmental conditions
- g) Availability
- h) Disposability
- i) Economic factors

2.0 Imperfection in crystals

2.1 Explain crystal, ideal crystal and crystal imperfection

2.2 Classify crystal imperfections or defects such as point defects, line defects, surface or grain boundaries defect and volume defects

- 2.3 Explain types of point defects such as vacancies, interstitials and impurities
- 2.4 Explain types of line defects such as dislocation and screw dislocation
- 2.5 State various causes of dislocation
- 2.6 Explain effect of imperfection on metal properties
- 2.7 Explain deformation by slip
- 2.8 Explain deformation by twinning
- 2.9 Explain property changes by deformation.

- 3.0 Iron carbon system
 - 3.1 Understand basic concept of phase diagram cooling curves.
 - 3.2 Explain the iron – carbon equilibrium diagram with salient micro constituents of iron and steel

- 4.0 Heat Treatment
 - 4.1 Explain purpose of heat treatment
 - 4.2 Describe processes of heat treatment and elaborate the methods of Annealing, normalizing, hardening, tempering, mar tempering, age hardening and surface hardening methods.
 - 4.3 List effects of heat treatment on the properties of steel
 - 4.4 Explain harden ability of steel

- 5.0 Non ferrous alloys
 - 5.1 Describe composition, properties and the use of
 - 5.1.1 Aluminum alloys such as duralumin, y-alloy
 - 5.1.2 Copper alloys such as
 - 5.1.2.1 Copper-aluminum (the aluminum bronzes)
 - 5.1.2.2 Copper-tin-antimony (Babbitt metal)
 - 5.1.2.3 Copper-tin (tin bronzes)
 - 5.1.2.4 Copper-tin-phosphorous (phosphor bronzes)
 - 5.1.2.5 Copper-zinc (brass)
 - 5.1.2.6 Copper-nickel (the cupro-nickels)
 - 5.1.3 Predominating elements of lead alloys
 - 5.1.4 Predominating elements of zinc alloys
 - 5.1.5 Predominating elements of nickel alloys
 - 5.2 Name the alloys for high temperature service & metals for nuclear energy

- 6.0 Bearing Material
 - 6.1 Classify bearing metals
 - 6.2 Describe composition, properties and use of copper-base bearing metal, tin-base bearing metal, lead-base bearing metal and cadmium-base bearing metal

7.0 Spring Material

7.1 List types and properties of iron-base spring material

7.2 List types and properties of copper-base spring material

8.0 Polymers

8.1 List properties and application of thermo-plastic and setting plastics

8.2 List properties of elastomers

9.0 Composites and ceramics

9.1 Classify of composite material

9.2 Explain particle-reinforced & fiber reinforced composites and their properties

9.3 Classify and state application of ceramics

RECOMMENDED BOOKS

1. Material Science & Processes by S.K.Hazra Choudhury
2. A textbook of material science and metallurgy by O.P.Khanna
3. A textbook of material science by G.B.S.Narang
4. Engineering materials and metallurgy by R. K. Rajput
5. Science of Engineering Materials by Srivastav and Srinivasan

Thermal Engineering - I

Periods / Week: 4+1

Total period : 60

Examination : 3Hrs

End exams: 80 marks

I.A. : 20 marks

Topic wise distribution of periods

Sl.No.	Topic	Periods
1.	Thermodynamic Concepts and Properties	08
2.	Laws of thermodynamics	10
3.	Properties & Process of ideal gas	08
4.	Heat transfer	06
5.	Internal Combustion engine	08
6.	Air Compressor	06
7.	Fuel and Combustion	14
	Total Periods	60

RATIONAL:

Thermal Engineering is the field of applied Science which deals with energy possessed by heated gases and vapors and the Laws which given the conversion of this energy into mechanical energy and vice versa.

COURSE CONTENT:

- 1.0 Thermodynamic concept and properties
 - 1.1 Explain energy
 - 1.2 Describe the sources of energy
 - 1.2.1 Conventional energy (thermal, mechanical)
 - 1.2.2 Non Conventional energy
 - 1.3 Explain various thermodynamic systems
 - 1.3.1 Closed system
 - 1.3.2 Open system
 - 1.3.3 Isolated system
 - 1.3.4 Explain thermodynamic equilibrium condition
 - 1.3.5 Explain quasistatic process
 - 1.3.6 Define thermodynamic properties, process and cycle
 - 1.4 Classify thermodynamic properties. (intensive, extensive)
 - 1.5 Explain point function & path function
 - 1.6 Define thermodynamic properties (Pressure, Volume, Temp., internal energy, enthalpy)
 - 1.7 Define heat, work and state their units
 - 1.8 Explain mechanical equivalent of heat

- 1.9 Derive PdV work transfer on P-V diagram
- 1.10 Explain specific heat of gas
 - 1.10.1 Specific heat at const. vol (C_v)
 - 1.10.2 Specific heat at const. pr. (C_p)
- 1.11 Derive relationship between C_p and C_v

- 2.0 Laws of thermodynamics.
 - 2.1 State and explain Zeroth law of thermodynamics.
 - 2.2 State and explain first law of thermodynamics.
 - 2.3 Explain the application of first law of thermodynamics to non-flow process and solve Simple problems on:
 - 2.3.1 Const. pr. Process
 - 2.3.2 Const. Vol. Process
 - 2.3.3 Adiabatic Process
 - 2.3.4 Isothermal Process
 - 2.4 Application of first law of thermodynamics to steady flow process and general energy equation applied to condenser, nozzle, and turbine.
 - 2.5 Explain the limitation of first law of thermodynamics.
 - 2.6 State and explain second law of thermodynamics
 - 2.6.1 Define heat engine, efficiency heat pump, refrigerator & C.O.P
 - 2.6.2 State Kelvin-Planks statement
 - 2.6.3 State Clausius statement
 - 2.6.4 Show equivalence of two statements
 - 2.7 Explain reversible and irreversible process and highlight causes of Irreversibility
 - 2.8 State Clausius inequality
 - 2.9 Define entropy
 - 2.10 Explain principle of increase of entropy

- 3.0 Properties, processes of ideal gas:
 - 3.1 Explain difference between ideal gas and vapour
 - 3.2 Explain difference between gas and vapour
 - 3.3 State Boyle's law, Charles's law, Gay Lussac law and combination gas equation (with problems)
 - 3.4 Derive and explain characteristic gas constant. Universal gas constant (with problems)
 - 3.5 Explain various non-flow thermodynamic processes and solve problems on
 - 3.5.1 Isothermal process
 - 3.5.2 Isobaric process
 - 3.5.3 Isochoric process
 - 3.5.4 Isentropic process
 - 3.5.6 Polytropic process
 - 3.6 Explain free-expansion & throttling process

- 4.0 Heat transfer
 - 4.1 Introduction
 - 4.2 Basic idea on modes of heat transfer (No mathematical treatment)
 - 4.2.1 Conduction
 - 4.2.2 Convection
 - 4.2.3 Radiation
 - 4.3 Define and explain the basic concept of Fourier's law and thermal Conductivity
 - 4.4 Explain the heat exchanger
 - 4.5 Explain the free, forced heat convection
 - 4.6 Describe the properties of heat radiation (no mathematical derivation)
 - 4.6.1 Kirchoff law
 - 4.6.2 Stefan boltzman
- 5.0 Internal Combustion engine
 - 5.1 Explain Air standard cycle
 - 5.1.1 Otto Cycle
 - 5.1.2 Diesel Cycle
 - 5.1.3 Dual _ Combustion Cycle
 - 5.2 Derive the air standard efficiency of above cycles, solve simple Problem
 - 5.3 Explain and classify of IC engine
 - 5.4 Identify various IC engine parts and their functions
 - 5.5 Explain the terminology of I.C. Engine Such as bore, dead centers, stroke volume, piston speed and RPM.
 - 5.6 Explain the working principle of 2-stroke, 4-stroke C.I. and S.I. engine with value timing diagram
 - 5.7 Differentiate between 2-stroke, 4-stroke engine, S.I. and C.I. engine
 - 5.8 Explain the performance testing of I.C. engine
 - 5.8.1 Describe the determination of I.H.P., B.H.P and F.H.P, Mechanical efficiency, indicated thermal efficiency brake thermal efficiency, specific fuel combustion
 - 5.8.2 Draw heat balance sheet
- 6.0 Air Compressor
 - 6.1 Explain the function of compressor and industrial use compressed air
 - 6.2 Classify air compressor and principle of operation
 - 6.3 Describe the parts and working principle of Reciprocating air compressor.
 - 6.4 Explain the terminology of Reciprocating compressor such as bore, stroke, pressure ratio, free-air delivered and volumetric efficiency
 - 6.5 Derive the work done of single stage and two stage compressor with and without clearance.
 - 6.6 Derive the volumetric efficiency of reciprocating compressor.
 - 6.7 Solve related simple problem.

7.0 Fuel and Combustion

7.1 Define Fuel

7.2 Types of Fuel

7.2.1 Solid

7.2.2 Liquid

7.2.3 Gaseous

7.3 Application of different types of fuel.

7.4 Define Calorific value of fuels.

7.5 Calculate minimum air requirement for the complete combustion of unit mass / unit volume of fuel.

7.6 Conversion of volumetric analysis to gravimetric analysis & vice-versa.

7.7 Describe Orsat apparatus.

7.8 Application of Orsat apparatus.

Recommended Book:

1. Thermal Engineering by A.S. Sarao
2. Thermal Engineering By R. S. Khurmi
3. Engineering Thermodynamics by P.K.Nag
4. Thermal Engineering by A.R.Basu
5. Thermal Engineering by P.L. Ballancy

STRENGTH OF MATERIAL

Periods / Week : 4+1

Total period : 60

Examination : 3Hrs

End exams TH: 80 marks

I.A. : 20 marks

Topic wise distribution of periods

Sl. No.	Topic	Periods
1.	Simple stress and strain	06
2.	Two dimensional Stress system	06
3.	Stress in composite section	06
4.	Thin cylindrical and spherical shells	06
5.	Bending moments and shear force	08
6.	Theory of simple bending	08
7.	Combined axial and bending stress	08
8.	Torsion	07
9.	Testing of materials	05

RATIONALE:

Strength of Material deals with the internal behavior of solid bodies under the action of external forces. The subject focuses on mechanical properties of material, analysis of stress, strain and deformations. Therefore, it is an important basic subject for students for mechanical and automobile engineering.

COURSE CONTENTS (in terms of specific objectives):

- 1.0 Simple stress and strain.
 - 1.1 Recall the types of loads, stresses, strain, elastic constant, Poisson's ratio.
 - 1.2 Establish the relation Between three elastic constants (E, G, K)
- 2.0 Two dimensional Stress systems.
 - 2.1 Determine normal stress, shear stress and resultant stress on oblique plane.
 - 2.2 Define principal plane.
 - 2.3 Define principal stress
 - 2.4 Determine principal plane, principle stress analytically
 - 2.5 Determine principal stresses from Mohr's circle.
- 3.0 Stress in composite section
 - 3.1 Solve simple problems using principle of super position
 - 3.2 Determine stresses in composite bar
 - 3.3 Define Temperature stress

- 3.4 Determine Temperature stress in composite bar (single core only)
 - 3.5 Define strain energy and resilience
 - 3.6 Determine stresses due to gradually applied, suddenly applied and impact load
- 4.0 Thin cylinder and spherical shells under internal pressure.
 - 4.1 State assumptions for thin shells
 - 4.2 Define hoop stress and longitudinal stress
 - 4.3 Define hoop strain and longitudinal strain
 - 4.4 Compute hoop stress, longitudinal stress, hoop strain, longitudinal strain and volumetric strain
 - 4.5 Compute the change in length, diameter and volume
- 5.0 Bending moment and shear force.
 - 5.1 State types of beam and loading
 - 5.2 Define and explain shear force and bending moment, shear force diagram and bending moment diagram
 - 5.3 Determine the B.M and S.F by analytical method subjected to concentrated load, uniformly distributed load for:
 - 5.3.1 Cantilever beam
 - 5.3.2 Simply supported beam
 - 5.3.3 Over hanging beam
 - 5.3.4 Draw the S.F and B.M diagram for clauses in 5.3.1, 5.3.2 & 5.3.3
 - 5.4 Define point of contraflexure
 - 5.4.1 Determine the point of contraflexure
- 6.0 Theory of simple bending.
 - 6.1 State various types of sections (symmetrical, unsymmetrical and built up sections)
 - 6.2 State the assumption for simple bending
 - 6.3 Derive the relation $M/I = f/y = E/R$
 - 6.4 Define the section modulus, flexural rigidity and moment of resistance
 - 6.5 Explain the distribution of bending stress across T, & I sections.
 - 6.6 Solve simple problems on above
- 7.0 Combined axial and bending stress
 - 7.1 Define columns (long and short)
 - 7.2 Derive the maximum stress developed in short column under eccentric loading
 - 7.3 Define crippling load
 - 7.4 State the formula (no derivation) for crippling load under various end conditions

8.0 Torsion.

- 8.1 Define torsion
- 8.2 State the assumption of pure torsion
- 8.3 Derive the relation $T/I_p = fs/r = G \theta / L$
- 8.4 Differentiate between the strength of hollow and solid shaft
- 8.5 Solve simple problem on above
- 8.6 Determine the stresses under twisting and bending moments

9.0 Testing of material.

- 9.1 Destructive Testing
 - 9.1.1 Tensile test
 - 9.1.2 Hardness test
 - 9.1.3 Torsion test
 - 9.1.4 Creep and fatigue
 - 9.1.5 Impact test
- 9.2 Non destructive testing
 - 9.2.1 Eddy current testing
 - 9.2.2 Magnetic particle testing

RECOMMENDED BOOKS:

1. Strength of material by S. Ramamrutham, Dhanpat Rai Pub.Co.
2. Strength of material by I.B Prasad.
3. Strength of Material by R. S. Khurmi
4. Element of strength of Materials by Timoshenko and Young, Affiliated East West Press.
5. Theory and problems of Strength of materials by W.A.Nash Shaum's Outline Series, Mc Graw Hill Inc.
6. Mechanical testing of materials (Theory and Practice) : C. Mohapatra

MANUFACTURING TECHNOLOGY - I

Periods / Week : 4+1
Total period : 60

Examination : 3Hrs
End exams TH : 80 marks
I.A. : 20 marks

Topic wise distribution of periods

Sl.No.	Topic	Periods
1.	Forging	08
2.	Metal forming	08
3.	Foundry	16
4.	Welding	14
5.	Soldering & brazing	05
6.	Riveting	03
7.	Sheet metal works	06

RATIONALE:

Engineering basically means production of goods and services for human consumption. The major function of mechanical engineering is to manufacture various products using machineries, production processes and production management techniques. Therefore, this is one of the important subjects to be learned by a mechanical and automobile engineer.

COURSE CONTENTS (in terms of specific objectives):

1.0 Forging

- 1.1 Describe open and closed hearth heating furnaces.
- 1.2 Explain different forging hand tools with size, specification and uses
- 1.3 Describe various forging process such as hand forging, machine forging, drop forging, stamping, bending and wire drawing.

2.0 Metal Forming.

- 2.1 Explain fundamentals of rolling & extrusion
- 2.2 Describe various rolling process and specify the field application with limitation.
- 2.3 Describe different types of extrusion process such as direct, indirect and impact extrusions with field of application

3.0 Foundry

- 3.1 Describe various foundry tools and their uses.
- 3.2 Describe construction of core and core boxes.
- 3.3 Classify different pattern and state various pattern allowances.
- 3.4 Describe different method of modeling and core making.
- 3.5 Explain different types of moulding sands with their composition and properties and specify different binding material.

- 3.6 Describe construction and working of cupola furnace and induction furnace.
- 3.7 Describe construction and working of furnaces such as crucible and pit furnace.
- 3.8 Explain different methods of pouring with pouring equipments such as ladle and lifting tackles.
- 3.9 List various casting defects with their causes and remedies.
- 4.0 Welding
 - 4.1 Define welding, classify various welding process and explain fluxes in welding.
 - 4.2 Describe oxy acetylene welding process with equipments required.
 - 4.3 Explain various types of flames, their adjustments and precautions in flame cutting.
 - 4.4 Specify arc welding electrodes.
 - 4.5 Explain welding current and voltage rating.
 - 4.6 Describe arc welding equipments such as welding transformer and welding generator set.
 - 4.7 Classify resistance welding process.
 - 4.8 Describe various resistance welding process such as butt welding, spot welding, flash welding, projection welding and seam welding.
 - 4.9 List various safety measures to be taken in welding.
 - 4.10 State different welding defects with causes and remedies.
 - 4.11 Explain TIG and MIG welding process and elaborate their specific field of application
- 5.0 Soldering and Brazing:
 - 5.1 Define soldering.
 - 5.2 Classify solders.
 - 5.3 Explain different procedure of soldering.
 - 5.4 Define brazing
 - 5.5 State different filler materials.
 - 5.6 Explain different procedure of brazing.
- 6.0 Riveting
 - 6.1 Describe different types of rivets.
 - 6.2 Explain various riveting procedure.
 - 6.3 Different between cold and hot rivets.
- 7.0 Sheet Metal Works
 - 7.1 Describe different metals used in a sheet metal works with their engineering application.
 - 7.2 Describe various sheet operations in sheet metal working.
 - 7.3 Explain different operation in sheet metal working.
 - 7.4 State different types of joints and allowances.

RECOMMENDED BOOKS:

1. Workshop Technology (Part-1) by Hazra Choudhury, Media Promoters and Publications Pvt.Ltd.
2. Workshop Technology by Raghubansi, Dhanpat Rai & Sons.
3. Production process by O.P.Khanna.
4. Manufacturing Technology by P.N. Rao, TMH.
5. Manufacturing Engineering and Technology by S.Kalpakjian, Addison-Wesly Publishing Co.

Hydraulics & Fluid mechanics

Periods / Week: 4+1

Exam : 3hr

Total periods : 60

End exams : 80 marks

IA : 20 marks

Total 100 marks

Topic wise distribution of periods

Sl. no	Topic	Periods
01	properties of fluids	8
02	flotation & buoyancy	8
03	Hydrostatic pressure	8
04	Types of flow	4
05	Bernoulli's equation & its application	8
06	flow through orifices & notches	8
07	flow through pipes	8
08	Impact of jet	8
	TOTAL	60 Periods

RATIONALE:

Use of fluids in engineering field is of great Importance. It is therefore necessary to study the physical properties & characteristics of fluids which have very important use & application in mechanical & automobile engineering.

1.0 Properties of a fluid

- 1.1 Define a fluid
- 1.2 Classify fluid.
- 1.3 Define various fluid properties such as density, specific weight, specific gravity, viscosity & surface tension & state the units.
- 1.4 Define fluid pressure.
- 1.5 Classify fluid pressure.
- 1.6 Explain working of various measuring devices for pressure
- 1.7 Solve numerical problem involving the principle of manometers of simple, differential & inverted types.

2.0 Flootation and Buoyancy.

- 2.1 Flootation: its meaning
- 2.2 Archimedes' principles
- 2.3 Buoyancy & centre of Buoyancy
- 2.4 Tilting of a floating Body in a liquid through slight angular displacement
- 2.5 Metacentre & metacentric height
- 2.6 Analytical determination of metacentric height.

3.0 Hydrostatic pressure

- 3.1 Meaning of hydrostatic pressure
- 3.2 meaning of total pressure & centre

- 3.3 Total pressure & centre of pressure on a vertically immersed surface.
- 3.4 Total pressure & depth of centre of pressure on horizontally immersed surface.

- 4.0 Types of flow
 - 4.1 steady flow & unsteady flow
 - 4.2 Uniform flow & non-uniform flow.
 - 4.3 Laminar flow & non-laminar flow.
 - 4.4 Compressible flow & incompressible flow.
 - 4.5 Rotational flow & irrotational flow.

- 5.0 Bernoulli's equation & its application
 - 5.1 State & prove equation of continuity for one dimensional flow.
 - 5.2 State various energies of fluid.
 - 5.3 State & prove Bernoulli's equation & its limitations.
 - 5.4 Specify application of Bernoulli's equation.
 - 5.5 Explain the working of venturimeter, pitot tube.
 - 5.6 Derive equation of flow rate & velocity with respect to venturimeter & pitot tube respectively.
 - 5.7 Explain the working of flow meter current meter.
 - 5.8 Solve numerical problem on above.

- 6.0 Flow through orifices & notches.
 - 6.1 Define & classify orifices.
 - 6.2 Define orifice coefficient such as C_c , C_v , C_d .
 - 6.3 Establish the relation between orifice coefficients.
 - 6.4 Define weir & notch
 - 6.5 State the types of weir & notch.
 - 6.6 Differentiate between weir & notch.
 - 6.7 Derive formula for the discharge over triangular notches & weir.
 - 6.8 Derive formula for the discharge over triangular notches.
 - 6.9 Solve numerical problems on above.

- 7.0 Flow through pipes.
 - 7.1 Define a pipe.
 - 7.2 State laws of fluid friction.
 - 7.3 Mention the equation of loss of head through pipe due to friction
 - 7.4 State Darcy's formula & Chezy's formula
 - 7.5 Explain hydraulic gradient & total energy line.
 - 7.6 Define nozzle & state its application.
 - 7.7 Derive the expression of power transmission through nozzle
 - 7.8 Compute the condition of maximum power transmission through nozzle.
 - 7.9 State the expression for diameter of nozzle for maximum power transmission.
 - 7.10 solve numerical problems on above

8.0 Impact of jet

8.1.1 Estimate impact of jet on flat surface.

8.1.2 Solve numerical problem on above

8.2 Estimate impact of jet & work done on moving flat plates.

8.2.1 Estimate impact of jet & work done on series of flat plates fixed on rim of a cylinder

8.2.1.2 Derive the condition for maximum hydraulic efficiency

8.2.1.2 Derive the condition for maximum hydraulic efficiency

8.2.2 Solve numerical on above

8.3 Draw velocity triangle for jet preparing transantally in curved vane.

8.3.1 Estimate work done & efficiency of above system

Recommended books

1. Fluid Mechanics & Hydraulic Machines - A.R. Basu.
2. Hydraulics & Hydraulic Machines – Modi &Seth.
3. Hydraulics & Hydraulic Machines – R.k.Bansal.
4. Fluid Mechanics – A.K.Jain
5. Hydraulic & Fluid Mechanics – Jagdish Lal.

Mechanical Engg. Lab _ I

Periods / Week : 06

Exam : 4hrs

Total periods : 90

End exam - 50

Sessional - 50

- 1 Applied mechanics
 - 1.1 Determine the MA, VR, efficiency of simple screw jack.
 - 1.2 Determine the end reaction of a beam.
 - 1.3 Determine the young's modulus by Searl's apparatus.
 - 1.4 Determine the torsional rigidity of the shaft by using torsion testing machine.
- 2 Thermal Engineering Lab:-
 - 2.1 Model study of 2 stroke/4 stroke petrol engine.
 - 2.2 Model study of 2 stroke/4 stroke Diesel engine.
 - 2.3 Determine the flash point, fire point of any fuel.
- 3 Hydraulics & fluid Mechanics lab:-
 - 3.1 Study and demonstrate the bourdon's tube pressure gauge, Manometers
 - 3.2 Verify the Bernoulli's theorem
 - 3.3 Determine the coefficient of discharge of venturimeter / orifice meter (Centrifugal pump having discharge line with venturimeter or orifice meter)
 - 3.4 Determine the coefficient of discharge of small orifice / mouth piece.

WORKSHOP PRACTICE-II

Periods / Week: 06
Total periods : 90

Exam : 4hr
End exam :
Practical : 50 marks
Sectional : 50 marks
Total : 100 marks

ROTIONALE:

Manufacturing of product is done through use of various machineries and processes in industry. It is therefore, essential for Mechanical students. To have practical training in these manufacturing processes and operation of the machineries.

1. Fitting:

1.1 Study and use common precision measuring tools.

- 1.1.1 Sine bar
- 1.1.2 Combination square slip gauge
- 1.1.3 Dial test indicator
- 1.1.4 Height gauge
- 1.1.5 Go and no go gauges.

1.2 Do jobs

- 1.2.1 Preparation of caliper.
- 1.2.2 Preparation of try square.
- 1.2.3 Preparation of hammer

2. Smithy:

- 2.1 Study of smithy hand tools, machine and their uses.
- 2.2 Observe Demonstration types of job
- 2.3 Perform jobs
- 2.4 Door ring with hook
- 2.5 Octagonal flat chisel.

3. Carpentry and pattern making:

3.1 Carpentry

- 3.1.1 Study carpentry hand tools, machine tools, & their use.
- 3.1.2 Study Timber and their uses.
- 3.1.3 Perform different carpentry operations such as planning, sawing & chiseling.
- 3.1.4 Do jobs
 - 3.1.4.1 Cutting of slot, botch, mortise & Tenon
 - 3.1.4.2 Single Dovetail joints.

3.2 Comply with safety norms.

4. Turning:

- 4.1 Study a lathe machine and its accessories.
- 4.2 Perform jobs involving the various operations.
 - 4.2.1 Plain turning
 - 4.2.2 Step turning
 - 4.2.3 Taper turning
 - 4.2.4 Grooving
 - 4.2.5 Chamfering
 - 4.2.6 External threading