COURSE CONTENT

ENGINEERING WORKSHOP								
I Semester: AE / CE / ME								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AMED01	**Foundation**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		0	1	2	2	40	60	100
Contact Classes: Nil	**Tutorial Classes: 15**	**Practical Classes: 30**				**Total Classes:45**		
Prerequisite: There is no prerequisite for this course.								

I. COURSE OVERVIEW:

This course provides the opportunity to become confident with new tools, equipment, and techniques for creating physical objects and mechanisms with a variety of materials. The students will learn principles of contemporary trends in manufacturing processes, such as CNC machining and 3D printing, as well as gain practical experience in carpentry, fitting, and welding. Skills learned in the course enable the students to learn about the design process in digital manufacturing used in various industrial applications.

II. COURSES OBJECTIVES:

The students will try to learn

I. The basics and hands-on practice of carpentry, fitting, and welding
II. The impart knowledge and skill to use tools, equipment, measuring instruments, and modern techniques.
III. The concepts apply to the manufacturing processes of casting, moulding and forging.
IV. The basic machining operations by CNC lathe, CNC milling, and 3D printing machine.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO 1 Select appropriate tools, work material and measuring instruments useful for carpentry, fitting, and welding.

CO 2 Use flat sheets for sheet metal and intricate shapes made from mild steel for Black smithy.

CO 3 Choose appropriate components and tools to prepare pipe fitting and joints of specific shapes and sizes.

CO 4 Experiment with the moulding techniques for producing cast components in complex shapes using different patterns.

CO 5 Execute hard soldering techniques to join similar and dissimilar materials used in industries.

CO 6 Demonstrate appropriate equipment and methods for various machining processes used in CNC machines and 3D printing for manufacturing industries.

IV. COURSE CONTENT:

EXERCISES IN ENGINEERING WORKSHOP

Note: All dimensions are in mm in experiments.

Getting started experiments

Introduction

Engineering workshop provides both tools and equipments (or machinery) that are required for the manufacture of the goods. Students are familiarized with basic workshop practice like Wood working, Sheet metal, metal joining processes, manufacturing processes etc. and required to identify, operate and control various machines, tools and equipments.

Safety

Safety is a vital issue in all workplaces. Before using any equipment and machines or attempt practical work in a workshop everyone must understand basic safety rules. These rules will help keep all safe in the workshop.

Safety Rules:

- Always listen carefully to the teacher and follow instructions.
- When learning how to use a machine, listen very carefully to all the instructions given by the faculty / instructor. Ask questions, especially if you do not fully understand.
- Always wear an apron as it will protect your clothes and holds lose clothing such as ties in place.
- Bags should not be brought into a workshop as people can trip over them.
- Do not use a machine if you have not been shown how to operate it safely by the faculty / instructors
- Know where the emergency stop buttons are positioned in the workshop. If you see an accident at the other side of the workshop you can use the emergency stop button to turn off all electrical power to machines.
- Wherever required, wear protective equipment, such as goggles, safety glasses, masks, gloves, hair nets, etc.
- Always be patient, never rush in the workshop.
- Always use a guard when working on a machine.
- Keep hands away from moving/rotating machinery.
- Use hand tools carefully, keeping both hands behind the cutting edge.
- Report any UNSAFE condition or acts to instructor.
- Report any damage to machines/equipment as this could cause an accident.
- Keep your work area clean.

DO's

- Students must always wear uniform and shoes before entering the lab.
- Proper code of conduct and ethics must be followed in the lab.
- Note down the specifications/drawings before working on the preparation of models.

- Receive the tools and materials required for preparation of models with signing in register.
- Properly fix hacksaw blade in frame with help of instructor.
- Use of safety goggles / face shield during welding.
- Do the models under the supervision/guidance of a faculty/ lab instructor only.
- Keep the sufficient distance from other students while preparing models.
- In case of fire use fire extinguisher/throw the sand provided in the lab.
- In case of any physical injuries or emergencies use first aid box provided.

DONT's

- Do not touch electrical circuits of welding machine.
- Be cautious while fixing hacksaw blade in frame, that may cause injuries to hand.
- Don't touch /operate power tools without aid from instructors.
- Don't gather while preparing models, that may hurt other with tools.
- Don't unlock snip/sheet metal cutter lock, without use.

1. Introduction to carpentry

Carpentry is the process of shaping wood, using hand tools. The products produced are used in building construction, such as doors and windows, furniture manufacturing, patterns for mouldin g infoundries, etc. Carpentry work mainly involves the joining together of wooden pieces and finishing the surfaces after shaping them. Hence, the term joining is also used commonly for carpentry. A student studying the fundamentals of wood working has to know about timber and other carpentry materials, wood working tools, carpentry operations and the method of making common types of joints.

1.1. Experiments on carpentry

1. Preparation of the cross-half lap joint as shown in Fig. 1.1

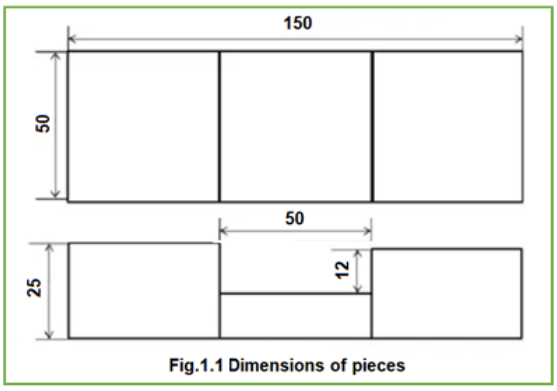

Fig.1.1 Dimensions of pieces

2. Preparation of the dove tail joint as depicted in Fig.1.2

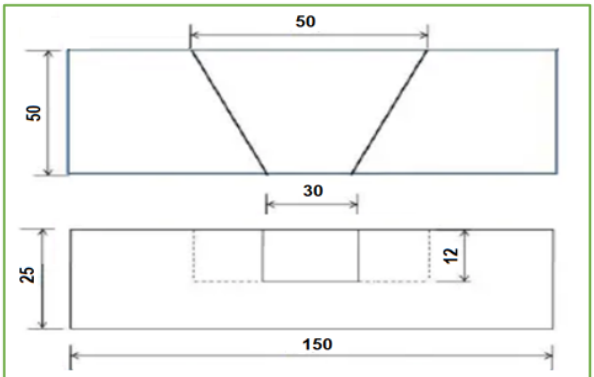

Fig.1.2 Dimensions of pieces

Try

1. Mortise and tenon joint preparation as illustrated in Fig.1.3 with dimensions of width = 50 mm and tenon thickness = 10 mm.
2. End lap joint preparation as illustrated in Fig. 1.4. The end lap projection dimensions to be taken into consideration are width = 50 mm and thickness = 15 mm.


Fig.1.3 Mortise and tenon joint

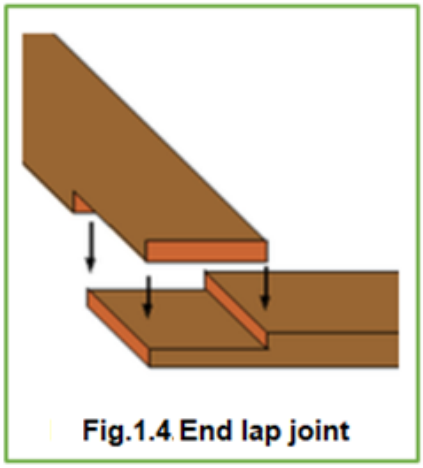
Fig.1.4 End lap joint

2. Introduction to fitting

The term fitting, is related to assembly of parts, after bringing the dimension or shape to the required size or form, in order to secure the necessary fit. The operations required for the same are usually carried out on a work bench, hence the term bench work is also added with the name fitting. The bench work and fitting play an important role in engineering. Although in today's industries most of the work is done by automatic machines which produces the jobs with good accuracy but still it(job) requires some hand operations called fitting operations.

2.1. Experiments on fitting

1. Making of a square fitting using mild steel plates of the specified size, as shown in Fig. 2.1
2. Making of a V-fit according to the size of the provided mild steel plates, as shown in Fig. 2.2

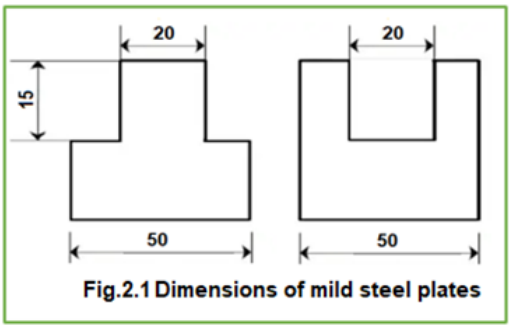

Fig.2.1 Dimensions of mild steel plates

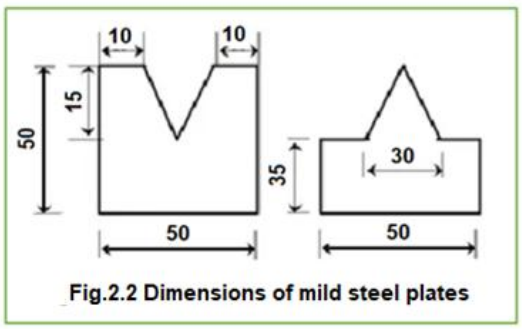

Fig.2.2 Dimensions of mild steel plates

Try

1. Straight fitting of mild steel plates to the specified sizes, as shown in Fig. 2.3
2. Making of semicircular fit with mild steel plates of the specified size, as depicted in Fig. 2.4

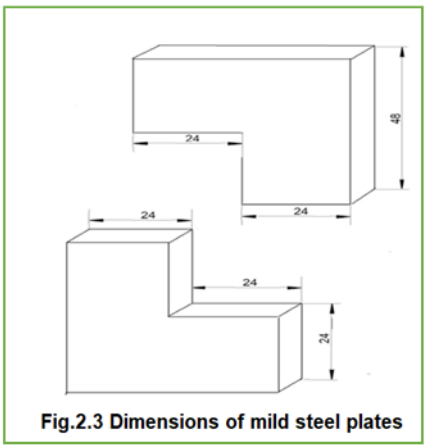

Fig.2.3 Dimensions of mild steel plates

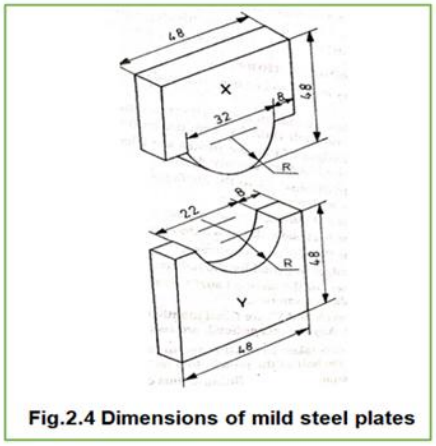

Fig.2.4 Dimensions of mild steel plates

3. Introduction to welding

Welding is a process for joining two similar or dissimilar metals by fusion. It joins different metals/alloys, with or without the application of pressure and with or without the use of filler metal. The fusion of metal takes place by means of heat. The heat may be generated either from combustion of gases, electric arc, electric resistance or by chemical reaction. Welding provides a permanent joint but it normally affects the metallurgy of the components. It is therefore usually accompanied by post weld heat treatment for most of the critical components. The welding is widely used as a fabrication and repairing process in industries. Some of the typical applications of welding include the fabrication of ships, pressure vessels, automobile bodies, off-shore platform, bridges, welded pipes, sealing of nuclear fuel and explosives, etc.

3.1. Experiments and demonstration on different welding techniques

1. Creating the lap joint in accordance with the mild steel plates given, as shown in Fig .3.1
2. Making the butt joint as depicted in Fig. 3.2 using the mild steel plates as are offered.

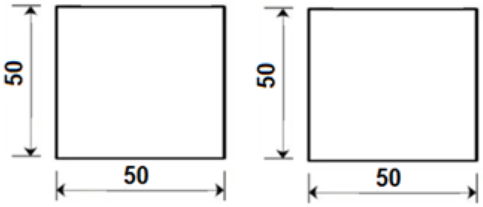

Fig.3.1 Dimensions of mild steel plates

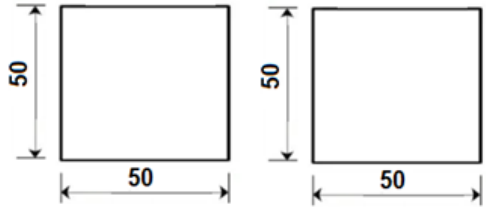

Fig.3.2 Dimensions of mild steel plates

Try

1. Construction of the tee joint using the mild steel plates provided, as shown in Fig. 3.3
2. As illustrated in Fig. 3.4, creating the corner (L) joint using the provided mild steel plates.

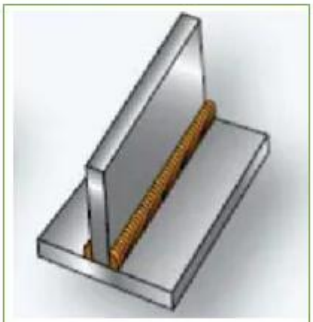
Fig.3.3 Tee joint

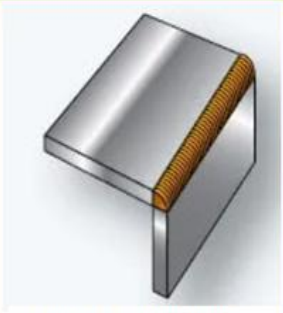
Fig.3.4 Corner joint

4. Introduction to sheet metal

Sheet metal work has its own significance in the engineering work. Many products, which fulfill the household needs, decoration work and various engineering articles, are produced from sheet metals. Common examples of sheet metal work are hoopers, canisters, guards, covers, pipes, hoods, funnels, bends, boxes etc. Such articles are found less expensive, lighter in weight and in some cases sheet metal products replace the use of castings or forgings.

4.1. Experiments on sheet metal forming

1. Create the rectangular tray as depicted in Fig. 4.1.

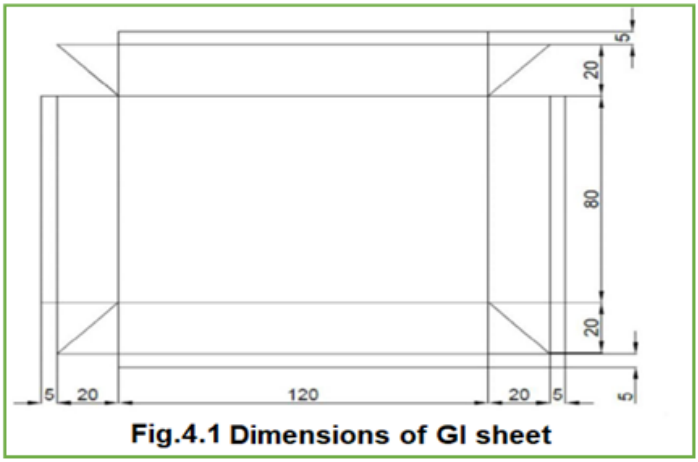

Fig.4.1 Dimensions of GI sheet

2. As illustrated in Fig.4.2, prepare the developing surface and create cylindrical tin.

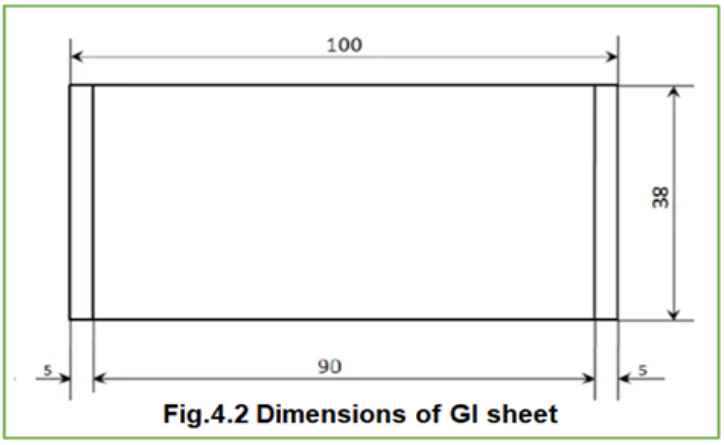

Fig.4.2 Dimensions of GI sheet

Try

1. Construct the open scoop as depicted in Fig. 4.3

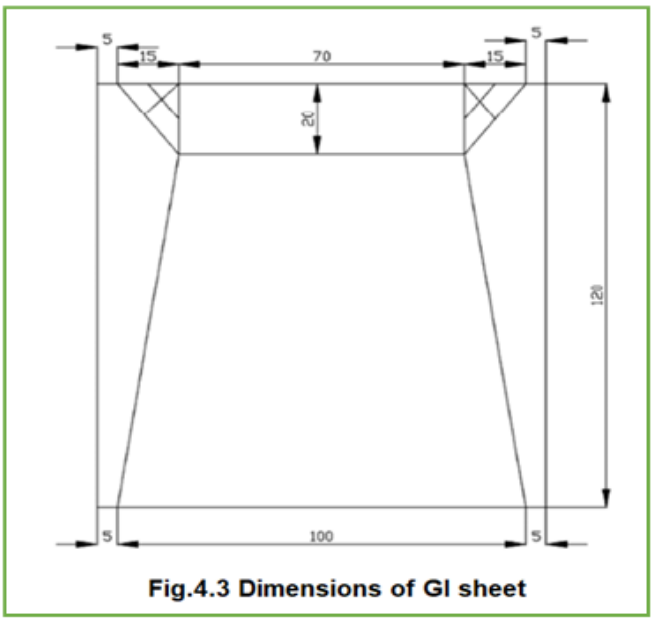

Fig.4.3 Dimensions of GI sheet

2. create the hexagonal prism as shown in Fig.4.4

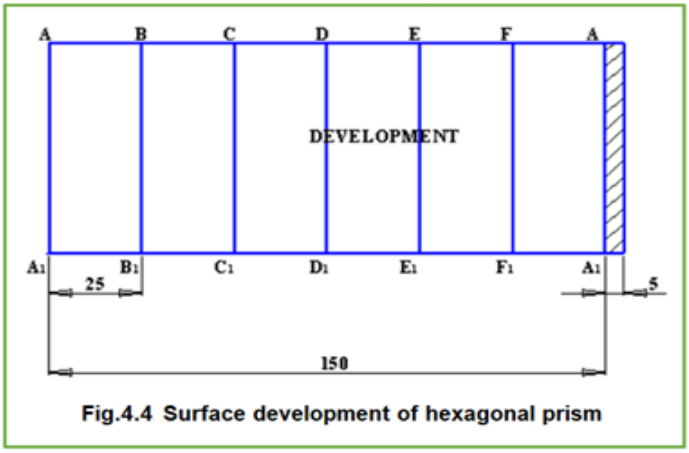

Fig.4.4 Surface development of hexagonal prism

5. Introduction to black smithy

Black smithy or Forging is an oldest shaping process used for the producing small articles for which accuracy in size is not so important. The parts are shaped by heating them in an open fire or hearth by the blacksmith and shaping them through applying compressive forces using hammer. Thus forging is defined as the plastic deformation of metals at elevated temperatures into a predetermined size or shape using compressive forces exerted through some means of hand hammers, small power hammers, die, press or upsetting machine. It consists essentially of changing or altering the shape and section of metal by hammering at a temperature of about 980°C, at which the metal is entirely plastic and can be easily deformed or shaped under pressure. The shop in which the various forging operations are carried out is known as the smithy or smith's shop.

5.1. Experiments on black smithy

1. Make the s-hook as depicted in Fig. 5.1 using the mild steel rod provided.
2. Construct the J-hook using the given mild steel rod as indicated in Fig. 5.2.

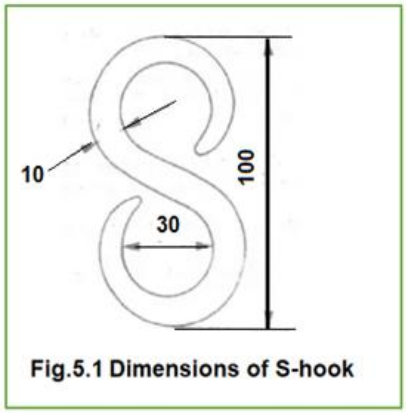

Fig.5.1 Dimensions of S-hook

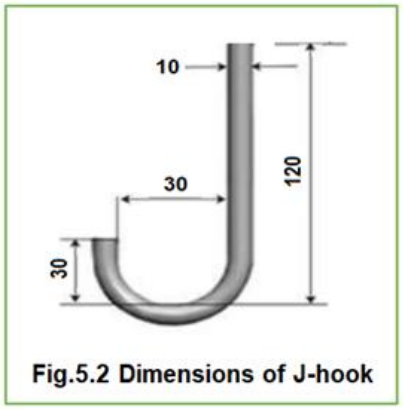

Fig.5.2 Dimensions of J-hook

Try

1 Create the C - hook with the given mild steel rod as shown in Fig. 5.3
2 Prepare the U - bend with the given mild steel rod as shown in Fig. 5.4

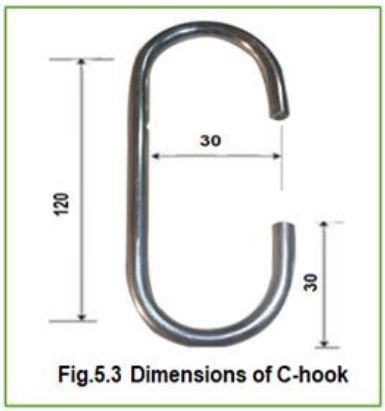

Fig.5.3 Dimensions of C-hook

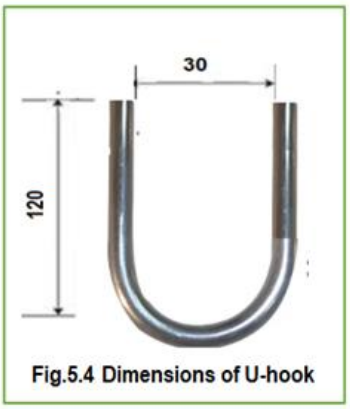

Fig.5.4 Dimensions of U-hook

6. Introduction to plumbing

Plumbing is a skilled trade of working with pipes or tubes and plumbing fixtures. The process is mainly used for the supply of drinking water and the drainage of waste water, sometimes mixed with waste floating materials in a living or working place. A plumber is someone who installs or repairs piping systems, plumbing fixtures and equipment such as valves, washbasins, water heaters, wa terclosests, etc. Thus it usually refers to a system of pipes and fixtures installed in a building for the distribution of water and the removal of waterborne wastes.

6.1. Experiments and demonstration on plumbing

1.Form of PVC pipe fitting through various components as shown in Fig. 6.1

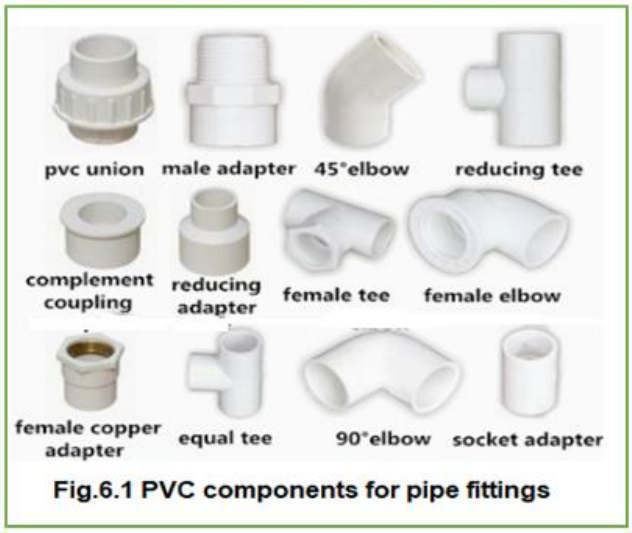

Fig.6.1 PVC components for pipe fittings

2. Form of GI pipe fitting with various components, as shown in Fig. 6.2

Fig.6.2 GI componets for pipe fittings

Try

1. Form of PVC pipe fitting with reducer for water tap with different components as shown in Fig. 6.1
2. Form of GI pipe fitting with different components as shown in Fig. 6.2 for different fluids.

7. Introduction to moulding

Moulding is the process of manufacturing by shaping liquid or pliable raw material using a rigid frame called a mold or matrix. This itself may have been made using a pattern or model of the final object.

A mould is a hollowed-out block that is filled with a liquid or pliable material such as plastic, glass, metal, or ceramic raw material. The liquid hardens or sets inside the mould, adopting its shape. A mould is a counterpart to a cast. The very common bi-valve moulding process uses two moulds, one for each half of the object.

7.1. Experiments on mechanical components moulding (casting process)

1. Making of flange mould using a given pattern as shown in Fig.7.1

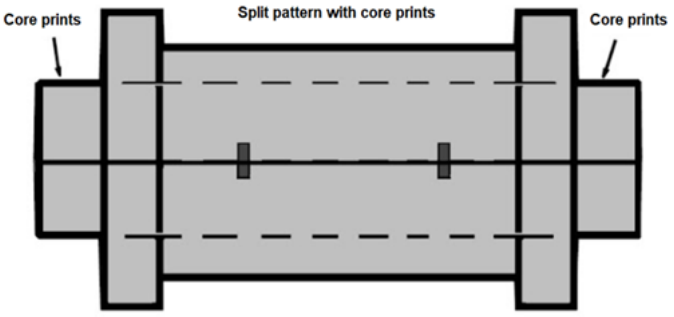

Fig.7.1 Flange coupling pattern

2. Utilizing the provided pattern, create the bearing housing mould as shown in Fig. 7.2.

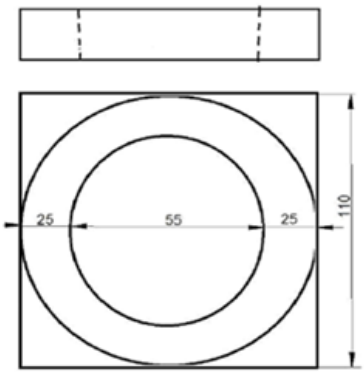

Fig.7.2 Bearing housing

Try

1. Making of dumble using a given pattern as shown in Fig.7.3
2. Using a single piece pattern, create a one-stepped shaft as shown in Fig. 7.4.

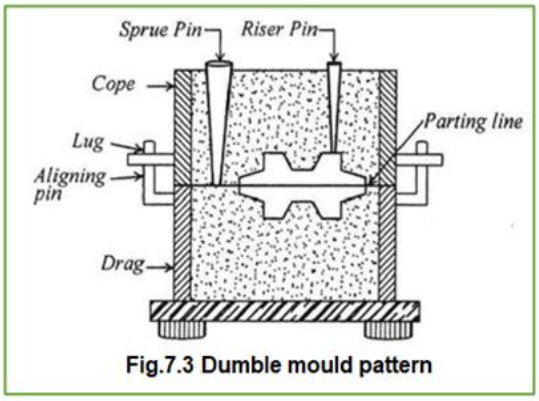

Fig.7.3 Dumble mould pattern

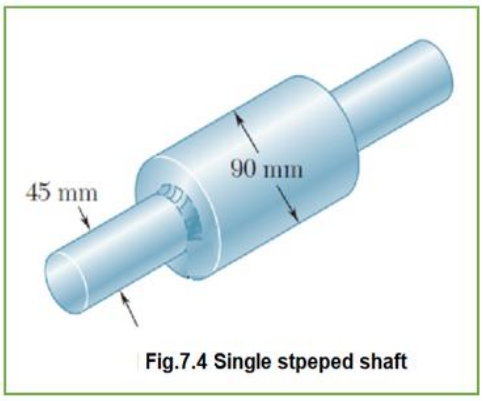

Fig.7.4 Single stpeped shaft

8. Introduction to concrete moulding and plaster of paris

Concrete is characterized by the type of aggregate or cement used, by the specific qualities it manifests, or by the methods used to produce it. In ordinary structural concrete, the character of the concrete is largely determined by a water-to-cement ratio. The lower the water content, all else being equal, the stronger the concrete. The mixture must have just enough water to ensure that each aggregate particle is completely surrounded by the cement paste, that the spaces between the aggregate are filled, and that the concrete is liquid enough to be poured and spread effectively.

Plaster of Paris is a white powder made from gypsum that mixes with water to form a paste that hardens quickly and is used chiefly for casts and moulds. It can be effectively worked with metal apparatuses or even abrasive sheets and can be shaped as per requirements. It is often applied in the form of a quick-setting paste with water.

8.1.Experiment on concrete/cement cube moulding and demonstration on plaster of paris mould making

1. Preparation of concrete cube by moulding technique as shown in Fig.8.1

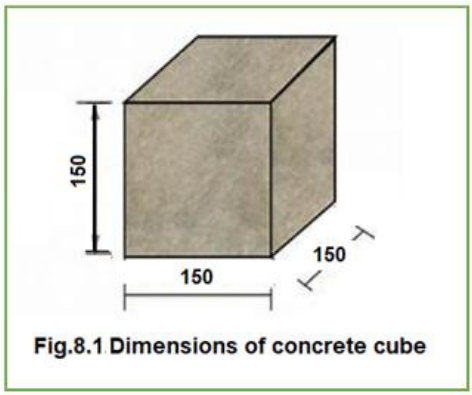

Fig.8.1 Dimensions of concrete cube

2. Demonstration on plaster of paris mould making.

Try

1. Preparation of any house hold specimens by plaster of paris mould making as shown in Fig. 8.2
2. Preparation of any intricate article by plaster of paris mould making as shown in Fig. 8.3

Fig.8.2 Plaster of paris House hold specimens

Fig.8.3 Plaster of paris intricate article

9. Introduction to hard soldering

Hard (silver) soldering (>450 °C) – Brass or silver is the bonding metal used in this process, and requires a blowtorch to achieve the temperatures at which the solder metals. Hard soldering is used to join precision components such as ferrous, brass, and copper.

9.1. Experiments on hard soldering

1. Soldering of two mild steel plates as shown in Fig. 9.1
2. Hard soldering of engine valve tappet as shown in Fig. 9.2

Fig.9.1 Soldering of mild steel plates

Fig.9.2 Engine valve tappet

Try

1. Hard soldering of copper with brass as shown in Fig.9.3
2. Hard soldering of stainless steel with brass as shown in Fig.9.4

Fig.9.3 Hard soldering of copper with brass

Fig.9.4 Hard soldering of stainless steel with brass

10. Demonstration on Computer Numerically Controlled (CNC) lathe

CNC turning is a highly precise and efficient subtractive machining process that works on the principle of the lathe machine. It involves placing the cutting tool against a turning workpiece to remove materials and give the desired shape.

Fig.10.1 CNC lathe

1. Demonstration of the plain turning process on a CNC lathe as shown in Fg.10.1
2. Demonstration of facing operations on a CNC lathe as shown in Fg.10.1.

11. Demonstration on Computer Numerically Controlled (CNC) milling

CNC milling involves cutting a prismatic workpiece using multipoint cutting tools producing precision components used in automotive and aeronautical industries.

Fig.11.1 CNC machining centre

1. Demonstration of plain milling (facing) on CNC milling as shown in Fig.11.1
2. Demonstration of precision slotting on CNC milling as shown in Fig.11.1.

12. Demonstration on 3D printing machine

3D printing or additive manufacturing enables to produce geometrically complex objects, shapes and textures. It often uses less material than traditional manufacturing methods and allows the production of prototypes / products that are not possible to produce economically with conventional manufacturing.

Fig.12.1 3D printer

1. Demonstration of 3D printing machine as shown in Fig.12.1 using Acrylonitrile butadiene styrene (ABS) material
2. Demonstration of 3D printing machine as shown in Fig.12.1 using Polylactic acid (PLA) material.

13. Demonstration on 6- axis robot

Robots have seen in recent years an expansion of their field of use with new requirements related to the increasing use of composites. The robots are then considered for machining operations (polishing, cutting, drilling etc.) that require high performance in terms of position, orientation, followed by trajectory precision and stiffness. The evolution of the performance of robots and programming software provides new machining solutions. For complex parts, six axis robots offer more accessibility than a machining center CNC 5 axis and allow the integration of additional axes to extend the workspace.

Fig.13.1 6-Axis robot

1. Demonstration of the 6 – axis aristo robot as shown in Fig.13.1.
2. Demonstration of aristo sim software for robot movements and control.

14. Demonstration on cylindrical grinding machine

Most commonly, cylindrical grinding is used for grinding pieces with a central axis of rotation, like rods and cylinders. This process involves using a cylindrical grinder, which is a type of machinery categorized by rotation style and wheel device.

A grinding machine uses an abrasive product usually a rotating wheel to shape and finish a workpiece by removing metal and generating a surface within a given tolerance. A grinding wheel is made with abrasive grains bonded together. Each grain acts as a cutting tool, removing tiny chips from the workpiece.

Fig.14.1 Cylindrical grinding machine

1. Demonstration of grinding process on a cylindrical grinding machine as shown in Fig.14.1
2. Demonstration of shaft grinding process on a cylindrical grinding machine as shown in Fig.14.1

V. TEXT BOOKS:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and NirjharRoy S.K., *"Elements of Workshop Technology"*, Media promoters and publishers private limited, Mumbai, 4th Edition ,2020.
2. Kalpakjian S, Steven S. Schmid, *"Manufacturing Engineering and Technology"*, Pearson Education India Edition, 7th Edition, 2019.
3. Gowri P. Hariharan, A. Suresh Babu," *Manufacturing Technology – I*", Pearson Education, 3rd Edition, 2018.

VI. REFERENCE BOOKS:

1. Gowri P. Hariharan, A. Suresh Babu, *"Manufacturing Technology – I"*, Pearson Education, 5th Edition, 2018.
2. Roy A. Lindberg, *"Processes and Materials of Manufacture",* Prentice Hall India, 4th Edition, 2017.
3. Rao P.N., "*Manufacturing Technology"*, Vol. I and Vol. II, Tata McGraw-Hill House, 2017.

VII. ELECTRONICS RESOURCES:

1. https://elearn.nptel.ac.in/shop/iit-workshops/ongoing/additive-manufacturing-technologies-for-practicing-engineers/.
2. https://akanksha.iare.ac.in/index?route=course/details&course_id=337

VIII. MATERIALS ONLINE:

1. Course Template
2. Laboratory manual