INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

AEROSPACE MATERIALS AND PRODUCTION TECHNOLOGY LABORATORY								
IV Semester: AE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
AAED13	**CORE**	-	-	2	1	40	60	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 45**				**Total Classes: 45**		
Prerequisite: Aircraft Materials and Production								

I. COURSE OVERVIEW:

The Aircraft Production Technology lab encompasses on providing sound practical knowledge on testing of engineering material and conventional machining process which plays a vital role in designing the components with minimum cost and with longer service.

II. COURSES OBJECTIVES:

The students will try to learn:

I. The basic material properties to identify the suitable applications in aerospace industries.
II. The conventional machining techniques required for aircraft production.
III. The tooling and material joining technique used in aircraft assembly.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO1 Identify the microstructures of the materials for selecting the suitability in industrial applications

CO2 Illustrate various jobs for joining the materials using welding operation in real time applications.

CO3 Identify the types of machining process required for producing desired shape of components used in Aerospace and allied industries.

CO4 Demonstrate molding processes and their application for producing machine components used in industries

CO5 Select the suitable tools and process parameters required in machining, drilling and slotting operations for producing components with minimum cost.

CO6 Illustrate various jobs for joining the materials using Riveting operation in industries.

EXERCISES FOR AIRCRAFT PRODUCTION TECHNOLOGY LABORATORY

1. Getting Started Exercises

1.1 Introduction to Aircraft Production Technology Laboratory

- Understand the working principle of microscope, lathe and milling machines used in the laboratory.
- Become familiar with grinding, shaping, slotting and drilling machines.
- Learn to take quality control measures to ensure precision and accuracy in aircraft component fabrication.

Try

1. Prepare the aluminum sample for evaluation of microstructures
2. Plain turning operation on lathe machine for a given sample

2. Exercises on Basic Metallurgy -I

2.1 Microstructure of pure materials

Observe the micro structural features using the microscope shown in Figure 1 for Mild steel Specimen.

Figure 1 Microscope

Try

1. Change the specimen to Aluminum with different surface finish and repeat the same experiment
2. Change the sample to Mild Steel with different surface finish and repeat the same experiment
3. Perform the experiment on Copper with different surface finish and repeat the same experiment

3. Exercises on Basic Metallurgy -II

3.1 Microstructure of non-ferrous alloys

Find the Micro structural Properties of the materials like weight, strength, toughness, hardness, corrosion, fatigue resistance, performance in temperature extremes using the microscope as shown in Figure 2.

Figure 2 Microscopic view of MS plate

Try

1. Change the specimen to mild steel and find the above properties
2. Perform the experiment on Aluminum and find the above properties
3. Change the specimen to Steel and find the above properties

4. Exercises on Lathe Operations - I

4.1 Plane turning

Using the lathe Machine, conduct the plain turning operation for the given work piece (mild steel) as shown in Figure 3.

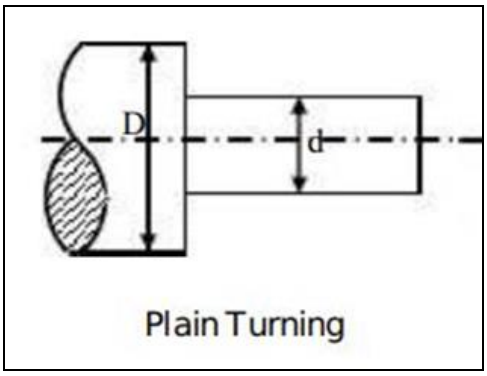

Figure 3 plain turning

4.2 Step turning and Grooving

Using the lathe Machine, conduct the step turning operation for the given work piece (mild steel) as shown in Figure 4.

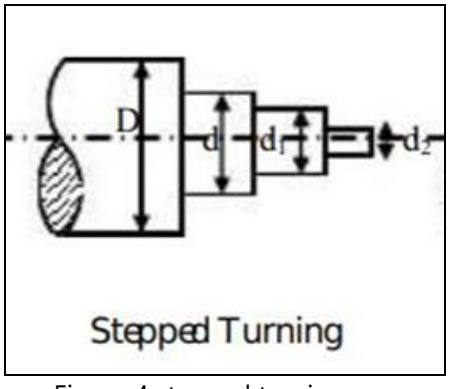

Figure 4 stepped turning

Try

1. Perform the Grooving operation for the Mild Steel(MS)Specimen.
2. Change the Specimen to steel the conduct the process.
3. Perform the step turning & grooving operation on Cast Iron Specimen.

5. Exercises on Lathe Operations - II

5.1 Taper turning-compound rest/offset method

Using the Lathe Machine, as shown in Figure 5 perform the Taper turning Operation for the given Specimen (Mild Steel)

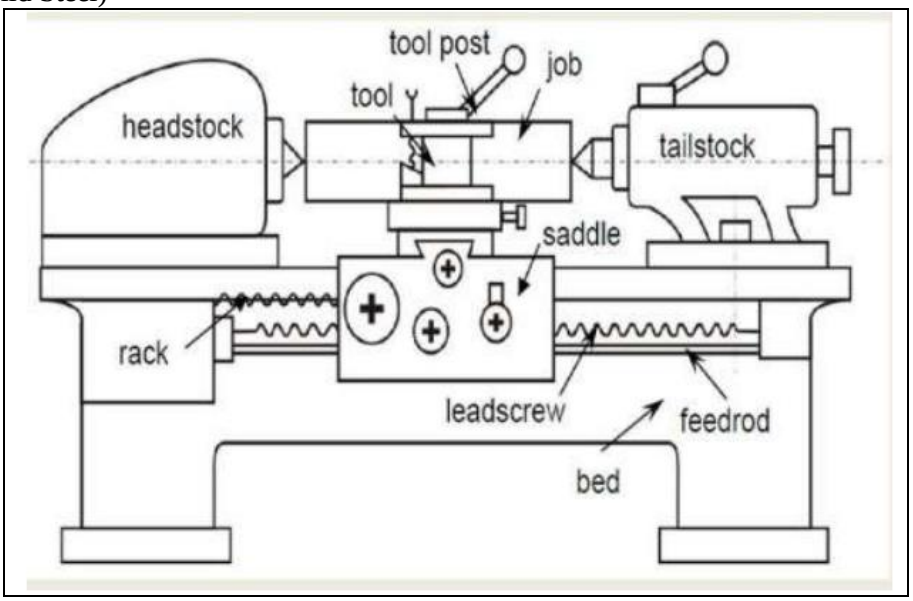

Figure 5 lathe machine

5.2 Drilling using lathe

Perform the drilling Operation on the Mild Steel work piece as shown in the Figure 6.

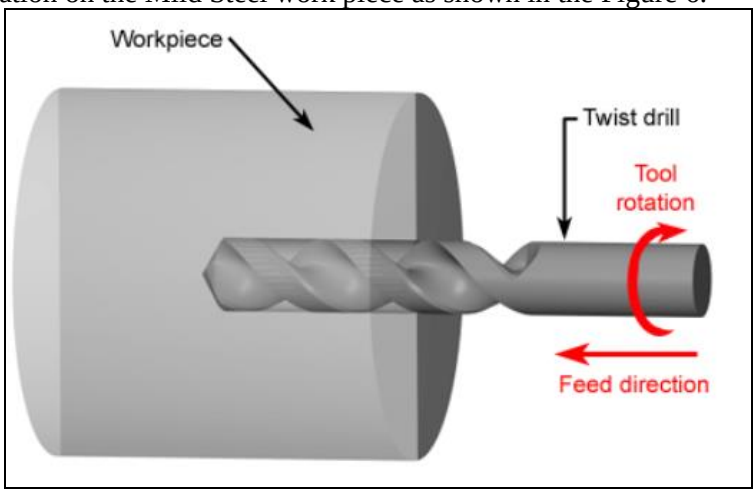

Figure 6 Drill bit & work piece

5.3 External threading-Single start

Perform the external threading operation on the mild steel work piece as shown in Figure 7.

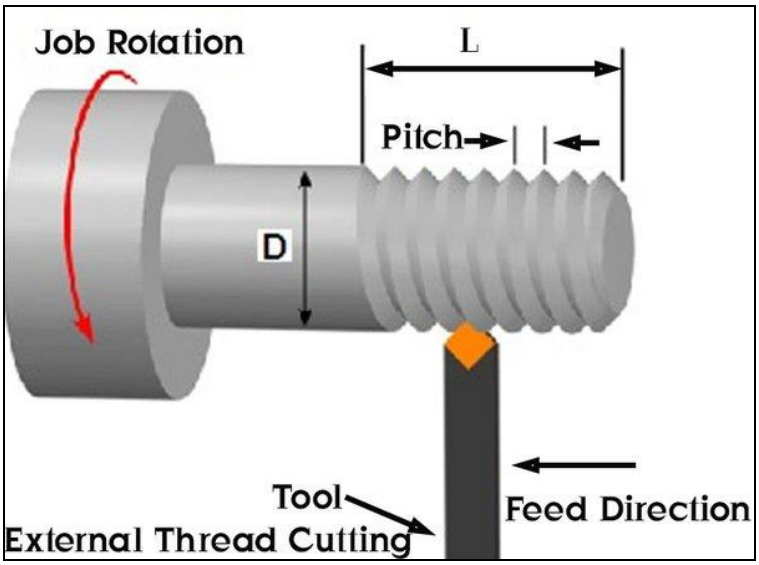

Figure 7 External threading operation by lathe

Try

1. Change the material to steel rod and perform the same operations.
2. Change the material t copper alloy and perform the threading operation.

6. Exercises on Shaping Machine

6.1 Shaping-V-Block

Using the Shaping Machine, perform the V- Shaped groove on Mild Steel as shown in Figure 8.

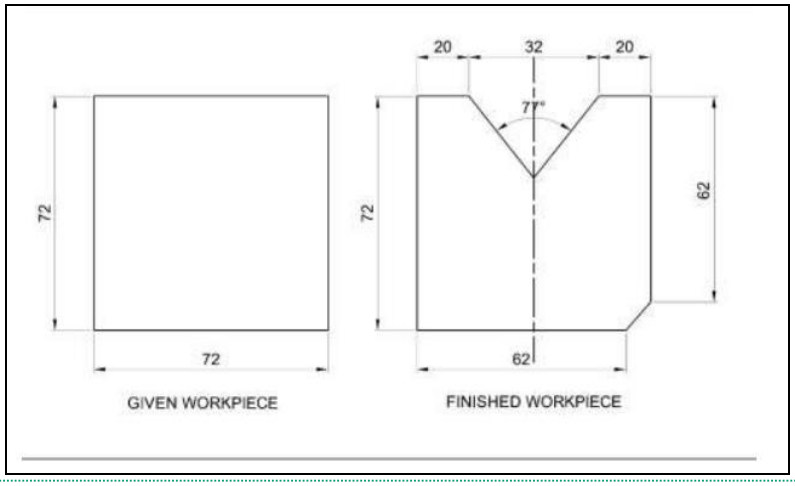

Figure 8 V-block shaping

Try

1. Change the Block to T Shape and perform the same operation on Mild Steel.
2. Perform the U shaped operation on the Mild steel work piece.
3. Change the tool bit to I Shape and perform the same operation on Mild Steel.

7. Exercises on Slotting Machine

7.1 Slotting-Keyways

Perform the Slotting Operation on the Mild Steel Specimen and obtain the required groove as shown in Figure 9b.

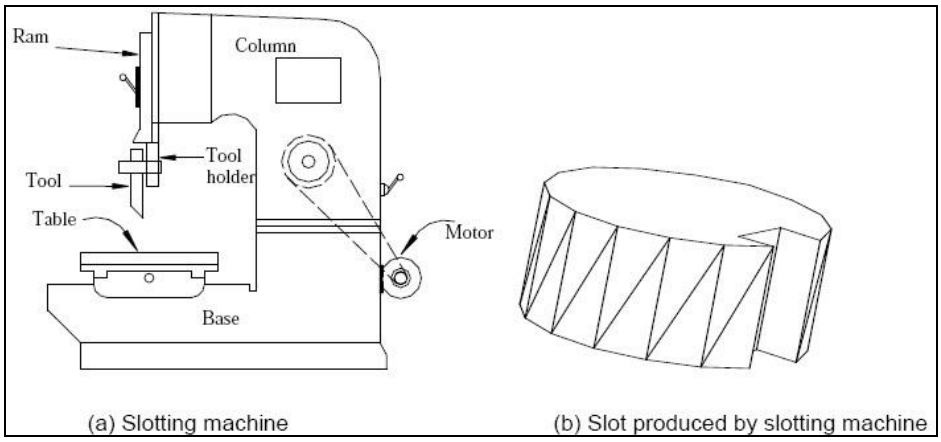

Figure 9 slotting machine & slot on work piece

Try

1. Slot the Cast Iron work piece and perform the same experiment.
2. Perform the Slotting Operation on the galvanized iron work piece and conduct the experiment.
3. Change the specimen to Steel with different surface finish and repeat the same experiment.

8. Exercises on Milling Machine

8.1 Milling-Face milling

Using the milling machine, perform the Face Milling Operation as shown in Figure 10, on the mild steel work piece as shown in Figure 11.

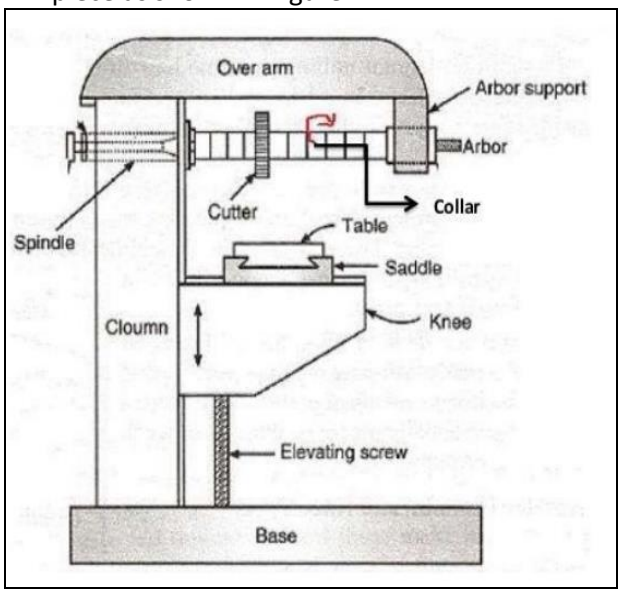

Figure 10 milling machine

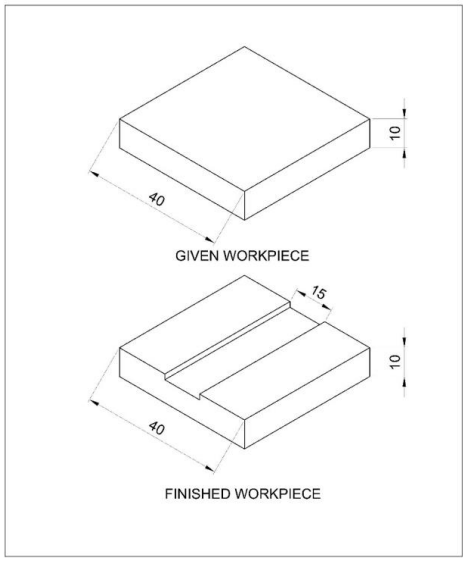

Figure 11 work piece performed

8.2 End milling

Perform the End milling operation on given work piece as shown in the Figure 12.

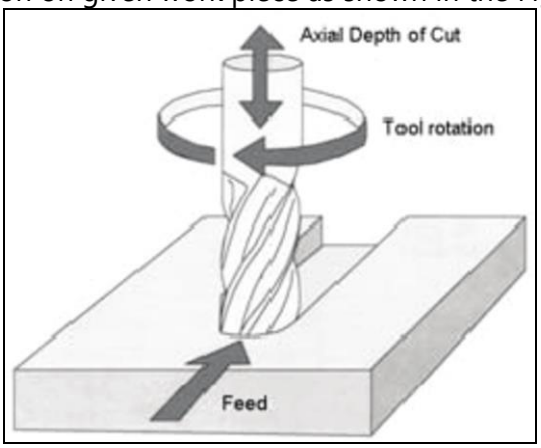

Figure 12 end milling performed

8.3 Side milling

Perform the side milling operation on the given work piece as shown in Figure 13.

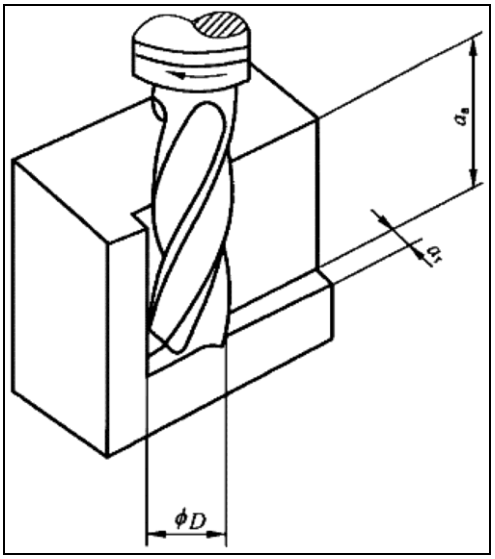

Figure 13 side milling performed

Try

1. Change the Specimen to steel and perform the same experiment.
2. Perform the end milling operation on the galvanized iron specimen.

9. Exercises on Grinding Machine

9.1 Grinding-Cylindrical /Surface/Tool & cutter.

Perform the Grinding Operation using grinding machine as shown in Figure 14, for the Mild Steel Specimen and remove the surface by 0.1 mm only as shown in the Figure 15.

Figure 14 grinding machine

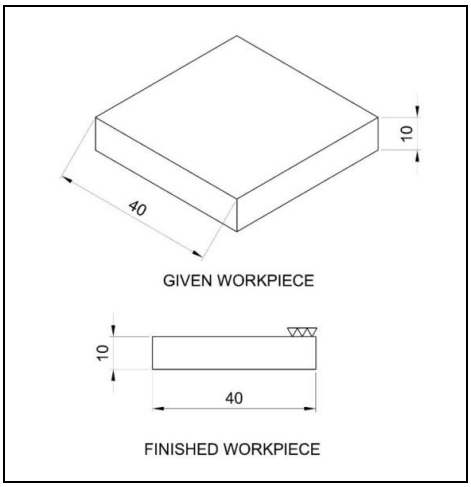

Figure 15 workpiece

Try

1. Grind the surface of Cast Iron and perform the same experiment.
2. Grind the surface of Galvanized Iron and repeat the same experiment.
3. Smoothen the surface of steel and redo the same experiment.

10. Exercises on Drilling Machine

10.1 Drilling, reaming Operation

Perform the Drilling & Reaming Operation on the Mild Steel Work Piece as shown in the Figure 16.

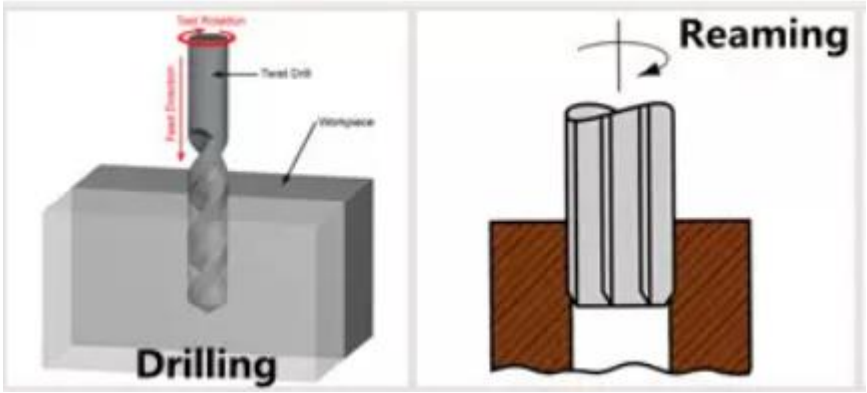

Figure 16 drilling & reaming

10.2 Counter boring, Counter sinking Operation

Perform the counter boring and counter sinking operation on the given specimen as shown in the Figure 17.

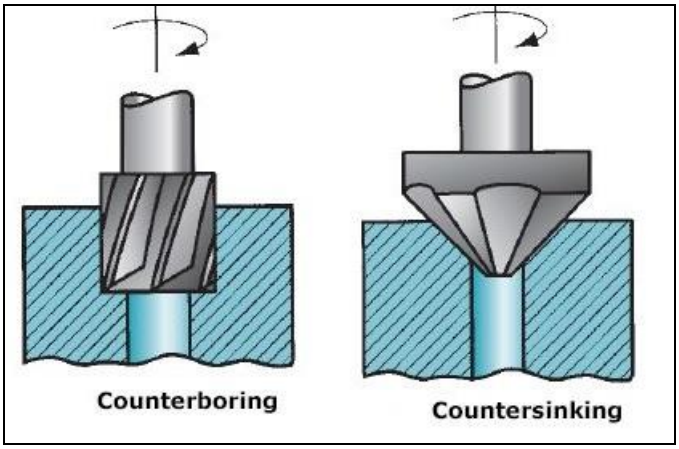

Figure 17 counter boring & counter sinking

Try

1. Perform the taping operation in the mild steel specimen using the drilling machine.
2. Perform this reaming and counter boring operation on steel using the drilling machine.
3. Perform the counter sinking operation in the mild steel using drilling machine.

11. Exercises on Welding Process-I

11.1 Gas Welding

Using Gas welding as shown in Figure 18, perform the Butt Joint of two Mild steel Metal as shown in Figure 19.

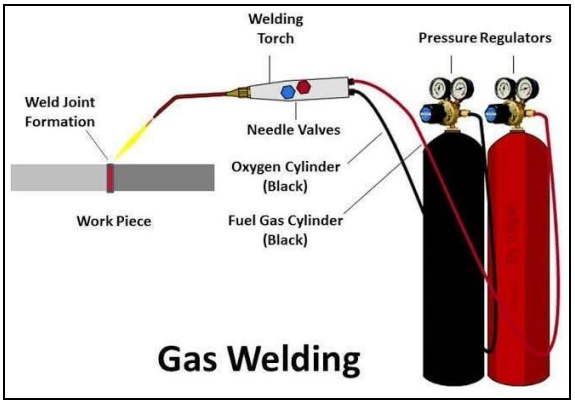

Figure 18 Gas welding

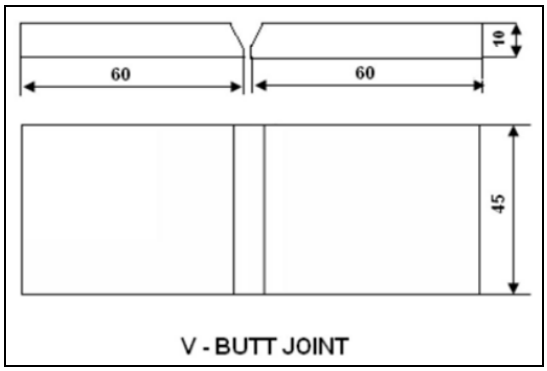

Figure 19 V- Butt joint

11.2 Brazing

Using brazing operation, perform the Joining of two Mild steel Metal pieces in Butt Joint as shown in Figure 20.

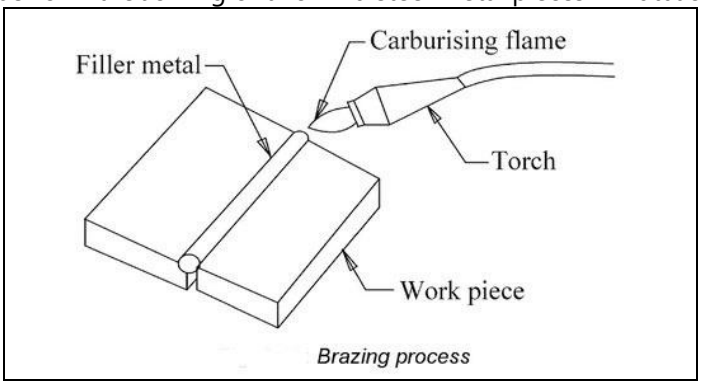

Figure 20 Brazing Operation

11.3 Soldering

using soldering, perform the Joining of two Mild steel Metal pieces in Butt Joint as shown in Figure 21.

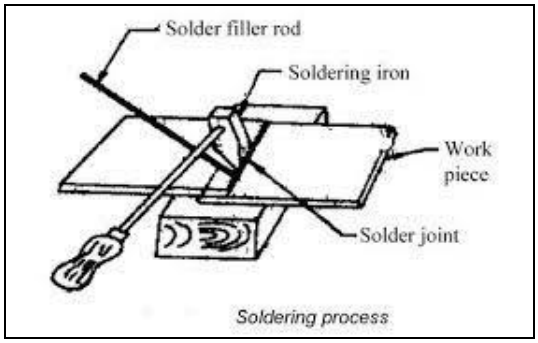

Figure 21 Soldering process

Try

1. Perform the joining process in steel sheets using the brazing operation.
2. Perform the joining process in the galvanized iron using the gas welding process.
3. Perform the joining process in the copper alloy using the gas welding & brazing process.

12. Exercises on Welding Process-II

12.1 Arc welding

Perform the Joining of two Mild Steel Work pieces using Arc welding as shown in Figure 22.

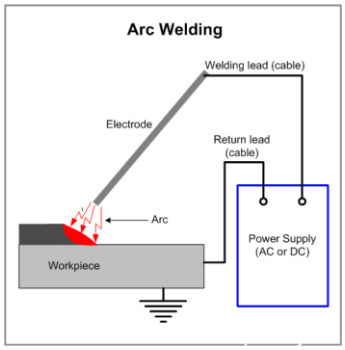

Figure 22 Arc welding

12.2 Spot welding

Perform the Joining of two Mild Steel Work pieces using the Spot Welding as shown in Figure 23.

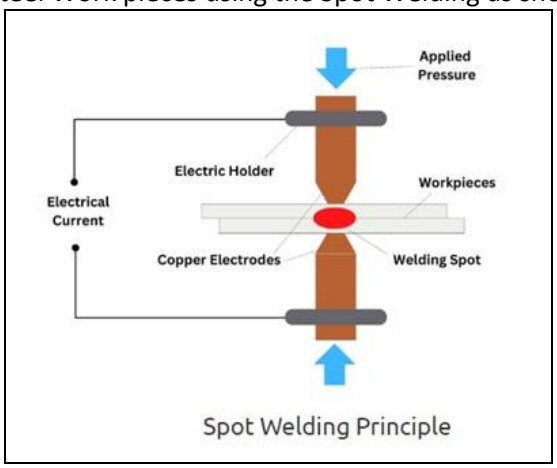

Figure 23 Spot welding principle

Try

1. Perform the Spot welding Operation using fixed length and find the strength.
2. Perform the Spot welding Operation Using Variable spot welding length and find the strength.
3. Perform the Arc welding operation with aluminum & riveting joint.

13. Exercises on Basic Casting

13.1 Preparation of casting with simple patterns.

Create a new solid rod with 50 mm length and 10 mm radius from the mold using the casting operation as shown in Figure 24.

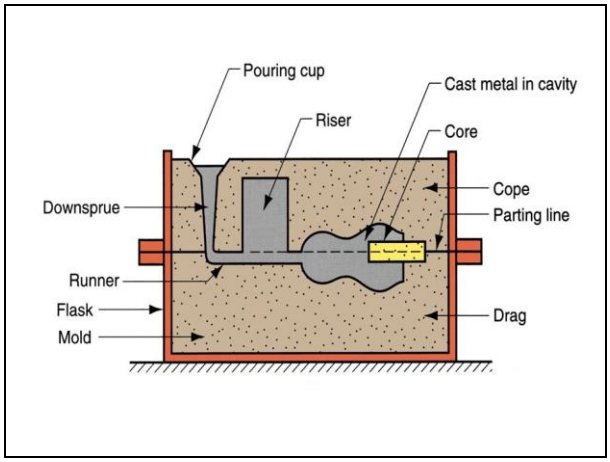

Figure 24 Basic Casting setup

Try

1. Create a Dumbbell using the casting operation.
2. Create a solid chair leg using the casting process.
3. Create a step based rod of aluminum material using the casting process.

13. Exercises on Injection Molding

13.1 Blow Molding

Perform the molding process using blow molding and make a new model out of it as shown in Figure 25.

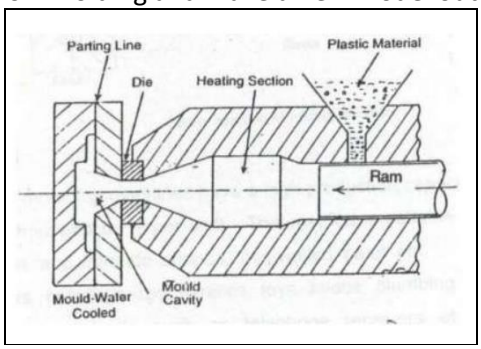

Figure 25 Blow molding

13.2 Injection Molding

Perform the molding process using Injection Molding and make a new model out of it as shown in Figure 26.

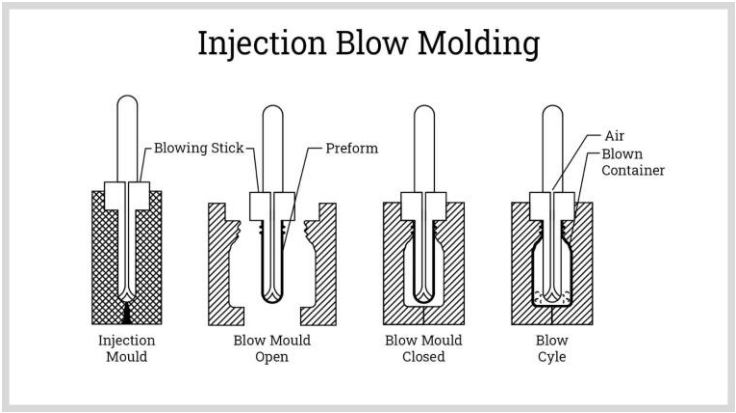

Figure 26 Injection Blow molding

Try

1. Create a cylindrical mold of Aluminum using the above two process.
2. Create a cylindrical mold of copper rod using the two processes mentioned above.
3. Create a dumbbell rod with 2.5 kg weight of aluminum metal.

14. Exercises on Additive Manufacturing

14.1 Cold riveting

Perform the Joining Process using the Riveting operation and find the strength as shown in the Figure 27.

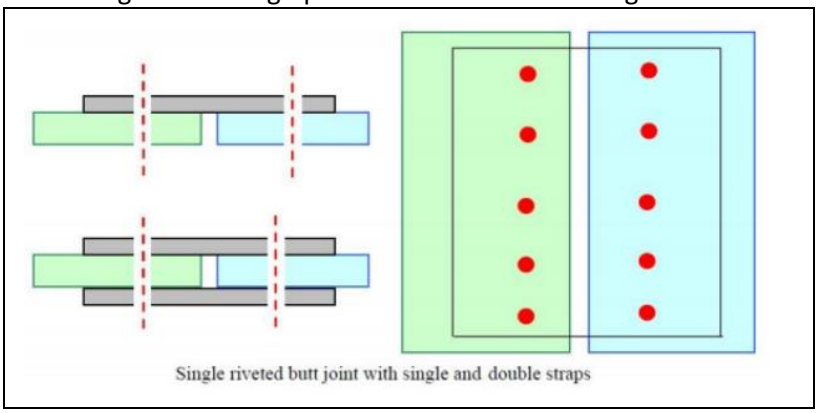

Figure 27 Single riveted butt joint with single & double straps

14.2 Hot riveting

Perform the Joining Process using the hot riveting operation where rivets are initially heated before applying force as shown in the Figure 28.

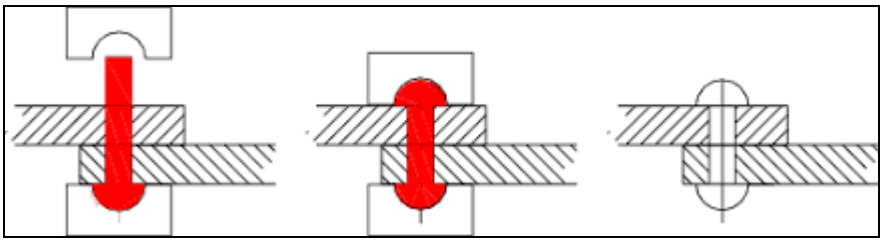

Figure 28 Hot riveting performed on work piece

Try

1. Perform the joining process using riveting of Aluminum Sheets with 5 rivets only.
2. Perform the Joining Process using Riveting of Galvanized sheets with 5 rivets only.
3. Perform the joining process using cold and hot riveting with 5 rivets only.

15. Exercises on Fused Deposition Modelling (FDM)

15.1 3D printing of a part

Perform the part modeling using 3D printing make a new model out of it as shown in Figure 29.

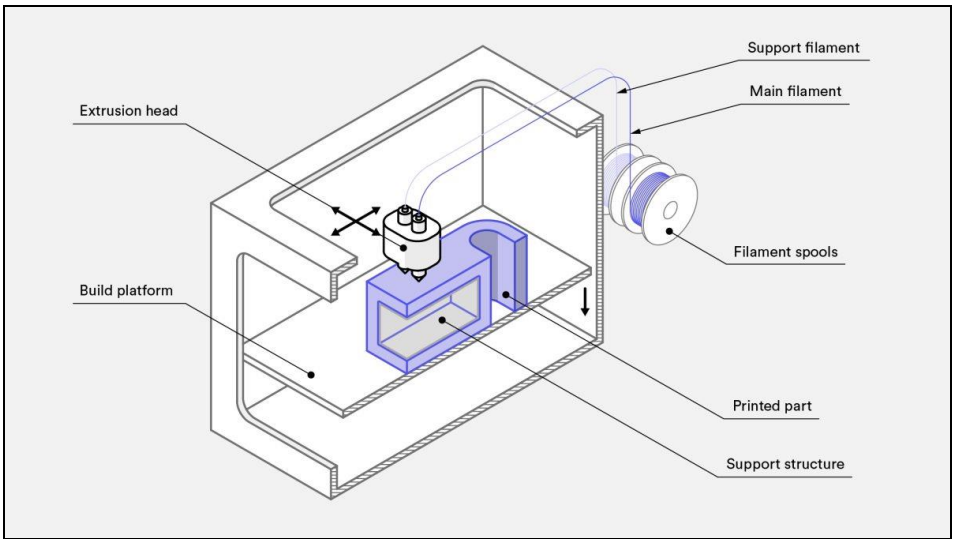

Figure 29 Part modeling in 3D printing

15.2 3D Printing of Gear

Perform the 3D modeling of a gear and make a new model out of it as shown in Figure 30.

Figure 30 3D printing of Gear

Try

1. Create a aircraft brackets by 3D modeling.
2. Create a aircraft wing modeling.
3. Create the turbine blades of the RC aircraft.

V. TEXT BOOKS:

1. Keshu S. C, Ganapathy K. K, "Air craft production techniques", Interline Publishing House, Bangalore, 3rd Edition, 1993.

VI. REFERENCE BOOKS:

1. R. K Jain-Khanna, "Production technology", McGraw Hill, 1st edition, 2002.
2. O. P Khanna, Lal. M. DhanpatRai, "Production technology, 5th edition, 1997.
3. C. P. Paul, A. N. Jinoop, "Additive Manufacturing", McGraw Hill India 1st edition, 2021,

VII. ELECTRONICS RESOURCES:

1. www.loc.gov/rr/scitech/tracer-bullets/aerodynamicstb.html
2. www.myopencourses.com/subject/aerodynamics-2

VIII. MATERIALS ONLINE

1. Course template
2. Lab manual