

**CURRICULUM**  
**Technical School Leaving Certificate**  
**Mechanical Engineering**  
(24 Months Apprenticeship Programme)



Council for Technical Education and Vocational Training  
**Curriculum Development Division**  
Sanothimi, Bhaktapur

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**Introduction:**

Nepal Government, Ministry of Education implemented the Letter grading system in SLC level. The door of TSLC program is open for those who have appeared 10th grade exam and achieved any GPA and any grade in any subject. Focusing on such students the curriculum of TSLC (Apprenticeship Programme) of 29 months has been converted into TSLC (Apprenticeship Programme) 24 months.

The world is using many mechanical appliances and equipment. Nepal is lacking to produce basic level mechanical workforce in the country, especially in the grass root level of rural and urban communities. Training of TSLC in Mechanical Engineering (Apprenticeship Programme) in mechanical sector, has presently become one of the major responsibilities of CTEVT. In this context, a well-developed curriculum is a fundamental pre-requisite for the training program.

The trained human resources of TSLC in Mechanical Engineering are employed in the world of work in national and international organizations and industries as a basic level mechanical workforce and some of them work as entrepreneurs by establishing their own mechanical workshop.

**Title:**

The title of the programme is TSLC in Mechanical Engineering (Apprenticeship Programme).

**Aim:**

The aim of the programme is to produce basic level mechanical workforce equipped with knowledge, skills and attitudes in related occupation and make them able to perform their jobs independently and accurately in the workshops/industries or in the communities.

**Objectives:**

After the completion of the training program the graduates will be able to:

- Perform basic mechanical works carried out in mechanical workshops.
- Perform mechanical drawings/drafting.
- Design and perform sheet metal, steel and aluminum fabrications.
- Operate lathe, milling and shaping machines.
- Repair and maintain mechanical devices.
- Perform simple calculations related to mechanical works.
- Identify & handle the main accessories & equipments.
- Weld different joint & positions by arc & gas welding.
- Familiarized with basic computer applications & computerized drawing system.
- Promote their own enterprise through entrepreneurship development.

**Program Description:**

The TSLC (Apprenticeship Programme) curriculum of Mechanical Engineering is designed to produce competent workforce equipped with knowledge, skills and attitudes related to the field of mechanical engineering. This curriculum focuses on basic mechanical skills and knowledge related to mechanical engineering to be used in related mechanical workshop and industries.

This course is based on practical exposure in different areas as required in the real world of work i.e. in the industries. In every subject, topical explanations will be followed by demonstrations by instructors and in all tasks, trainees will be asked to practice by themselves through do-it-yourself/hands-on exercises so that they can internalize what they learn in the classroom.

This curriculum includes basic and essential theoretical inputs, yet the focus is given on enhancement of the required skills, enabling techniques and competency building on disciplinary subjects such as Applied Mathematics, Mechanical Fitting & Maintenance, Arc & Gas Welding,

Lathe Operation, Milling & Shaping Operation, Engineering Drawing & AutoCAD, Structural Fabrication, Material Science, Trade Technology and Industrial Practice. This course also imparts the skills on basic computer application and entrepreneurship development. Theory classes are offered to enhance practical skills.

The program is designed on the basis of 20% theory and 80% practical classes. All practical skills are performed individually in the real working conditions. Trainees must learn to use a wide variety of hand tools and equipment to work safely, as well as simple machine operating and repairing works.

### **Course Duration**

This course will be completed within 24 months after the enrolment in a formal setting. The total hours for the course will be 3120 within the 24 months period of time. Pre-training course includes Trade Training for 3 months at the beginning and one month block released at the last month of the whole course will be conducted in the institute. Industrial practice & related skills will be learned in the related sponsoring industries. Related technical knowledge and basic skills will be provided at institution as required within the industrial practice period. Tripartite training agreement among trainees, sponsoring industries and training institute will be prepared and signed by all parties. The agreement terms and conditions will be implemented during the whole training period.

### **Entry criteria:**

Individuals with following criteria will be eligible for this program:

- SLC with any grade and any GPA (Since 2072 SLC).
- SLC appeared (Before 2072 SLC).
- Nepalese citizen of 16 to 25 years of age.
- Mentally & physically fit for training.

### **Selection criteria:**

The selection criteria should be as follows;

- Should pass entrance examination administered by CTEVT.
- Selection should be done on the merit basis of entrance examination.
- Final selection should be done after interview by the training institute.

### **Group size:**

The group size will be maximum 20 (twenty) in a batch.

### **Medium of Instruction:**

The medium of instruction will be in English and Nepali language.

### **Pattern of Attendance:**

The students should have minimum 90% attendance in theory classes and practical/performance to be eligible for internal assessments and final examinations.

### **Instructors' Qualification:**

- Instructors should have Bachelor's degree in Mechanical Engineering or Diploma in Mechanical Engineering with minimum 5 years practical based experiences.
- The demonstrator should have Diploma in Mechanical Engineering with minimum 2 years practical based experiences.
- Good communicative/instructional skills

**Teacher and Student Ratio:**

- Overall at institutional level: 1:10
- Theory: 1:40
- Practical: 1:10
- Minimum 60% of the Instructor must be fulltime

**Instructional Media and Materials:**

The following instructional media and materials are suggested for the effective instruction, demonstration and practical.

- Printed media materials (assignment sheets, handouts, information sheets, procedure sheets, performance check lists, textbooks, newspaper etc.).
- Non-projected media materials (display, photographs, flip chart, writing board etc.).
- Projected media materials (multimedia/overhead transparencies, slides etc.).
- Audio-visual materials (films, videodiscs, videotapes etc.).
- Computer-based instructional materials (computer-based training, interactive video etc.)

**Teaching Learning Methodologies:**

The methods of instruction for this program will be a combination of several approaches such as;

- Theory: lecture, discussion, assignment, group work, question-answer.
- Practical: demonstration, observation, guided practice and self-practice in industry as well as in institute.
- Apprenticeship: Industries, under guidance of seniors and supervisors.

**Evaluation Details:**

- The ratio between the theory and practical tests will be as per the marks given in the course structure of this curriculum for each subject. Ratio of internal and final evaluation is as follows:

S.N.	Particulars	Internal Assessment	Final Exam	Pass %
1.	Theory	50%	50%	40%
2.	Practical	50%	50%	60%

- There will be three internal assessments conducted by institute and one final examination in each subject at the end of second year. Moreover, the mode of assessment and examination includes both theory and practical or as per the nature of instruction as mentioned in the course structure.
- Every student must pass in each internal assessment to appear the final exam.
- Continuous evaluation of the students' performance is to be done by the related instructor/ trainer/supervisor to ensure the proficiency over each competency under each area of a subject specified in the curriculum.

**Grading System:**

The grading system will be as follows:

<u>Grading</u>	<u>Overall marks</u>
Distinction	80% or above
First division	75% to below 80%
Second division	65% to below 75%
Third division	Pass aggregate to below 65%

**Certificate Awarded:**

The council for technical education and vocational training will award certificate in “**Technical School Leaving Certificate in Mechanical Engineering**” to those graduates who has successfully completed the requirements as prescribed by the curriculum.

**Job Opportunity:**

The graduate will be eligible for the position equivalent to Non-gazetted 2nd class/level 4 (technical) as Mechanical Sub-Overseer or as prescribed by the Public Service Commission or the concerned authorities. The graduate is eligible for registration with the related professional council in the grade as mentioned in the council act (if any).

## Course Structure

S. SN	Subjects	Nature	Hours/week			2 Years Total Class Hours			Full Marks			Pass Marks		
			T	P	Total	T	P	Total	T	P	Total	T	P	Total
1	Applied Math	T	1	0	1	78	0	78	50	0	50	20	0	20
2	Mechanical Fittings & Maintenance	T+P	1	3	4	78	234	312	50	150	200	20	90	110
3	Arc & Gas Welding Technology	P	0	2	2	0	156	156	0	100	100	0	60	60
4	Lathe Operation	P	0	1	1	0	78	78	0	50	50	0	30	30
5	Milling & Shaping Operation	P	0	1	1	0	78	78	0	50	50	0	30	30
6	Engineering Drawing & AutoCAD	P	0	2	2	0	156	156	0	100	100	0	60	60
7	Structural Fabrication	P	0	1	1	0	78	78	0	50	50	0	30	30
8	Material Science	T	1	0	1	78	0	78	50	0	50	20	0	20
9	Trade Technology	T	2	0	2	156	0	156	100	0	100	40	0	40
10	Entrepreneurship Development	T	1	0	1	78	0	78	50	0	50	20	0	20
11	Industrial Practice	P	0	24	24	0	1872	1872	0	1200	1200	0	720	720
<b>Total</b>			<b>6</b>	<b>34</b>	<b>40</b>	<b>468</b>	<b>2652</b>	<b>3120</b>	<b>300</b>	<b>1700</b>	<b>2000</b>	<b>120</b>	<b>1020</b>	<b>1140</b>

## Subjects

1. Applied Mathematics
2. Mechanical Fittings & Maintenance
3. Arc & Gas Welding Technology
4. Lathe Operation
5. Milling & Shaping Operation
6. Engineering Drawing & AutoCAD
7. Structural Fabrication
8. Material Science
9. Trade Technology
10. Entrepreneurship Development
11. Industrial Practice

## Applied Mathematics

**Course Nature: Theory**  
**Full marks: 50**

**Total: 78 hrs.**  
**Class/ week: 1 hr.**

<b>Subject 1: Applied Mathematics</b>	
<b>Description:</b>	This course provides skill and knowledge to solve the numerical problems related to the TSLC Mechanical Engineering (Apprenticeship) course.
<b>Objectives:</b>	<p><b>At the end of the course the participants will be able to:</b></p> <ul style="list-style-type: none"> <li>• Calculate and convert units.</li> <li>• Calculate area, volume, percentage, wastage of metal and circumference.</li> <li>• Calculate mass, work, power, efficiency.</li> <li>• Apply different types of mechanical machines' related calculation.</li> </ul>

Unit	Skills	Topic/ Contents	Time (hrs.)
<b>Area calculations</b>			
1	Calculate SI units / conversion factors	System of units Conversion of units	2



2	Calculate percentage	Conversion of the percentage into actual number Conversion of the real number into percentage	2
3	Calculate circumferences	Definition Circumference of <ul style="list-style-type: none"> <li>• Sector</li> <li>• Polygons</li> </ul>	2
4	Calculate area	Area calculation of: <ul style="list-style-type: none"> <li>• Square</li> <li>• Rhombus</li> <li>• Rectangle</li> <li>• Parallelogram</li> <li>• Triangle</li> <li>• Trapezium</li> <li>• Circle</li> <li>• Sector</li> <li>• Circular ring</li> </ul>	4
5	Calculate Sheet metal requirements and wastage	Divide area of sheet metal Wastage Examples and Exercises	4
6	Calculate volume of right bodies, pointed and truncated bodies	Concept of cube, prism and cylinder <ul style="list-style-type: none"> <li>• Prism</li> <li>• Cylinder</li> <li>• Cone / Pyramid</li> <li>• Truncated cone / Pyramid</li> </ul> Examples and Exercises	4
7	Calculate taper and inclination	Concept of taper & taper ratio Taper ratio Ratio of inclination Setting angles Taper length Examples and Exercises	4
8	Calculate mass and force	Concept of mass and Density Mass Density Examples and Exercises Concept of force Weight Force Examples and Exercises	4
9	Calculate Lever Forces	Moment of force One side lever Two side lever Elbow lever Several forces Examples and Exercises	2
10	Calculate uniform speeds	Laws of motion V is in a straight line V is circular Acceleration	4

		Examples and Exercises	
11	Calculate work, power and efficiency	Work Power Efficiency Examples and Exercises	4
12	Calculate Simple belt drive	Peripheral speed Transmission ratio Examples and Exercises	2
13	Calculate Multiple belt drive	Components, transmissions Total transmission Examples and Exercises	4
14	Calculate gear wheel dimensions	Pitch Module Examples and Exercises	4
15	Calculate Simple gear drive	Dependency of pitch diameter and revolution Dependency of number of teeth and revolution Transmission ratio Distance between axis Examples and Exercises	2
16	Calculate Multiple gear drive	Component transmission Total transmission Examples and Exercises	2
17	Calculate processing time for drilling	Calculation of feed speed Calculation of processing time in min. Calculation of initial cut Examples and Exercises	4
18	Calculate processing time for turning	Calculation of feed speed Calculation of processing time in min. Examples and Exercises	4
19	Calculate processing time for planning, slotting & shaping	Processing time for planning Processing time for slotting (shaping) Examples and Exercises	4
20	Calculate processing time for milling	Calculation of run up Calculation of feed speed Calculation of processing time in min Examples and Exercises	4
21	Calculate Indexing (Direct & Indirect indexing)	Calculation of Indexing numbers Examples and Exercises	4
22	Calculate taper turning	Calculation of taper Examples and Exercises	4
23	Calculate threads cutting	Change gear calculation Example and Exercises	4
<b>Grand Total</b>			<b>78</b>

#### **BIBLIOGRAPHY:**

- Technical Mathematics for the Metal Trade, German Agency for Technical Cooperation (GTZ).

## Mechanical Fittings & Maintenance

**Course Nature: Theory +Practical**  
**Full marks: 50+150**

**Class per Week: 1+3 hrs.**  
**Total Class: 78+234 hrs.**

<b>Subject 2: Mechanical Fittings and Maintenance</b>	
<b>Description:</b>	This subject provides essential skill and knowledge to perform mechanical fitting and repair and maintenance works. This subject mainly focused on measuring, marking, filling, sawing, punching, drilling, die, tapping, cutting, folding, riveting with repair maintenance of tools equipments and machinery etc.
<b>Objectives:</b>	<p><b>At the end of the course the participants will be able to:</b></p> <ul style="list-style-type: none"> <li>▪ Apply safety rules.</li> <li>▪ Use measuring, marking and cutting tools, instruments and machines.</li> <li>▪ Perform basic operation related to mechanical fitting, such as: measure, mark, cut, bend, file, drill and rivet according to the specification.</li> <li>▪ Perform repair maintenance works.</li> </ul>

S.N.	Topics	Contents	Time Hours		
			Th.	Pr.	Total
<b>Mechanical Fittings and Maintenance -Theory</b>					
<b>1. Safety</b>					
1.1	<b>Importance of Safety</b>	<ul style="list-style-type: none"> <li>• Tidiness with machine, tools &amp; materials. Being aware of what other people are doing</li> </ul>	<b>1</b>	-	<b>1</b>
1.2	<b>General workshop safety</b>	<ul style="list-style-type: none"> <li>• Safety with workshop machinery</li> <li>• Fixed and portable drilling machines</li> <li>• Fixed and portable grinding machines</li> <li>• Safe working above ground level</li> </ul>	<b>2</b>	-	<b>2</b>
1.3	<b>Occupational health &amp; environment surveillance</b>	<ul style="list-style-type: none"> <li>• Know about own occupation and related safety</li> <li>• Effect of heaths and how save from its</li> </ul>	<b>2</b>	-	<b>2</b>
1.4	<b>Electrical safety</b>	<ul style="list-style-type: none"> <li>• Correct use of electrical equipment, flexible cables, ear thing, emergency and routine Isolation, Repairs</li> <li>• Response to an electrical accident</li> </ul>	<b>2</b>	-	<b>2</b>
1.5	<b>Fire hazards safety</b>	<ul style="list-style-type: none"> <li>• Fire hazards and fighting safety</li> <li>• Fire prevention, firefighting, alarms, emergency</li> <li>• Firefighting and evacuation demonstration</li> <li>• Risks from fires and other emergencies</li> </ul>	<b>2</b>	-	<b>2</b>

<b>1.6</b>	<b>Emergency first aid treatment.</b>	<ul style="list-style-type: none"> <li>• Importance of first aid</li> <li>• Basic first aid in the event of an accident, including resuscitation demonstration</li> <li>• Isolation of the injured/unconscious person</li> </ul>	<b>2</b>	-	<b>2</b>
<b>1.7</b>	<b>Lifting safety</b>	<ul style="list-style-type: none"> <li>• Safe manual lifting and carrying loads</li> <li>• Manual lifting, levers, avoiding damage to back muscles</li> <li>• Carrying ladders, working on ladders and elevated working platforms</li> <li>• Safe use of lifting equipment</li> <li>• Using slings, overhead/mobile crane, forklift truck</li> </ul>	<b>3</b>	-	<b>3</b>
<b>1.8</b>	<b>Risks from toxic materials</b>	<ul style="list-style-type: none"> <li>• Toxic materials, liquids, fumes and gases</li> </ul>	<b>2</b>	-	<b>2</b>
<b>1.9</b>	<b>Color coding safety</b>	<ul style="list-style-type: none"> <li>• Color coding and gas cylinders, electric cables and link to safety.</li> </ul>	<b>2</b>	-	<b>2</b>
<b>1.10</b>	<b>Accident Reporting</b>	<ul style="list-style-type: none"> <li>• How to prepare an accident report, why it is necessary</li> </ul>	<b>2</b>	-	<b>2</b>
<b>2.</b>	<b>Bench work hand tools</b>				
<b>2.1</b>	<b>Introduce hand tools</b>	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types of hand tools</li> <li>• Application of hand tools</li> <li>• Care and handling</li> <li>• Safety precaution</li> </ul>	<b>2</b>	-	<b>2</b>
<b>2.2</b>	<b>File</b>	<ul style="list-style-type: none"> <li>• Introduction of File and its elements</li> <li>• File safety</li> <li>• Needle file</li> <li>• Size of files</li> <li>• Types of file, Cuts of files</li> <li>• Cut of teeth</li> <li>• Grades of cut</li> <li>• Methods of filling</li> </ul>	<b>4</b>	-	<b>4</b>
<b>2.3</b>	<b>Hand Hacksaw</b>	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Hacksaws and sawing</li> <li>• Types of frame</li> <li>• Hacksaw blades</li> <li>• Safety precaution</li> </ul>	<b>2</b>	-	<b>2</b>
<b>2.4</b>	<b>Hammers</b>	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Safety precaution</li> <li>• Types and use of hammer</li> </ul>	<b>2</b>	-	<b>2</b>
<b>2.5</b>	<b>Chisels, Scraper and chippings</b>	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Purpose</li> </ul>	<b>2</b>	-	<b>2</b>

		<ul style="list-style-type: none"> <li>• Importance</li> <li>• Types</li> <li>• Types and use</li> <li>• Safety precaution</li> </ul>			
2.6	<b>Punch and punches</b>	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types and use of Punches</li> <li>• letter and Number punch</li> <li>• Punching tools</li> <li>• Safety precautions</li> </ul>	2	-	2
2.7	<b>Pliers and Cutters</b>	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types and use of Pliers and cutters</li> <li>• Safety precaution</li> </ul>	2	-	2
2.8	<b>Taps and dies</b>	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Thread and its nomenclature</li> <li>• Describe tap and die</li> <li>• Selection of drill bit for tapping(TDS)</li> <li>• Measuring and marking tools, drill bits, tap and die</li> <li>• Safety precautions</li> <li>• Tap handles and die stocks</li> <li>• Size of Tap drills (tapping drills)</li> <li>• Screw extractor</li> </ul>	5	-	5
2.9	<b>Wrench and spanners</b>	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types and use of wrenches and spanners</li> <li>• Safety precaution</li> </ul>	4	-	4
<b>3. Work clamping devices</b>					
3.1	<b>Vices</b>	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types of vices</li> <li>• Main parts of the vices</li> <li>• Uses of vices</li> <li>• Materials of work piece</li> </ul>	6	-	6
3.2	<b>C-clamps</b>	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types and use of C-clamps</li> </ul>	2	-	2
3.3	<b>V- Block with bridges</b>	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types and use of V-Blocks and clamping</li> </ul>	2	-	2
3.4	<b>Angle plate &amp; Vice Grip</b>	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types and uses</li> <li>• Safety precaution</li> </ul>	2	-	2
<b>4. Cutting Tools</b>					
4.1	<b>Reamer</b>	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types of reamer</li> <li>• Safety precaution</li> </ul>	2	-	2
4.2	<b>Countersink</b>	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Countersunk process</li> <li>• Handling of tools</li> <li>• Safety precaution</li> </ul>	2	-	2

<b>4.3</b>	<b>Drills</b>	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types, uses and parts</li> <li>• Drill bit (parallel and tapper sank) and countersink</li> <li>• Drill chuck, drill drift, sleeve</li> <li>• Counter bore</li> <li>• Drill size for reaming operation</li> <li>• RPM selection</li> <li>• Definition of drilling</li> <li>• Drilling Technique</li> <li>• Safety precaution</li> </ul>	<b>4</b>	<b>-</b>	<b>4</b>
<b>4.4</b>	<b>Grinding</b>	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types/parts (Bench/pedestal grinding)</li> <li>• Grinding wheel</li> <li>• Drill grinding gauge</li> <li>• Bevel Protector</li> <li>• Use and handle of hand grinder machine</li> <li>• Grinding process</li> <li>• Safety precaution</li> </ul>	<b>4</b>	<b>-</b>	<b>4</b>
<b>5</b>	<b>Rivet Work</b>	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types &amp; size of rivet</li> <li>• Riveting process</li> <li>• Safety precaution</li> </ul>	<b>3</b>	<b>-</b>	<b>3</b>
<b>6</b>	<b>Repair and Maintenance</b>	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types of repairs &amp; maintenance</li> <li>• Tools &amp;equipment</li> <li>• Application of lubricants</li> <li>• Introduction of electricity</li> <li>• Fuse</li> <li>• Fault of electrical supply</li> <li>• Mechanical and electrical safety</li> <li>• Preventive maintenance plan</li> <li>• Introduction of repair &amp; maintenance</li> <li>• Types of repair maintenance</li> <li>• Tools &amp;equipment</li> <li>• Application of lubricants</li> <li>• Introduction of electricity</li> <li>• Types and uses of belts</li> </ul>	<b>3</b>		<b>3</b>
<b>7</b>	<b>Explain machine elements</b>	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Bush, gear, shaft</li> <li>• Pin, bearing, belt, gear, nut-bolt</li> <li>• Safety</li> </ul>	<b>1</b>	<b>-</b>	<b>1</b>
<b>8</b>	<b>Explain 'V' and 'Flat' belts</b>	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types and uses of belts</li> </ul>	<b>1</b>	<b>-</b>	<b>1</b>

		<ul style="list-style-type: none"> <li>• Tools and equipment</li> <li>• Safety</li> </ul>			
<b>9</b>	<b>Measuring, marking and punching</b>			<b>3</b>	<b>3</b>
		<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types and parts</li> <li>• Importance and uses</li> <li>• Measuring instrument (steel ruler, bevel protector, try square and vernier calipers)</li> <li>• letter and Number punch</li> <li>• Punching tools</li> <li>• Measuring and marking tools (steel ruler, marking scribe, center punch, try square)</li> <li>• Safety precautions</li> </ul>			
<b>Total</b>			<b>78</b>	<b>-</b>	<b>78</b>
<b>Mechanical Fittings and Maintenance - Practical</b>					
<b>S.N.</b>	<b>Skill</b>	<b>Tasks</b>	<b>Time Hours</b>		
			<b>Th./Demo.</b>	<b>Pr.</b>	<b>Total</b>
<b>1</b>	<b>Perform filing</b>	<ul style="list-style-type: none"> <li>• File flat surface</li> <li>• File external radius</li> <li>• File internal profiles</li> <li>• Perform scraping</li> <li>• Sharpen the scraper</li> <li>• Procedure</li> <li>• Demonstration</li> <li>• Exercises</li> </ul>		20	20
<b>2</b>	<b>Perform measuring, marking and punching</b>	<ul style="list-style-type: none"> <li>• Measure and mark on the work piece</li> <li>• Stamp letter and number on work piece</li> <li>• Punch Dot and Center</li> <li>• Demonstration of measuring, marking and punching</li> <li>• Procedure</li> <li>• Demonstration</li> <li>• Exercises</li> </ul>		12	12
<b>3</b>	<b>Perform sawing</b>	<ul style="list-style-type: none"> <li>• Saw metal by hand hacksaw and power hacksaw</li> <li>• Procedure</li> <li>• Demonstration</li> <li>• Exercises</li> </ul>		8	8
<b>4</b>	<b>Perform drilling</b>	<ul style="list-style-type: none"> <li>• Drill a hole</li> <li>• Drill countersunk on hole</li> <li>• Perform Counter bore on drilled hole</li> <li>• Procedure</li> <li>• Demonstration</li> <li>• Exercises</li> </ul>		12	12

5	<b>Perform Tapping/die</b>	<ul style="list-style-type: none"> <li>• Cut external threads by die</li> <li>• Cut internal threads by taps</li> <li>• Procedure</li> <li>• Demonstration</li> <li>• Exercises</li> </ul>		8	8
6	<b>Perform off-hand grinding</b>	<ul style="list-style-type: none"> <li>• Grind center punch</li> <li>• Grind marking scriber</li> <li>• Grind twist drill</li> <li>• Procedure of offhand grinding</li> <li>• Demonstration of off-hand grinding operations</li> <li>• Exercises</li> </ul>		12	12
7	<b>Handle Measuring Instruments</b>	<ul style="list-style-type: none"> <li>• Measure dimension by using steel ruler</li> <li>• Measure dimension using bevel protector</li> <li>• Check square by using try square</li> <li>• Measure dimension by using vernier calipers</li> <li>• Procedure</li> <li>• Demonstration</li> <li>• Exercises</li> </ul>		12	12
8	<b>Perform project works</b>				
	Skill	Tasks	-	130	130
	Job I - Manufacture a T-Joint. Job II - Manufacture a Dove – tail Joint. Job III - Exercises on wire bending. Job IV - Manufacture a 'V' & Radius Profile. Job V - Manufacture a Multiple Gauging. Job VI - Manufacture a 'S' Fittings. Job VII - Manufacture a Drilled Plate. Job VIII - Manufacture a Male & Female profile Fittings. Job IX - Manufacture a Riveted Joint. Job X - Manufacture a Micrometer stand.	<ul style="list-style-type: none"> <li>• Obtain the drawing as Instructor's instruction</li> <li>• Read &amp; understand given drawing</li> <li>• Obtain tools, equipments &amp; materials from the tools room</li> <li>• Clean the work pieces by using wire brush if needed</li> <li>• Check flatness &amp; squareness</li> <li>• Layout/Mark the work pieces as per given drawing</li> <li>• Cut the raw materials</li> <li>• Prepare the work pieces per given drawing</li> <li>• Select &amp; use appropriate tools, equipments &amp; machines</li> <li>• Assemble/Fit the work pieces &amp; check it</li> <li>• Correction the wrong work pieces if necessary</li> <li>• Finish the surface of the work pieces</li> <li>• Stamp the Number &amp; Letter Punch on the work pieces</li> </ul>			



	Job XI - Manufacture a C-Clamp.	<ul style="list-style-type: none"> <li>Follow all the necessary safety rules &amp; regulations</li> <li>Exercises on above skill</li> </ul>			
9	<b>Perform Repair and Maintenance</b>	<ul style="list-style-type: none"> <li>Break down maintenance</li> <li>Diagnose faults</li> <li>Repair machine elements</li> <li>Replace machine elements</li> <li>Adjust/replace 'V' and 'Flat' belts</li> <li>Procedure</li> <li>Demonstration</li> <li>Exercises</li> </ul>		20	20
<b>Grand Total</b>			-	<b>234</b>	<b>234</b>

**Reference Books:**

- G.S Sethi & Balbir Singh-Machinist 1<sup>st</sup> & 2<sup>nd</sup> Year
- B. S. Raghuwanshi, A Course in Workshop Technology Vol 1 and 2, Dhanpat Rai and Co.
- S. K. Hajra Chaudhary, *Workshop Technology (Vol. 1)*, Media promoters
- Henp Fort, *Shop Theory (Vol. 1)*, Trade School
- W.A.J. Chapman, *Workshop Technology (Vol. 1)*, Elsevier Science
- Heinrich Gerling, *Elementary Metal Course Training Section I*
- ETHIO, *Arbeitsstelle fur Unterricht und Technik*, GERMAN Technical Institute, Holetta.
- Heinrich Gerling, *All about MACHINE TOOLS*, New Wiley Eastern Ltd India, 1965.
- P S Gill, *Engineering Drawing*, S K Kataria & Sons

## Arc & Gas Welding Technology

**Course Nature: Practical**

**Class per Week: 2 hrs.**

**Full marks: 100**

**Total Class: 156 hrs.**

<b>Subject 3: Arc &amp; Gas Welding Technology</b>	
<b>Description:</b>	<p>This course intends to impart the knowledge and skills required to perform SMAW, OAW, GTAW and GMAW.</p> <p>This course is mainly focused on position of welding, welding joint, Set of machine &amp; selection of electrode and shielding gas, Set of gas welding plant &amp; selection of filler rod.</p>
<b>Objectives:</b>	<p><b>At the end of the course the participants will be able to:</b></p> <ul style="list-style-type: none"> <li>• Setting up of SMAW, OAW, GTAW and GMAW plant.</li> <li>• Perform arc striking and maintaining of arc.</li> <li>• Perform surface weld in flat position.</li> <li>• Perform butt, corner, lap &amp; edge joint in flat position.</li> <li>• Perform pipe &amp; plate welding in flat position.</li> <li>• Select &amp; Handle welding tools/equipment.</li> <li>• Select welding current and electrode wire.</li> <li>• Prepare and set up welding material.</li> <li>• Use and follow safety precaution.</li> <li>• Select and set up gas pressure &amp; flame.</li> <li>• Identify and use of tungsten electrode.</li> <li>• Identify and use of shielding gas.</li> <li>• Set the Shielding gas flow rate.</li> </ul>

S.N.	Skill/Tasks	Contents/Topics	Time (hrs)		
			Th./ Demo.	Pr.	Total
<b>Unit 1. Shielded Metal Arc Welding (SMAW)</b>					
<b>1. Perform Flat Position Welding</b>					
1.1	Perform striking	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Safety</li> <li>▪ Set up arc welding plant</li> <li>▪ Operate and controls of arc welding machines.</li> <li>▪ Indentify arc welding accessories</li> <li>▪ Electrode</li> <li>▪ Set ampere</li> <li>▪ Arc Length</li> <li>▪ Striking Method</li> <li>▪ Demonstration</li> <li>▪ Exercises</li> </ul>	1.5	7.5	9
1.2	Perform surface weld	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Electrode</li> <li>▪ Set ampere</li> <li>▪ Procedure</li> <li>▪ Angle of electrode</li> <li>▪ Welding technique</li> <li>▪ Deposition</li> <li>▪ Demonstration</li> </ul>	1	8	9

		<ul style="list-style-type: none"> <li>▪ Inspect the welded beads for surface defects</li> <li>▪ .Exercises</li> </ul>			
1.3	Grind off welding surfaces	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Safety</li> <li>▪ Types of grinding machine</li> <li>▪ Grinding process</li> <li>▪ Material</li> <li>▪ Demonstration</li> <li>▪ Exercises</li> </ul>	0.5	5.5	6
1.4	Perform straight multi run beads	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Set ampere</li> <li>▪ Angle of electrode</li> <li>▪ Welding technique</li> <li>▪ Deposition</li> <li>▪ Demonstration</li> <li>▪ Exercises</li> </ul>	1	7	8
1.5	Perform tack weld for joints	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Safety</li> <li>▪ Set ampere</li> <li>▪ Angle of electrode</li> <li>▪ Deposition</li> <li>▪ Technique</li> <li>▪ Demonstration</li> <li>▪ Exercises</li> </ul>	1	4	5
1.6	Weld corner joint	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Safety</li> <li>▪ Set and tack the plate to form corner joint.</li> <li>▪ Set ampere</li> <li>▪ Angle of electrode</li> <li>▪ Welding technique</li> <li>▪ Deposition</li> <li>▪ Exercises</li> </ul>	1	6	7
1.7	Weld edge joint	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Prepare base metal and set up edge joint.</li> <li>▪ Set Ampere</li> <li>▪ Angle of electrode</li> <li>▪ Welding technique</li> <li>▪ Deposition</li> <li>▪ Exercises</li> </ul>	1	5	6
1.8	Weld Lap joint	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Safety</li> <li>▪ Set and tack the lap joint in correct alignment</li> <li>▪ Electrode</li> <li>▪ Set ampere</li> <li>▪ Angle of electrode</li> <li>▪ Welding technique</li> <li>▪ Deposition</li> <li>▪ Exercises</li> </ul>	1	5	6
1.9	Weld square butt from both sides	<ul style="list-style-type: none"> <li>▪ Introduction</li> </ul>	1	9	10

		<ul style="list-style-type: none"> <li>▪ Safety</li> <li>▪ Preparation and set of square butt joint</li> <li>▪ Set ampere</li> <li>▪ Penetration</li> <li>▪ Angle of electrode</li> <li>▪ Welding technique</li> <li>▪ Deposition</li> <li>▪ Exercises</li> </ul>			
1.10	Weld V-butt joint with backing	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Safety</li> <li>▪ Electrode</li> <li>▪ Set ampere</li> <li>▪ Penetration</li> <li>▪ Angle of electrode</li> <li>▪ Weaving and travel speed</li> <li>▪ Material</li> <li>▪ Deposition</li> <li>▪ Welding technique</li> <li>▪ Exercises</li> </ul>	1.5	9.5	11
<b>2. Perform Horizontal, Vertical &amp; Flat Position Pipe Welding</b>					
2.1	Perform surface weld in horizontal position	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Safety</li> <li>▪ Electrode</li> <li>▪ Set ampere</li> <li>▪ Arc</li> <li>▪ Angle of electrode</li> <li>▪ Electrode manipulation</li> <li>▪ Material</li> <li>▪ Deposition</li> <li>▪ Welding technique</li> <li>▪ Demonstration</li> <li>▪ Exercises</li> </ul>	1	5	6
2.2	Perform surface weld in vertical position	<ul style="list-style-type: none"> <li>▪ Introduction and safety</li> <li>▪ Electrode</li> <li>▪ Set ampere</li> <li>▪ Arc</li> <li>▪ Angle of electrode</li> <li>▪ Welding technique</li> <li>▪ Deposition</li> <li>▪ Demonstration</li> <li>▪ Exercises</li> </ul>	1	5	6
2.3	Perform fillet weld in horizontal position	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Safety</li> <li>▪ Electrode</li> <li>▪ Set ampere</li> <li>▪ Angle of electrode</li> <li>▪ Welding technique</li> <li>▪ Material</li> <li>▪ Deposition</li> <li>▪ Exercises</li> </ul>	0.5	3.5	4
2.4	Perform fillet weld in vertical position	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Penetration</li> </ul>	0.5	3.5	4

		<ul style="list-style-type: none"> <li>▪ Set ampere</li> <li>▪ Angle of electrode</li> <li>▪ Welding technique</li> <li>▪ Exercises</li> </ul>			
2.5	Perform surface weld	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Safety</li> <li>▪ Electrode</li> <li>▪ Set ampere</li> <li>▪ Arc</li> <li>▪ Angle of electrode</li> <li>▪ Deposition</li> <li>▪ Welding technique</li> <li>▪ Exercises</li> </ul>	0.5	4.5	5
2.6	Perform fillet weld	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Tools &amp; equipment</li> <li>▪ Set ampere</li> <li>▪ Angle of electrode</li> <li>▪ Deposition</li> <li>▪ Welding technique</li> <li>▪ Exercises</li> </ul>	0.5	4.5	5
2.7	Weld pipe to pipe joint in flat position by rotated	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Safety</li> <li>▪ Tools &amp; equipment</li> <li>▪ Electrode</li> <li>▪ Set ampere</li> <li>▪ Angle of electrode</li> <li>▪ Deposition</li> <li>▪ Welding technique</li> <li>▪ Demonstration</li> <li>▪ Exercises</li> </ul>	0.5	4.5	5
2.8	Weld pipe to flat metal joint in flat position	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Safety</li> <li>▪ Tools &amp; equipment</li> <li>▪ Electrode</li> <li>▪ Set ampere</li> <li>▪ Arc</li> <li>▪ Angle of electrode</li> <li>▪ Deposition</li> <li>▪ Welding technique</li> <li>▪ Demonstration</li> <li>▪ Exercises</li> </ul>	0.5	4.5	5

**Unit 2. Perform Oxy-Acetylene Welding (OAW)**

**1. Gas Welding (OAW)**

1.1	Set up gas welding plant	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Safety precautions</li> <li>▪ Set up arc gas welding plant</li> <li>▪ Operate and controls of gas welding plant</li> <li>▪ Indentify gas welding accessories</li> <li>▪ Applications</li> <li>▪ Demonstration</li> </ul>	1	1	2
1.2	Perform gas flame setting	<ul style="list-style-type: none"> <li>▪ Introduction</li> </ul>	1	1	2

		<ul style="list-style-type: none"> <li>▪ Safety precautions</li> <li>▪ Types of flame</li> <li>▪ Set pressure</li> <li>▪ Applications</li> <li>▪ Importance of cleaning</li> <li>▪ Manipulation of torch</li> <li>▪ Demonstration</li> </ul>			
1.3	Weld surface in flat position a) Weld straight bead on surface without using filler rod	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Flame setting</li> <li>▪ Weld deposition</li> <li>▪ Tools/materials/filler wire</li> <li>▪ Welding technique</li> <li>▪ Safety precaution</li> <li>▪ Demonstration</li> <li>▪ Exercises</li> </ul>	0.5	3.5	4
1.4	Weld surface in flat position a) Weld straight bead on surface with using filler rod	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Flame setting</li> <li>▪ Weld deposition</li> <li>▪ Tools/materials/filler wire</li> <li>▪ Welding technique</li> <li>▪ Safety precaution</li> <li>▪ Demonstration</li> <li>▪ Exercises</li> </ul>	1	4	5

**Unit 3. Gas Metal Arc Welding and Gas Tungsten Arc Welding (GMAW & GTAW)**

**Gas Tungsten Arc Welding (GTAW)**

1.1	Set up welding machine and equipment	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Machine/Tools/equipment</li> <li>▪ Advantages/Disadvantages</li> <li>▪ Applications</li> <li>▪ Set up GTAW plant</li> <li>▪ Safety precautions</li> <li>▪ Demonstration</li> </ul>	1	2	3
1.2	Perform surface welding in flat position a) Weld surface without filler rod b) Weld surface with filler rod	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Welding wave/deposition of bead</li> <li>▪ Tools/materials</li> <li>▪ Tungsten electrode/filler rod</li> <li>▪ Importance &amp; Applications</li> <li>▪ Shielding gases</li> <li>▪ Gas flow rate</li> <li>▪ Angle of torch and filler rod</li> <li>▪ Welding Process</li> <li>▪ Tip preparation of tungsten electrode</li> <li>▪ Safety precautions</li> <li>▪ Demonstration</li> <li>▪ Exercises</li> </ul>	1	4	5
1.3	Perform welding in flat position a) Weld square butt joint	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Torch angle and filler rod</li> <li>▪ Tack welding</li> <li>▪ Welding process</li> <li>▪ Work piece setting</li> <li>▪ Welding current</li> </ul>	1	4	5

		<ul style="list-style-type: none"> <li>▪ Metal preparation</li> <li>▪ Safety precaution</li> <li>▪ Exercises</li> </ul>			
<b>Gas Metal Arc Welding (GMAW)</b>					
1.1	Set up welding machine and equipment	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Machine/Tools/equipment</li> <li>▪ Advantages/Disadvantages</li> <li>▪ Applications</li> <li>▪ Setting up of GMAW plant</li> <li>▪ Safety precautions</li> <li>▪ Demonstration</li> </ul>	1	2	3
1.2	Weld surface in flat position a) Weld straight bead on surface	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Welding wave/deposition of bead</li> <li>▪ Tools/materials/filler wire</li> <li>▪ Importance &amp; Applications</li> <li>▪ Shielding gas</li> <li>▪ Gas flow rate</li> <li>▪ Welding Process</li> <li>▪ Safety precaution</li> <li>▪ Demonstration</li> <li>▪ Exercises</li> </ul>	1	4	5
1.3	Weld in flat position a) Weld square butt joint b) Weld T joint	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Welding process</li> <li>▪ Work piece setting</li> <li>▪ Welding current</li> <li>▪ Angle of welding gun</li> <li>▪ Work piece preparation</li> <li>▪ Safety rules</li> <li>▪ Demonstration</li> <li>▪ Exercises</li> </ul>	1	4	5
Total			25	131	156

### **BIBLIOGRAPHY**

<b>S.N.</b>	<b>Name</b>	<b>Author</b>	<b>Publication</b>
1	Welding Engineering and Technology	Dr. R. S. Parmar	Khanna Publishers
2	Principal of Welding Technology	L M Gourd	Viva Books Private Ltd.
3	Welding Principles and Applications	Larry Jeffus	Thomsom Delmar Learning
4	AWS D1.1/D1.1M:2004 Structural Welding Code-Steel		American Welding Society
5	Gas Metal Arc Welding Handbook	William H. Minnick	The Good heart-Willcox Company
6	Electric Arc Welding Technology	Man Kaji Kumal	Contact 9847034087

## Lathe Operation

Course Nature: Practical  
Full Marks: 50

Class Per week: 1 hr.  
Total Class: 78 hrs.

<b>Subject 4: Lathe Operation</b>	
<b>Description:</b>	This course provides essential skill and knowledge to perform lathe works. It focuses on performing set up, operate, turning/boring/facing/parting/threads cutting/off-hand grinding etc. in lathe machine workshop.
<b>Objectives:</b>	At the end of the course the participants will be able to: <ul style="list-style-type: none"> <li>• Set up lathe machine.</li> <li>• Measure &amp; mark the dimensions.</li> <li>• Perform machine operations.</li> <li>• Perform threads cutting.</li> <li>• Perform off-hand grinding.</li> <li>• Conduct project works.</li> </ul>

<b>Subject: Lathe Operation</b>					
S.N.	Skill/Tasks	Contents/Topics	Time Hours		
			Th/ Demo.	Pr.	Total
<b>Unit 1: Set up Lathe machine</b>					
1.1	Align a work piece in three jaws chucks	<ul style="list-style-type: none"> <li>▪ Introduction of lathe machine</li> <li>▪ Parts and function</li> <li>▪ Define general lathe machine safety</li> <li>▪ Demonstration</li> <li>▪ Exercises</li> </ul>	1	1	2
1.2	Align a round rod in a four jaw independent chuck with the help of a surface gauge	<ul style="list-style-type: none"> <li>▪ Introduction of chuck</li> <li>▪ Types of chuck</li> <li>▪ Principle of three and four jaw chuck</li> <li>▪ Mount the three and four jaw chuck</li> <li>▪ State the merits and demerits of the 4 jaw chuck over a 3 jaw chuck</li> <li>▪ Demonstration</li> <li>▪ Exercises</li> </ul>	1	1	2
1.3	Set turning tool on tool post <ul style="list-style-type: none"> <li>▪ Set the tool in the tool post for performing the operation</li> </ul>	<ul style="list-style-type: none"> <li>▪ Introduction of Lathe tools</li> <li>▪ Classify lathe cutting tools</li> <li>▪ Identify and name the types and angles of lathe cutting tools</li> <li>▪ Tools Geometry</li> <li>▪ Introduction of tools post</li> <li>▪ Principle of tools setting</li> <li>▪ Demonstration</li> <li>▪ Exercises</li> </ul>	0.5	0.5	1
1.4	Set machine control	<ul style="list-style-type: none"> <li>▪ Selection of RPM</li> <li>▪ Selection of feed, depth of cut and number of cut</li> <li>▪ Setting of gear box</li> <li>▪ Manual and automatic</li> </ul>	0.5	0.5	1



		<ul style="list-style-type: none"> <li>▪ Demonstration</li> </ul>			
1.5	Set work piece center to center with dog and clamp	<ul style="list-style-type: none"> <li>▪ Introduction of Lathe dog and dog clamp</li> <li>▪ Necessity of Lathe dog and dog clamp</li> <li>▪ Process of clamping work piece on center to center</li> <li>▪ Exercises</li> </ul>	0.5	1.5	2
<b>Unit 2: Perform Machine operation</b>					
2.1	Perform plain turning	<ul style="list-style-type: none"> <li>▪ Lathe machine operation</li> <li>▪ Define plain turning operation</li> <li>▪ Purpose of turning</li> <li>▪ Name the two stage of plain turning</li> <li>▪ Distinguish between the two stage of plain turning</li> <li>▪ Procedures</li> <li>▪ Demonstration of plain turning</li> <li>▪ Exercises on plain turning</li> </ul>	0.5	1.5	2
2.2	Perform facing	<ul style="list-style-type: none"> <li>▪ Define facing operation &amp; facing tool</li> <li>▪ Purpose of facing</li> <li>▪ Procedures</li> <li>▪ Demonstration of facing</li> <li>▪ Exercises on facing</li> </ul>	0.5	1.5	2
2.3	Perform Centre drilling <ul style="list-style-type: none"> <li>▪ Centre drill a work held in a chuck</li> </ul>	<ul style="list-style-type: none"> <li>▪ Define centre drilling operation</li> <li>▪ Identify the centre drills</li> <li>▪ State the purpose of centre drilling</li> <li>▪ State the defects in centre drilling</li> <li>▪ Indicate the causes for the defects</li> <li>▪ State the remedies to avoid the defects</li> <li>▪ State the methods of centre drilling</li> <li>▪ Demonstration of centre drilling</li> <li>▪ Exercises on centre drilling</li> </ul>	1	1.5	2.5
2.4	Perform drilling <ul style="list-style-type: none"> <li>• Drill large diameter holes using pilot holes</li> <li>• Drill blind holes to the required using the depth stops</li> </ul>	<ul style="list-style-type: none"> <li>▪ Define drilling operation</li> <li>▪ State the necessity of drilling</li> <li>▪ Name the types of drills used</li> <li>▪ Identify the parts of a twist drill</li> <li>▪ Identify the defects in a drilled hole</li> <li>▪ State the causes and the remedies for the defect</li> <li>▪ Drilling procedure</li> <li>▪ Drill bit geometry</li> <li>▪ Demonstration of drilling</li> <li>▪ Exercises on drilling</li> </ul>	1	1.5	2.5
2.6	Turn steps of different diameters for definite	<ul style="list-style-type: none"> <li>▪ Define step turning</li> <li>▪ Procedures</li> </ul>	0.5	1.5	2

	lengths	<ul style="list-style-type: none"> <li>▪ Demonstration of step turning</li> <li>▪ Exercises on step turning</li> </ul>			
2.7	Perform chamfering	<ul style="list-style-type: none"> <li>▪ Define chamfering operation</li> <li>▪ State the necessity of chamfering</li> <li>▪ Identify the methods of chamfering</li> <li>▪ Distinguish between the various methods of chamfering</li> <li>▪ Demonstration of chamfering</li> <li>▪ Exercises on chamfering</li> </ul>	0.5	1.5	2
2.8	Perform external grooving	<ul style="list-style-type: none"> <li>▪ Define grooving operation</li> <li>▪ Procedures</li> <li>▪ Select the grooving tools</li> <li>▪ Demonstration of external grooving</li> <li>▪ Exercise on external grooving</li> </ul>	0.5	1.5	2
2.9	Perform boring <ul style="list-style-type: none"> <li>▪ Set the boring tool in the tool post</li> <li>▪ Bore the drilled hole to the required size</li> <li>▪ Check the hole with the help of a vernier caliper</li> </ul>	<ul style="list-style-type: none"> <li>▪ Define boring operation</li> <li>▪ Necessity of a boring hole</li> <li>▪ Identify and name the different types of boring tools</li> <li>▪ List out the advantages of the different boring tools</li> <li>▪ Procedures</li> <li>▪ Demonstration of boring</li> <li>▪ Exercises on boring</li> </ul>	1	1.5	2.5
2.10	Perform internal grooving <ul style="list-style-type: none"> <li>▪ Set the undercutting tool in the tool post</li> <li>▪ Set the tool at the required position</li> <li>▪ Perform undercut operations</li> </ul>	<ul style="list-style-type: none"> <li>▪ Distinguish between internal and external grooving</li> <li>▪ Select the grooving tools</li> <li>▪ Procedures</li> <li>▪ Demonstration of internal grooving</li> <li>▪ Exercises on internal grooving</li> </ul>	0.5	1.5	2
2.11	Perform external and internal taper turning <ul style="list-style-type: none"> <li>• Turn taper by compound slide swiveling</li> <li>▪ Set and swivel the top slide of the compound rest to the required taper angle</li> <li>▪ Set the tool in the tool post</li> <li>▪ Turn the taper</li> </ul>	<ul style="list-style-type: none"> <li>▪ Point out the taper turning methods on a lathe</li> <li>▪ State the features of each method</li> <li>▪ List out the advantage and disadvantages of each method</li> <li>▪ Define a taper</li> <li>▪ State the uses of a taper</li> <li>▪ Identify the elements of taper</li> <li>▪ Express the taper and its conversion</li> <li>▪ Classify the tapers</li> <li>▪ State the different standard tapers and their uses</li> <li>▪ State the principle of taper turning</li> <li>▪ Taper setting in machine</li> <li>▪ Procedures</li> <li>▪ Demonstration of external and internal turning</li> <li>▪ Exercises on external and internal taper turning</li> </ul>	2	4	6

2.12	<p>Perform knurling operation</p> <ul style="list-style-type: none"> <li>▪ Prepare the work for knurling</li> <li>▪ Set the speed for knurling</li> <li>▪ Set the knurling tool in the tool post</li> <li>▪ Knurl the job using the required grade of knurl</li> </ul>	<ul style="list-style-type: none"> <li>▪ Define knurling operation</li> <li>▪ State the purpose of knurling</li> <li>▪ Identify the different types of knurls and knurling patterns</li> <li>▪ Identify the grades of knurls</li> <li>▪ Distinguish between the various types of knurling tool-holders</li> <li>▪ Demonstration of knurling</li> <li>▪ Exercises on knurling</li> </ul>	1	1.5	2.5
2.13	<p>Perform parting off operation</p> <ul style="list-style-type: none"> <li>▪ Set the parting off tool in the machine to the correct centre height</li> <li>▪ Follow the correct procedure while parting off</li> <li>▪ Observe certain precautions while parting off</li> </ul>	<ul style="list-style-type: none"> <li>▪ Define parting off operation</li> <li>▪ Types and its importance</li> <li>▪ Introduction of parting tool</li> <li>▪ Demonstration of parting off operation</li> <li>▪ Exercises on parting off operation</li> </ul>	1	1.5	2.5
2.14	<p>Perform reaming operation</p> <ul style="list-style-type: none"> <li>▪ Set the machine for hand reaming</li> <li>▪ Set the reamer on a lathe</li> <li>▪ Ream a hole accurately with a hand reamer</li> </ul>	<ul style="list-style-type: none"> <li>▪ State the purpose of reaming</li> <li>▪ Identify the types of reamers</li> <li>▪ Identify and name the parts of a hand reamer</li> <li>▪ Identify the different types of hand reamers used for reaming operations</li> <li>▪ Mention the allowance given for reaming operations</li> <li>▪ State the difference between machine and hand reamers</li> <li>▪ Determine the hole size for reaming</li> <li>▪ State the care and maintenance of reamers</li> <li>▪ Demonstration of reaming</li> <li>▪ Exercises on reaming</li> </ul>	1	1.5	2.5
<b>Unit 3: Perform Threads Cutting</b>					
3.1	<p>Cut threads by die/taps on a lathe machine</p> <ul style="list-style-type: none"> <li>▪ Cut internal threads in blind holes</li> <li>▪ Cut external threads using dies</li> </ul>	<ul style="list-style-type: none"> <li>▪ State the uses of screw threads</li> <li>▪ Differentiate between external and internal threads</li> <li>▪ State the elements of screw threads</li> <li>▪ State the purpose of screw pitch gauge</li> <li>▪ State the uses of threading hand taps</li> <li>▪ Distinguish between different taps in a set</li> <li>▪ Name and state the different types of tap wrenches</li> </ul>	2	2	4

		<ul style="list-style-type: none"> <li>▪ Identify the different types of dies</li> <li>▪ State the uses of each type of die</li> <li>▪ Name the type of diestock for each type of work</li> <li>▪ State tap drill size</li> <li>▪ Choose the tap drill sizes for different threads from tables</li> <li>▪ Calculate the tap drill size for ISO metric and ISO inch</li> <li>▪ Introduction of die and taps</li> <li>▪ Procedures</li> <li>▪ Demonstration of threads cutting by taps and dies</li> <li>▪ Exercises on threads cutting by taps and dies</li> </ul>			
3.2	Cut external & internal V-threads using a single point tool on a lathe	<ul style="list-style-type: none"> <li>▪ Name the basic forms of screw threads</li> <li>▪ State the uses of different forms of screw threads</li> <li>▪ Name the types of 'vee' threads used for thread fastening</li> <li>▪ Distinguish between types of 'vee' threads</li> <li>▪ Procedures</li> <li>▪ Demonstration of threads cutting on a lathe machine</li> <li>▪ Exercises on threads cutting on a lathe machine</li> </ul>	2	6	8
<b>Unit 4: Perform off-hand grinding</b>					
4.1	<p>Re-sharpen twist drills bit</p> <ul style="list-style-type: none"> <li>▪ Dress and true a grinding wheel of a pedestal grinder for tool grinding</li> <li>▪ Test the drill that has been re-sharpened by drilling a through hole</li> </ul>	<ul style="list-style-type: none"> <li>▪ Define off-hand grinding</li> <li>▪ Denote the applications of off-hand grinding</li> <li>▪ Identify and name the different types of off-hand grinding machines</li> <li>▪ Name the common types of wheel dressers</li> <li>▪ State the uses of each type of wheel dressers</li> <li>▪ Angle of drill bit tip</li> <li>▪ Procedures</li> <li>▪ Grinding safety</li> <li>▪ Demonstration</li> <li>▪ Exercises</li> </ul>	1	1.5	2.5
4.2	<p>Grind lathe cutting tools</p> <ul style="list-style-type: none"> <li>• Grind a right/Left hand side cutting tool to machine steel</li> <li>• Grind a right/Left hand rough turning tool on a pedestal grinder for turning</li> </ul>	<ul style="list-style-type: none"> <li>▪ Define lathe cutting tools</li> <li>▪ Types of tool</li> <li>▪ Tool geometry</li> <li>▪ Procedures</li> <li>▪ Demonstration</li> <li>▪ Exercises on lathe cutting tools</li> </ul>	1	2.5	3.5

	steel <ul style="list-style-type: none"> <li>• Facing tool</li> <li>• Threads cutting</li> <li>• Grooving tool</li> <li>• Boring tool</li> </ul>				
4.3	Perform simple eccentric turning <ul style="list-style-type: none"> <li>▪ True the job for external eccentric turning</li> <li>▪ Turn external eccentric diameter</li> </ul>	<ul style="list-style-type: none"> <li>▪ Define eccentric turning</li> <li>▪ Types of eccentric turning</li> <li>▪ Purpose of eccentric turning</li> <li>▪ Procedures</li> <li>▪ Demonstration</li> <li>▪ Exercises on simple eccentric turning</li> </ul>	1	3	4
<b>Unit 5: Conduct Project Works</b>					
<b>Project/Skill</b>		<b>Tasks/Topics</b>	<b>Th.</b>	<b>Pr.</b>	<b>Total</b>
5.1	Job I - Prepare a Measuring Tools Holder. Job II - Prepare a 'C'-Clamp. Job III - Machine a Lathe Centre. Job IV - Machine a Centre Punch. <ul style="list-style-type: none"> <li>▪ Measure with a vernier caliper</li> <li>▪ Measure angles with a vernier bevel protractor</li> <li>▪ Check the taper with a vernier bevel protractor</li> <li>▪ Measure with an outside micrometer</li> <li>▪ Mark with a vernier height gauge</li> <li>▪ Mark concentric and eccentric lines of a job by using a vernier height gauge</li> <li>▪ Check the undercut width and depth with a vernier caliper</li> </ul>	<ul style="list-style-type: none"> <li>▪ Inform &amp; plan the requirements in process planning</li> <li>▪ Determine &amp; describe steps in process planning</li> <li>▪ Exercises on above skill</li> </ul>	2	14	16
<b>Grand Total</b>			<b>23.5</b>	<b>54.5</b>	<b>78</b>

**Reference Books:**

- Machinist - 1<sup>st</sup> & 2<sup>nd</sup> year - G. S. Sethi & Balbir Singh
- Work Shop Technology (Volume I & II) – Hajra & Chaudhary
- Production Technology R. K. Jain S. C. Gupta
- Westermann Table book Metal
- All about Machine tools

## Milling and Shaping Operation

**Course Nature: Practical**  
**Full Marks: 50**

**Class per Week: 1 hr.**  
**Total Class: 78 hrs.**

<b>Subject 5: Milling Shaping and Operation</b>	
<b>Description:</b>	This subject provides essential skill and knowledge to perform milling and shaping operation. This subject is mainly focused on Plane, steps, angular surface, grooves, key ways and gear milling operation on milling machine and plane, steps, angular surfaces and slotting on shaper machine.
<b>Objectives:</b>	At the end of the course the participants will be able to: <ul style="list-style-type: none"> <li>▪ Apply safety rules.</li> <li>▪ Perform milling machine operation (plane, steps, angular surfaces , grooves, spur gear).</li> <li>▪ Perform shaper machine operation (plane, steps, surface).</li> </ul>

### 1. Milling Machine Operation

S.N.	Skill/Tasks	Contents/Topics	Time Hours		
			Th./Demo	Pr.	Total
<b>Set up machine</b>					
	<ul style="list-style-type: none"> <li>▪ Set up machine control</li> </ul>	<ul style="list-style-type: none"> <li>▪ Introduction of milling machine</li> <li>▪ Types of milling machine</li> <li>▪ Identification of main parts</li> <li>▪ Milling machine mechanism</li> <li>▪ Care of the milling machine</li> <li>▪ Demonstration</li> </ul>	2	1	3
	<ul style="list-style-type: none"> <li>▪ Set up milling vice on machine table</li> <li>▪ Set up work piece on vice</li> </ul>	<ul style="list-style-type: none"> <li>▪ Introduction of work holding devices</li> <li>▪ Types of work holding devices</li> <li>▪ Milling safety</li> <li>▪ Procedure</li> <li>▪ Demonstration</li> <li>▪ Exercises</li> </ul>	1	1	2
	<ul style="list-style-type: none"> <li>▪ Mount milling cutters on long arbor in horizontal spindle</li> </ul>	<ul style="list-style-type: none"> <li>▪ Introduction of cutter holding devices</li> <li>▪ Types of cutter holding devices</li> <li>▪ Types and uses of milling cutters</li> <li>▪ Procedure</li> <li>▪ Demonstration</li> <li>▪ Exercises</li> </ul>	2	2	4

<b>2. Perform milling operations</b>					
	<ul style="list-style-type: none"> <li>• Mill a block square</li> <li>• Face to length on a horizontal machine</li> <li>• Mill a shoulder</li> <li>• Mill a slot</li> <li>• Mill a keyway</li> <li>• Mill a vees on a horizontal machine</li> <li>• Mill an angle by setting the work at an angle</li> </ul>	<ul style="list-style-type: none"> <li>▪ Fundamental of milling process</li> <li>▪ Define milling machine operations</li> <li>▪ Distinguish between horizontal &amp; Vertical milling machine</li> <li>▪ RPM selection</li> <li>▪ Procedure</li> <li>▪ Demonstration</li> <li>▪ Exercises on above milling operations</li> </ul>	3	14	17

### 3. Indexing

	<ul style="list-style-type: none"> <li>• Mill hexagonal shape on round work piece</li> </ul>	<ul style="list-style-type: none"> <li>• Define indexing</li> <li>• Method of indexing</li> <li>• Differentiate between end mill &amp; face milling cutters</li> <li>• Procedure</li> <li>▪ Demonstration</li> <li>• Exercises</li> </ul>	1	3	4
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<b>4. Project/Skill</b>		<b>Tasks/Topics</b>	<b>Th./Demo</b>	<b>Pr.</b>	<b>Total</b>
	Job I - Machine a rectangular block.	<ul style="list-style-type: none"> <li>• Inform &amp; plan the requirements in process planning</li> </ul>	1	8	9
	Job II - Prepare a spur gear.	<ul style="list-style-type: none"> <li>• Determine &amp; describe steps in process planning</li> <li>▪ Exercises</li> </ul>			
<b>Total</b>			<b>10</b>	<b>29</b>	<b>39</b>

### 2. Shaper Machine Operation

S.N.	Skill/Tasks	Contents/Topics	Time Hours		
			Th./Demo	Pr.	Total
1	Set up machine control	<ul style="list-style-type: none"> <li>▪ Introduction of shaper machine</li> <li>▪ Main parts of shaper</li> <li>▪ Specification of a shaper</li> <li>▪ Types of shapers</li> <li>▪ Shaper safety</li> <li>▪ Demonstration</li> </ul>	3	1	4
2	Set up shaper vice on machine table	<ul style="list-style-type: none"> <li>▪ Introduction of work holding devices</li> <li>▪ Types of work holding devices</li> <li>▪ Procedure</li> <li>▪ Demonstration</li> <li>▪ Exercises</li> </ul>	2	1	3
3	Hold single point cutting tool (HSS)	<ul style="list-style-type: none"> <li>▪ Define shaper tools</li> <li>▪ Types of cutting tool</li> <li>▪ Procedure</li> </ul>	1	1	2
4	<ul style="list-style-type: none"> <li>▪ Adjust the length of stroke</li> <li>▪ Adjust the position</li> </ul>	<ul style="list-style-type: none"> <li>▪ Function</li> <li>▪ Tools and equipment</li> <li>▪ Procedure</li> </ul>	1	1	2

	of the stroke	<ul style="list-style-type: none"> <li>▪ Demonstration</li> <li>▪ Exercises</li> </ul>			
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### 5. Perform shaper operations

	I. Machine horizontal surface II. Machine vertical surface III. Machine angular surface IV. Perform plane slot V. Perform the groove VI. Perform a keyway <ul style="list-style-type: none"> <li>• Check parallelism of flat surfaces using a dial test indicator</li> </ul>	<ul style="list-style-type: none"> <li>▪ Define shaper operations</li> <li>▪ Tools and equipment</li> <li>▪ Single point cutting tool</li> <li>▪ Procedure</li> <li>▪ Demonstration</li> <li>▪ Exercises on above shaper operations</li> </ul>	2	10	12
<b>6. Project/Skill</b>		<b>Task/Topics</b>	<b>Th./Demo</b>	<b>Pr.</b>	<b>Total</b>
	Job I - Prepare a V-block. Job II - Prepare a "C" Clamp.	<ul style="list-style-type: none"> <li>▪ Inform &amp; plan the requirements in process planning</li> <li>▪ Determine &amp; describe steps in process planning</li> <li>▪ Exercises on above skill</li> </ul>	1	15	16
<b>Total</b>			<b>10</b>	<b>29</b>	<b>39</b>
<b>Grand Total</b>			<b>20</b>	<b>58</b>	<b>78</b>

### Reference Books:

- Machinist - 1<sup>st</sup> & 2<sup>nd</sup> year - G. S. Sethi & Balbir Singh
- Work Shop Technology (Volume I & II) – Hajra & Chaudhary
- Production Technology R.K. Jain S. C. Gupta
- Westermann Table book Metal
- All about Machine tools



## Engineering Drawing & AutoCAD

**Course Nature: Practical**

**Class per Week: 2 hrs.**

**Full Marks: 100**

**Total Class: 156 hrs.**

### Subject 6: Engineering Drawing & AutoCAD

<b>Description:</b>	This Engineering Drawing subject provides essential skill and knowledge to communicate ideas and information from one mind to another fully and clearly define requirements for engineered items in graphical language. This subject mainly focused in Orthographic representation, Oblique/Isometric views, various types of lines, Dimensions, Tolerance, lettered, notes, Sectional views, Development of Sheet metal and Symbols, etc.
	This Computer application is the very basic computer course. This course familiarizes trainees about computer.
	This AutoCAD course intends to impart the knowledge and skills required to create two dimensional (2D) drawing and drafting using Computer Aided Drafting (CAD) software with a focus mainly on <i>mechanical engineering drawings</i> . Trainees develop competencies focusing mainly on different features such as Geometric shapes, Layers and Line types, Annotating a drawing with Text, Hatching and Dimensioning and creating output.
<b>Objectives:</b>	At the end of the course the participants will be able to:
	<ul style="list-style-type: none"> <li>▪ Handle drawing instruments.</li> <li>▪ Read and analyze engineering drawings.</li> <li>▪ Draw engineering drawings.</li> <li>▪ Annotate a drawing with Text, Dimensioning, Tolerance and related information.</li> <li>▪ Represent Drawing symbols and different shapes accurately.</li> <li>▪ Represent three dimensional objects in orthographic form.</li> <li>▪ Draw sectional views of the given three dimensional solid.</li> <li>▪ Draw pictorial projections from the given orthographic views.</li> <li>▪ Develop the surfaces.</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Understand the concept of computer.</li> <li>▪ Able to work with Ms Word.</li> <li>▪ Can create Spreadsheet.</li> <li>▪ Formulate charts with data.</li> <li>▪ Send and receive Email.</li> <li>▪ Search information on the Internet.</li> <li>▪ Familiarize with Windows operating system.</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Use Computer Aided Drafting (CAD) Software.</li> <li>▪ Construct 2D Engineering Drawing using AutoCAD.</li> <li>▪ Annotate a drawing with Text, Dimensioning.</li> <li>▪ Edit drawing using CAD Software.</li> </ul>

1 Engineering Drawing					
S.N.	Skill/Tasks	Topics/Contents	Time Hours		
			Th.	Pr.	Total
1	Explain engineering/technical drawing	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Classification</li> <li>• Applications</li> <li>• Distinguish</li> </ul>	2	-	2
2	Identify and handle drawing instruments	<ul style="list-style-type: none"> <li>• Selection of drawing instruments</li> <li>• Types, uses and sizes</li> <li>• Handling techniques</li> </ul>	1	1	2

		<ul style="list-style-type: none"> <li>• Precautions</li> <li>• Demonstration of instruments</li> </ul>			
3	<p>Draw/Construct a title block and lines</p> <ul style="list-style-type: none"> <li>• Set up paper in drawing board</li> <li>• Prepare a drawing sheet using Mini Drafter</li> </ul>	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Layout of the drawing sheet</li> <li>• Convention for lines and materials</li> <li>• Uses of lines and title block</li> <li>• Types and Thickness of lines</li> <li>• Demonstration</li> <li>• Exercises</li> </ul>	1	3	4
4	Practice lettering	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Requirements of good lettering</li> <li>• Spacing and sizes of letters</li> <li>• Single-stroke, freehand gothic and italic lettering</li> <li>• Demonstration</li> <li>• Exercises</li> </ul>	1	1	2
5	Identify and construct of four sided plane figures, triangles and regular polygons	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Concept and Importance</li> <li>• Handling techniques</li> <li>• Types</li> <li>• Procedure for making geometrical constructions</li> <li>• Drawing exercises</li> </ul>	1	3	4
6	Construct an ellipse	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Drawing exercises on rectangle and two circles method</li> </ul>	0.5	1.5	2
7	Dimension the drawing objects	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Elements of dimensioning</li> <li>• Method of dimensioning</li> <li>• Arrangement of dimensioning</li> <li>• Symbols for shape indication</li> <li>• General rules for dimensioning <ul style="list-style-type: none"> <li>▪ Flat work pieces with straight edges</li> <li>▪ Flat work pieces with holes &amp; round edges</li> <li>▪ Practical hints on dimensioning</li> </ul> </li> <li>• Problems on dimensioning</li> <li>• Demonstration</li> </ul>	2	2	4

8	Draw in scales	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Uses and sizes of scale</li> <li>• Metric and British measurement</li> <li>• Drawing exercises on sizes of scale</li> </ul>	1	1	2
9	Identify pictorial views	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Differences between isometric and oblique views</li> <li>• Drawing exercises</li> </ul>	1	3	4
10	Explain and obtain orthographic views	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Selection of views</li> <li>• Spacing of views</li> <li>• Principles of orthographic views</li> <li>• Comparison of first and third angle projection</li> <li>• Demonstration</li> <li>• Drawing exercises</li> </ul>	1.5	2.5	4
11	Select and identify orthographic views from pictorial views	<ul style="list-style-type: none"> <li>• Analysis of three views including missing views</li> <li>• Simple cuboids shapes</li> <li>• Angles and slopes</li> <li>• Demonstration</li> <li>• Drawing exercises</li> </ul>	1	1	2
12	Draw orthographic views from isometric & oblique views by first & third angle projection	<ul style="list-style-type: none"> <li>• Procedure for making orthographic views</li> <li>• Rectangular objects with horizontal</li> <li>• Vertical and inclined surfaces</li> <li>• Objects with cylindrical surfaces</li> <li>• Demonstration</li> <li>• Drawing exercises</li> </ul>	1	9	10
13	Select, sketch and identify isometric and oblique views from orthographic views	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Differences between isometric and oblique views</li> <li>• Orientation of objects in isometric and oblique views</li> <li>• Demonstration</li> <li>• Drawing exercises</li> </ul>	1	3	4
14	Draw simple isometric and oblique views from orthographic views	<ul style="list-style-type: none"> <li>• Procedure of making isometric and oblique views</li> <li>• Simple cube shapes</li> <li>• Angles and slopes</li> <li>• Demonstration</li> </ul>	1	5	6

		<ul style="list-style-type: none"> <li>• Drawing exercises</li> </ul>			
15	Identify and explain sectional views	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Define cutting plane line and hatching lines</li> <li>• Procedure for making section lines</li> <li>• Reasons for section</li> <li>• Types of sectional views</li> <li>• Drawing exercises</li> </ul>	1	3	4
16	Sketch full sectional orthographic views from sample/real objects	<ul style="list-style-type: none"> <li>• Orientation of objects in full Section objects</li> <li>• Rectangular objects with horizontal</li> <li>• Vertical and inclined surfaces</li> <li>• Objects with cylindrical surfaces</li> <li>• Demonstration</li> <li>• Drawing exercises</li> </ul>	1	3	4
17	Draw full sectional orthographic views from isometric views	<ul style="list-style-type: none"> <li>• Procedure for making full section views</li> <li>• Rectangular objects with horizontal</li> <li>• Vertical and inclined surfaces</li> <li>• Objects with cylindrical surfaces</li> <li>• Drawing exercises</li> </ul>	1	7	8
18	Draw half section orthographic views from isometric views	<ul style="list-style-type: none"> <li>• Procedure for making half section views</li> <li>• Rectangular objects with horizontal</li> <li>• Vertical and inclined surfaces</li> <li>• Objects with cylindrical surfaces</li> <li>• Demonstration</li> <li>• Drawing exercises</li> </ul>	1	3	4
19	Draw partial and offset sections	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Procedure for making partial and offset section views</li> <li>• Drawing exercises</li> </ul>	1	1	2
20	Explain and draw working, detail and assembly drawings	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Information</li> <li>• Procedure for making a working drawing</li> <li>• Procedure for making assembly drawing from</li> </ul>	1.5	2.5	4

		<ul style="list-style-type: none"> <li>• details</li> <li>• Drawing exercises</li> </ul>			
21	Define general tolerance, limits and fits	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Uses</li> <li>• Differences between hole basis and shaft basis System</li> <li>• Drawing exercises</li> </ul>	1.5	2.5	4
22	Draw machining symbols and surface finish	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Methods of placing machining symbols on orthographic views</li> <li>• Specification of surface finish</li> <li>• Drawing exercises</li> </ul>	1	1	2
23	Draw screw threads	<ul style="list-style-type: none"> <li>• Forms of screw threads</li> <li>• Comparison of 'v' and square threads</li> <li>• Thread designation</li> <li>• Conventional representation of Screw threads</li> <li>• Demonstration</li> <li>• Drawing exercises</li> </ul>	1	1	2
24	Identify fastenings (nuts & bolts)	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Forms of nuts &amp; bolts</li> <li>• Demonstration</li> <li>• Drawing exercises</li> </ul>	1	1	2
25	Draw symbols of pipe fittings and welding	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Symbols for pipe fittings</li> <li>• Basic welding symbols</li> </ul>	1.5	4.5	6
26	Draw complicated isometric views from orthographic views	<ul style="list-style-type: none"> <li>• Rectangular objects with horizontal</li> <li>• Vertical and inclined surfaces</li> <li>• Objects with cylindrical surfaces and holes</li> <li>• Drawing exercises</li> </ul>	0.5	3.5	4
27	Draw complicated missing orthographic views in first and third angle projection including sectional views	<ul style="list-style-type: none"> <li>• Procedure for drawing the missing lines/views</li> <li>• Rectangular objects with horizontal</li> <li>• Vertical and inclined surfaces</li> <li>• Objects with cylindrical surfaces</li> <li>• Drawing exercises</li> </ul>	1	9	10
28	Development of sheet metal <ul style="list-style-type: none"> <li>• Draw a right prism</li> <li>• Draw a right cylinder</li> <li>• Draw a right cone</li> </ul>	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Development of surfaces</li> <li>• Applications</li> <li>• Principle of development</li> </ul>	2	7	9

	<ul style="list-style-type: none"> <li>development</li> <li>• Draw a right conic frustum</li> <li>• Draw a cylindrical pipe elbow</li> <li>• Draw a right angled tee</li> </ul>	<ul style="list-style-type: none"> <li>• Method of development</li> <li>• Drawing exercises</li> </ul>			
Total			32	85	117
<b>2</b>	<b>Computer Application</b>				
S.N.	Skill/Tasks	Topics/Contents	Time (hrs)		
			Th.	Pr.	Total
1	Turn on computer/start program/paint/typing tutor	<ul style="list-style-type: none"> <li>• Explain about computer</li> <li>• Switch on computer</li> <li>• Explain about mouse and keyboard</li> <li>• Log in to the computer</li> <li>• Mouse and keyboard practice</li> </ul>	0.20	0.40	1.00
2	Controlling program windows/ Introduce program menus/ Keyboard keys	<ul style="list-style-type: none"> <li>• Explain about how to control opened program windows (minimize, maximize/restore, close)</li> <li>• Explain about program menus (file, edit, view)</li> <li>• Explain keyboard different keys</li> </ul>	0.20	0.40	1.00
3	Introduce MS Word Fundamental of MS Word	<ul style="list-style-type: none"> <li>• Open MS Word program</li> <li>• Save a document</li> <li>• Close a document</li> <li>• Create a New document</li> <li>• Exit from Ms Word Program</li> </ul>	0.20	0.40	1.00
4	Formatting text in MS Word	<ul style="list-style-type: none"> <li>• Formatting Text Font, Size, color, align text</li> <li>• Spell checker</li> <li>• Copy, cut, move and paste</li> </ul>	0.20	0.40	1.00
5	Writing reports and letters with 'Word'	<ul style="list-style-type: none"> <li>• Introduce the concept of <i>styles</i></li> <li>• Bullets and numbering</li> <li>• Write simple reports and letters</li> </ul>	0.20	0.40	1.00
6	Inserting tables and drawing objects in 'Word'	<ul style="list-style-type: none"> <li>• Create tables</li> <li>• Format rows and columns in table</li> <li>• Simple drawing with drawing toolbar</li> <li>• Create lines and shapes</li> </ul>	0.20	0.40	1.00
7	Inserting pictures, clip art into 'Word'	<ul style="list-style-type: none"> <li>• Insert clip art into word</li> <li>• Insert picture into word</li> <li>• Wrapping or positioning picture</li> <li>• Crop insert picture</li> <li>• Manage inserting pictures.</li> </ul>	0.20	0.40	1.00
8	Working with my computer	<ul style="list-style-type: none"> <li>• Familiarize with my computer</li> </ul>	0.20	0.40	1.00

	(drives, files and folders)	<ul style="list-style-type: none"> <li>• Familiarize with computer drives</li> <li>• Manage files and folders</li> <li>• Fundamental of files and folders</li> </ul>			
9	Introduction to 'Ms Excel'	<ul style="list-style-type: none"> <li>• Introduce to MS Excel</li> <li>• Fundamental and use of MS Excel</li> <li>• Workbook and worksheet</li> <li>• Rows columns and cells borders</li> <li>• Editing and formatting cells</li> <li>• Adding text in cells</li> <li>• Formula bar, selecting cells</li> </ul>	0.20	0.40	1.00
10	Formatting borders and sorting, calculating data	<ul style="list-style-type: none"> <li>• Format borders</li> <li>• Sorting data (alphabetically or by columns)</li> <li>• Improve look of the table</li> <li>• Formatting tables</li> </ul>	0.20	0.40	1.00
11	Complete data automatically Merging cells/Simple calculations/freeze cell	<ul style="list-style-type: none"> <li>• Merge cells</li> <li>• Use of toolbar</li> <li>• Calculate data (adding, subtracting, multiply, divide)</li> <li>• Use formula</li> <li>• Competing sequences automatically</li> <li>• Freezing reference cell</li> <li>• Copying cells</li> </ul>	0.20	0.40	1.00
12	Useful functions Plotting data on a chart	<ul style="list-style-type: none"> <li>• Useful functions (sum, if,&lt; &gt;)</li> <li>• Plotting a chart (column, pie)</li> <li>• Format chart</li> <li>• Data for plotting chart</li> </ul>	0.20	0.40	1.00
13	Windows operating system Customizing the desktop	<ul style="list-style-type: none"> <li>• Explain Windows operating system</li> <li>• Customizing the desktop Changing date and time Change desktop background Manage desktop icons</li> </ul>	0.20	0.40	1.00
14	Internet	<ul style="list-style-type: none"> <li>• Introduction to Internet</li> <li>• Fundamentals of internet</li> <li>• Use of internet</li> <li>• Browsers</li> <li>• Network</li> <li>• Connect with internet</li> </ul>	0.20	0.40	1.00
15	Email and social network	<ul style="list-style-type: none"> <li>• Email</li> <li>• Social networks</li> <li>• Send and receive emails</li> <li>• Attach document with emails</li> <li>• Create email accounts</li> <li>• Register with social networking sites</li> </ul>	0.20	0.40	1.00

			Total	5	10	15
<b>3</b>	<b>AutoCAD</b>					
S.N.	Skill/Tasks	Topics/Contents	Time (hrs)			
			Th.	Pr.	Total	
<b>Unit: 1. Familiarize with Computer Aided Drafting (CAD) Software</b>						
1	Startup Computer Aided Drafting (CAD) software	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Enlist different types of CAD software.</li> <li>▪ System requirement for CAD</li> <li>▪ Startup CAD by start menu</li> <li>▪ Interpret CAD graphics window including screen layout, pull-down menus, screen icons, command line and dialogue boxes.</li> <li>▪ Modify display</li> <li>▪ Introduce and arrange toolbar</li> <li>▪ Managing unit/limit</li> <li>▪ Start, organize and save file</li> </ul>	0.25	0.50	0.75	
2	Setup a Drawing	<ul style="list-style-type: none"> <li>▪ Explain how to start drawing from scratch, using wizard and, using and creating a template file.</li> <li>▪ Describe setting preferences (units, angle, direction, area)</li> </ul>	0.25	0.25	0.50	
3	Manage Toolbar	<ul style="list-style-type: none"> <li>▪ Standard tool bar</li> <li>▪ Draw tool bar</li> <li>▪ Modify toolbar</li> <li>▪ Dimensioning tool bar</li> <li>▪ Other</li> </ul>	0.25	0.25	0.50	
<b>Unit: 2 Construct 2-D drawing using CAD Software</b>						
1	Draw lines	<ul style="list-style-type: none"> <li>▪ Different system Relative, Cartesian and absolute coordinate system.</li> <li>▪ Start and end point of a line</li> <li>▪ Different methods of drawing a line in CAD</li> <li>▪ Options available in drawing line in CAD (Undo, Close)</li> </ul>	0.25	0.75	1.00	
2	Draw rectangle	<ul style="list-style-type: none"> <li>▪ Corner points (first and other)</li> <li>▪ Options available in drawing rectangle (chamfer, fillet)</li> <li>▪ Chamfer distance</li> <li>▪ Fillet radius</li> </ul>	0.25	0.25	0.50	
3	Draw arc	<ul style="list-style-type: none"> <li>▪ Identify arc among various types of geometric shapes.</li> <li>▪ Describe different options for drawing arc (3 points method, Start Center method, Start End method, Center Start method)</li> </ul>	0.25	0.25	0.50	
4	Draw circle	<ul style="list-style-type: none"> <li>▪ Describe different options for drawing arc (Center Radius method, Center Diameter</li> </ul>	0.25	0.25	0.50	



		method, 2P method, 3P method, Tan, Tan Radius method, Tan, Tan, Tan method)			
5	Draw polygon	<ul style="list-style-type: none"> <li>▪ Describe different options for drawing polygon (center, edge)</li> </ul>	0.25	0.25	0.50
6	Manage lines	<ul style="list-style-type: none"> <li>▪ Line properties</li> <li>▪ Line weight</li> <li>▪ Line color</li> <li>▪ Line loading</li> </ul>	0.25	0.25	0.50
7	Draw an Isometric drawing	<ul style="list-style-type: none"> <li>▪ Concept Isometric snap and rectangular snap</li> <li>▪ Setting of isometric snap</li> </ul>	0.25	0.25	0.50
8	Draw Ellipse	<ul style="list-style-type: none"> <li>▪ Ellipse in rectangular snap <ul style="list-style-type: none"> <li>▪ Center Radius method</li> <li>• Center Diameter method</li> </ul> </li> <li>▪ Ellipse in isometric snap</li> </ul>	0.25	0.25	0.50
<b>Unit: 3 Edit drawing using CAD Software</b>					
1	Relocate object using Move command	<ul style="list-style-type: none"> <li>▪ Different methods of selecting objects for editing such as window, crossing, fence, all ...</li> <li>• Base point</li> <li>• Second point of displacement</li> </ul>	0.25	0.25	0.50
2	Relocate object using rotate command	<ul style="list-style-type: none"> <li>▪ Define rotation angle</li> <li>▪ Explain Reference Point.</li> </ul>	0.25	0.25	0.50
3	Duplicate object using Copy command	<ul style="list-style-type: none"> <li>▪ Differentiate multiple copy and Single copy.</li> <li>▪ Explain the procedure for duplicating object using copy command.</li> </ul>	0.25	0.25	0.50
4	Duplicate object using Mirror command	<ul style="list-style-type: none"> <li>▪ State the purpose of Mirror.</li> <li>▪ Explain First point and Second point of mirror line</li> <li>▪ Second point of mirror line</li> <li>▪ Describe options available in mirror command</li> </ul>	0.25	0.25	0.50
5	Duplicate object using Offset command	<ul style="list-style-type: none"> <li>▪ Describe options available for <ul style="list-style-type: none"> <li>▪ Offset distance</li> <li>▪ Through</li> </ul> </li> </ul>	0.25	0.25	0.50
6	Duplicate object using Array command	<ul style="list-style-type: none"> <li>▪ Differentiate Rectangular Array and Polar Array</li> <li>▪ Explain Rows, Columns ad Distance, Center point, number, angle and rotation</li> </ul>	0.25	0.25	0.50
7	Modify object using Break command	<ul style="list-style-type: none"> <li>▪ Define break line</li> <li>▪ Break the selected object between two points</li> </ul>	0.25	0.25	0.50
8	Modify object using Explode command	<ul style="list-style-type: none"> <li>▪ Define explode</li> <li>▪ Break a compounded object into its component object</li> </ul>	0.25	0.25	0.50

9	Modify object using Trim command	<ul style="list-style-type: none"> <li>▪ Define Cutting edge</li> <li>▪ Explain the options available for trimming object (project, edge, undo)</li> </ul>	0.25	0.25	0.50
10	Modify object using Extend command	<ul style="list-style-type: none"> <li>▪ Define Boundary edge</li> <li>▪ State the procedure for modifying object using Extend command.</li> </ul>	0.25	0.25	0.50
11	Modify object using Fillet command	<ul style="list-style-type: none"> <li>▪ Differentiate Chamfer and Fillet.</li> <li>▪ Explain the options available for filleting object i.e. fillet radius</li> <li>▪</li> </ul>	0.25	0.25	0.50
12	Modify object using chamfer command	Explain the options available for chamfering object i.e. Distance, angle	0.25	0.25	0.50
<b>Unit: 4 Annotate a drawing with Text, layer, lock, Hatching and Dimensioning</b>					
1	Create a Layer	<ul style="list-style-type: none"> <li>▪ Define Layer.</li> <li>▪ Explain different attributes and properties of a Layer (Line type, line weight, Global Scale Factor, Current Object Scale, Names, Of/Off, Freeze/Thaw, Lock/unlock, Color, Plot style, Plot/don't plot)</li> <li>▪ Explain the procedure for creating a layer.</li> </ul>	0.25	0.25	0.50
2	Create text and text styles.	<ul style="list-style-type: none"> <li>▪ Differentiate Single line text [TEXT] and Multiline Text [MTEXT]</li> <li>▪ Explain Style name, Font Name, Style and Height</li> <li>▪ Describe Font effect, Width factor and Oblique angle</li> <li>▪ Explain the procedure for creating text styles.</li> </ul>	0.25	0.25	0.50
3	Edit text	<ul style="list-style-type: none"> <li>▪ Multiline Text Editor <ul style="list-style-type: none"> <li>• Character</li> <li>• Properties</li> <li>• Line spacing</li> <li>• Find/replace, import text</li> </ul> </li> </ul> Layer and symbol	0.25	0.25	0.50
4	Hatch the sectional area	<ul style="list-style-type: none"> <li>▪ Define hatching.</li> <li>▪ Differentiate ISO Hatch Pattern, User Defined Hatch Pattern, Pre-Defined Hatch and Associative Hatch</li> <li>▪ Explain Boundary set, copying</li> </ul>	0.25	0.25	0.50

		of hatch properties, pick point, hatch angle, scale, pattern, and object selection. <ul style="list-style-type: none"> <li>▪ modify the hatched pattern</li> </ul>			
5	Create Block	<ul style="list-style-type: none"> <li>▪ Definition</li> <li>▪ Name</li> <li>▪ Pick point</li> <li>▪ selection</li> </ul>	0.25	0.25	0.50
6	Add dimensions to a drawing	<ul style="list-style-type: none"> <li>▪ Interpret dimension elements (dimension text, lines and arrowheads, leader, extension lines, units, tolerance and center marks)</li> <li>▪ Describe dimension types (linear, aligned, ordinate, radius, diameter, angular, baseline and continue)</li> <li>▪ Dimension dialog box <ul style="list-style-type: none"> <li>▪ Lines and arrow</li> <li>▪ Dimension and text</li> <li>▪ Fit</li> <li>▪ Unit</li> <li>▪ Tolerances</li> </ul> </li> <li>▪ Modify Dimension style</li> <li>▪ Dimension in isometric drawing</li> </ul>	0.25	0.50	0.75
<b>Unit: 5 Create output</b>					
1	Configure Plotters/Printers	<ul style="list-style-type: none"> <li>▪ Define Plotter Manager</li> <li>▪ Explain Plot Style Manager</li> <li>▪ State the Printer/Plotter Installation process</li> </ul>	0.25	0.25	0.50
2	Plot drawing	<ul style="list-style-type: none"> <li>▪ Explain paper size and paper units, drawing orientation, plot area and plot scale, plot offset.</li> <li>▪ Describe the procedure for printing a drawing.</li> </ul>	0.25	0.25	0.50
<b>Unit: 6 Project works</b>					
1	Prepare following drawings (e-copy and hard copy both) using CAD software. <ul style="list-style-type: none"> <li>• Draw an Isometric/ Oblique drawing</li> <li>• Draw Orthographic drawing</li> <li>• Draw an assembly drawing</li> <li>• Draw Orthographic drawing</li> <li>• Draw Workshop drawing</li> <li>• Give dimension(Orthographic, Isometric)</li> </ul>		0.5	<b>7.0</b>	7.0
<b>Total</b>			<b>8.25</b>	<b>15.75</b>	<b>24</b>
<b>Grand Total Hours</b>			<b>45.25</b>	<b>110.75</b>	<b>156</b>

**References Books:**

<b>S. N.</b>	<b>Name</b>	<b>Author</b>	<b>Publications</b>
1	Fundamental of Engineering Drawing for Polytechnics	Er. R. K. Dhawan	S. Chand & Company Ltd.
2	Engineering Drawing + AutoCAD	K. Venugopal V. Prabhu Raja	New Age International (P) Ltd.
3	A Textbook of Machine Drawing (First Angle Projection)	Er. R. K. Dhawan	S. Chand & Company Ltd.
4	Engineering Drawing (Geometrical Drawing)	P. S. Gill	S. K. Kataria & sons
5	Engineering Drawing-Plane & solid geometry	N. D. Bhatta	Charotar Publishing House (P) Ltd.

## Structural Fabrication

**Course Nature: Practical**  
**Full marks: 50**

**Class per Week: 1 hr.**  
**Total Class: 78 hrs.**

<b>Subject 7: Structural Fabrication</b>	
<b>Description:</b>	This course intends to impart the knowledge and skills required for steel structural, sheet metal and aluminum fabricator. This course is mainly focus on marking, cutting, bending, rolling, forging, twisting, soldering, gas cutting and painting related on steel fabrication.
<b>Objectives:</b>	<p>At the end of the course the participants will be able to:</p> <ul style="list-style-type: none"> <li>• Fabricate steel &amp; aluminum product.</li> <li>• Produce assembly structure.</li> <li>• Paint steel products.</li> <li>• Operate power hacksaw, shearing, bending, rolling, grinding and welding machines.</li> <li>• Perform forming and sheet metal work.</li> </ul>

S.N.	Skill/Tasks	Contents/Topics	Time (hrs.)		
			Th./Demo.	Pr.	Total
<b>1. Perform steel fabrication and forming</b>					
1.1	Perform sawing on a power hacksaw	<ul style="list-style-type: none"> <li>▪ Define power hacksaw</li> <li>▪ Select the correct blade for different jobs</li> <li>▪ State the work-holding and supporting devices</li> <li>▪ Name the parts of a power hacksaw</li> <li>▪ Mount and install a blade</li> <li>▪ Power hacksaw safety</li> <li>▪ Procedures</li> <li>▪ Demonstration</li> <li>▪ Exercises</li> </ul>	1	2	3
1.2	Perform shearing	<ul style="list-style-type: none"> <li>▪ Define shearing</li> <li>▪ Operation of shearing</li> <li>▪ Shearing process</li> <li>▪ Demonstration</li> <li>▪ Exercises</li> </ul>	1	1	2
1.3	Perform off-hand grinding	<ul style="list-style-type: none"> <li>▪ Define off-hand grinding</li> <li>▪ Purpose of off-hand grinding</li> <li>▪ Types of grinding machines</li> <li>▪ Safety in grinding</li> <li>▪ Procedure</li> <li>▪ Demonstration</li> <li>▪ Exercises</li> </ul>	1	1	2
1.4	Perform riveting joint	<ul style="list-style-type: none"> <li>• Define rivet and riveting</li> <li>• Types and uses of rivets</li> <li>• Rivet properties</li> <li>• Types of riveted joints</li> <li>• Tools for hand riveting</li> <li>• Defects in rivet joints</li> </ul>	1	2	3

		<ul style="list-style-type: none"> <li>• Procedures</li> <li>• Safety precautions</li> <li>▪ Demonstration</li> <li>• Exercises</li> </ul>			
1.5	<p>Prepare jigs and fixture</p> <p>Job I - Prepare a bending fixture.</p> <p>Job II - Prepare a welding jig.</p>	<ul style="list-style-type: none"> <li>• Define Jigs and fixture</li> <li>• Difference between Jigs and fixture</li> <li>• Advantages of using Jigs and fixture</li> <li>• Types</li> <li>• Exercises on above Jigs and fixture</li> </ul>	1	6	7
1.6	<p>Perform bending</p> <ul style="list-style-type: none"> <li>▪ Bend a pipe by a bending machine</li> <li>▪ Bend a pipe by heating</li> </ul>	<ul style="list-style-type: none"> <li>▪ Define bending</li> <li>▪ Method of bending</li> <li>▪ Types of Bending machine</li> <li>▪ Tools &amp; equipment</li> <li>▪ Defects in bending</li> <li>▪ Procedure</li> <li>▪ Demonstration</li> <li>▪ Exercises</li> </ul>	1	2	3
1.7	Perform rolling	<ul style="list-style-type: none"> <li>• Define rolling</li> <li>• Principle and mechanism of rolling process</li> <li>• Typical rolling shapes</li> <li>• Types of rolling mills</li> <li>• Defects in rolling</li> <li>▪ Demonstration</li> <li>• Exercises</li> </ul>	1	2	3
1.8	Perform black smithy and forging	<ul style="list-style-type: none"> <li>▪ Define forging</li> <li>▪ Types of forging</li> <li>▪ Tools</li> <li>▪ Forging operation</li> <li>▪ Defects in forging</li> <li>▪ Demonstration</li> <li>▪ Exercises</li> </ul>	1	2	3
1.9	Perform twisting	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Procedure</li> <li>▪ Exercises</li> </ul>	0.5	0.5	1
1.10	Perform cuts the material by oxy fuel gas cutting	<ul style="list-style-type: none"> <li>▪ The oxidation principle</li> <li>▪ Cuttability of metal</li> <li>▪ Types of cutting process</li> <li>▪ Gases used</li> <li>▪ Gas cutting installation</li> <li>▪ The cutting torch and cutting tip</li> <li>▪ Defect in gas cut edges</li> <li>▪ Tools &amp; equipment</li> <li>▪ Safety</li> <li>▪ Cutting Procedure</li> <li>▪ Gas cutting machine</li> <li>▪ Demonstration</li> <li>▪ Exercises</li> </ul>	1.5	2.5	4
1.11	Fabricate a simple	<ul style="list-style-type: none"> <li>▪ Introduction</li> </ul>	0.5	3.5	4

	windows grill	<ul style="list-style-type: none"> <li>▪ Purpose</li> <li>▪ Safety</li> <li>▪ Tools &amp; equipment</li> <li>▪ Clamping device</li> <li>▪ Procedure</li> <li>▪ Material</li> <li>▪ Exercises</li> </ul>			
<b>2. Perform Painting</b>					
2.1	Perform enamel coating by brush painting	<ul style="list-style-type: none"> <li>▪ Define surface finishing</li> <li>▪ Surface finishing process</li> <li>▪ Introduction of paint</li> <li>▪ Types of paint</li> <li>▪ Painting procedure</li> <li>▪ Exercises</li> </ul>	1	1	2
2.2	Perform spray painting	<ul style="list-style-type: none"> <li>▪ Safety</li> <li>▪ Types of compressor machine</li> <li>▪ Tools &amp; equipment</li> <li>▪ Clamping device</li> <li>▪ Procedure</li> <li>▪ Types of emery paper</li> <li>▪ Processes</li> <li>▪ Exercises</li> </ul>	0.5	1.5	2.0
<b>Total</b>			<b>12</b>	<b>27</b>	<b>39</b>
<b>3. Sheet Metal Works</b>					
3.1	Introduce sheet metal works	<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Sheet metal related hand tools and materials</li> <li>▪ Metals used in sheet metal work</li> <li>▪ Safety precaution</li> <li>▪ Demonstration</li> </ul>	1.5	0	1.5
3.2	Cut metal sheet in straight and curve shape by snip	<ul style="list-style-type: none"> <li>• Common sheet metal operations</li> <li>• Tools and materials</li> <li>• Straight snip</li> <li>• Curve snip</li> <li>• Application</li> <li>• Procedure</li> <li>• Safety precautions</li> <li>• Demonstration</li> <li>• Exercises</li> </ul>	0.5	1	1.5
3.3	Fold metal sheet by hand tools	<ul style="list-style-type: none"> <li>• Tools and materials</li> <li>• Mallet</li> <li>• Stack</li> <li>• Procedure</li> <li>• Safety precaution</li> <li>• Demonstration</li> <li>• Exercises</li> </ul>	0.5	1	1.5
3.4	Roll metal sheet by hand tools	<ul style="list-style-type: none"> <li>• Tools and materials</li> <li>• Procedure</li> <li>• Safety precautions</li> <li>• Demonstration</li> </ul>	0.5	1	1.5

		<ul style="list-style-type: none"> <li>Exercises</li> </ul>			
3.5	Fold metal sheet by folding machine	<ul style="list-style-type: none"> <li>Tools and materials</li> <li>Folding machine</li> <li>Procedure</li> <li>Safety precautions</li> <li>Demonstration</li> <li>Exercises</li> </ul>	1	1	2
3.6	Perform seam joint	<ul style="list-style-type: none"> <li>Introduction</li> <li>Types of seam joint</li> <li>Tools/equipment</li> <li>Margin calculation</li> <li>Procedure</li> <li>Safety</li> <li>Demonstration</li> <li>Exercises</li> </ul>	1	1	2
3.7	Develop pattern of rectangular/square box, cylindrical container and cone	<ul style="list-style-type: none"> <li>Introduction of pattern development</li> <li>Develop pattern of any one of the following project</li> <li>Demonstration</li> <li>Exercises</li> </ul>	1	5	6
3.8	Perform Project works Job I - Make a shop case box. Job II - Make a dust pan. Job III - Make a right Cylinder. Job IV - Make a right cone. Job V - Make a 90 degree elbow. Job VI - Exercises on soldering & riveting.	<ul style="list-style-type: none"> <li>Obtain the drawing as Instructor's instructions</li> <li>Read and understand given drawing</li> <li>Obtain tools, equipments and materials from the tools room</li> <li>Layout/Mark the work pieces as per given drawing</li> <li>Select &amp; use appropriate tools, equipments and machines</li> <li>Cut the raw materials</li> <li>Assemble the work pieces and check it</li> <li>Correction the wrong work pieces if necessary</li> <li>Follow all the necessary safety rules and regulations</li> <li>Exercises on above project works</li> </ul>	1	10	11
<b>4. Perform aluminum fabrication</b>					
4.1	Introduce aluminum fabrication	<ul style="list-style-type: none"> <li>Introduction</li> <li>Tools/equipments</li> <li>Safety precautions</li> </ul>	1	0	1
4.2	Cut work pieces in straight and angle by abrasive m/c.	<ul style="list-style-type: none"> <li>Tools and materials</li> <li>Application</li> <li>Procedure</li> <li>Safety precautions</li> </ul>	0.5	0.5	1
4.3	Prepare and set of work pieces	<ul style="list-style-type: none"> <li>Tools and materials</li> <li>Application</li> <li>Procedure</li> </ul>	0.5	3.5	4



		<ul style="list-style-type: none"> <li>• Safety precautions</li> </ul>			
4.4	Sketch doors, partition and windows	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Uses</li> <li>• Process</li> </ul>	0.5	1.5	2
4.5	Perform fabrication of doors, partition and windows	<ul style="list-style-type: none"> <li>• Tools and materials</li> <li>• Application</li> <li>• Procedure</li> <li>• Safety precautions</li> </ul>	0.5	3.5	4
<b>Total</b>			<b>10</b>	<b>29</b>	<b>39</b>
<b>Grand Total</b>			<b>22</b>	<b>56</b>	<b>78</b>

**Reference Books:**

- Machinist - 1<sup>st</sup> & 2<sup>nd</sup> year - G. S. Sethi & Balbir Singh
- Engineering Drawing - K. Venugaopal & V. Prabhu Raja
- Work Shop Technology (Volume I & II) – Hajra & Chaudhary
- Westermann Table book Metal

## Material Science

**Course Nature: Theory**  
**Full marks: 50**

**Class/week: 1 hr.**  
**Total: 78 hrs.**

<b>Subject 8: Material Science</b>	
<b>Description:</b>	This subject provides to equip selected general SLC graduates with their introductory knowledge about materials. It also describes the knowledge for classification, heat treatment, mechanical test, metal, non metal, ferrous, non-ferrous and Abrasive & bonds.
<b>Objectives:</b>	<p><b>At the end of the course the participants will be able to:</b></p> <ul style="list-style-type: none"> <li>• Know the history &amp; properties of the materials.</li> <li>• Differentiate between metal &amp; non metal, ferrous &amp; non ferrous metal and metal &amp; non metal.</li> <li>• Explain the heat treatment process.</li> <li>• Understand about the mechanical tests.</li> <li>• Know the corrosion &amp; its preventions.</li> <li>• Classify the metal &amp; non metal.</li> <li>• Define abrasive &amp; bonds with its applications.</li> </ul>

Unit/sub unit	Topics	Time (hrs.)
<b>1</b>	<b>Introduction to Material Science</b>	<b>4</b>
1.1	Introduction & history of material science	
1.2	Elements and Its General properties (Symbol, Specific weight, Melting Temperature Tensile strength)	
<b>2</b>	<b>Classification of Materials</b>	<b>4</b>
2.1	According to state, Metal and non-metal	
2.2	Differentiate metal and non metal	
2.3	Differentiate ferrous and non ferrous metals	
<b>3</b>	<b>Ferrous Metal</b>	
<b>3.1</b>	<b>Iron and steel</b>	<b>8</b>
3.1.1	Mining & Iron ore	
3.1.2	Define & differentiate Iron and Steel	
3.1.3	Production of iron (blast furnace)	
3.1.4	Production of steel (open hearth, convertor, electric furnace and duplex process)	
<b>3.2</b>	<b>Carbon steel</b>	<b>6</b>
3.2.1	Define carbon steel	
3.2.2	Classification of carbon steel with their definition, properties and application	
3.2.3	Effect of carbon and other minor elements on steel	
3.2.4	Specification of steels according to code and classification(AISI/SAE/ISI specification)	
<b>3.3</b>	<b>Alloy steel</b>	<b>6</b>
3.3.1	Definition of alloy steel	
3.3.2	Classification of alloy steel	
3.3.3	Effect of alloying elements in steel	
3.3.4	Properties and uses of common alloy steels (Stain less Steel, High Speed Steel, Tool Steels, Spring Steels, Structural Steels)	
<b>3.4</b>	<b>Cast Iron</b>	<b>6</b>
3.4.1	Introduction and definition	
3.4.2	Types, properties and uses of cast iron (Gray, white & Malleable & alloy cast iron)	
3.4.3	Alloying elements in cast iron	

<b>4</b>	<b>Non Ferrous Metals</b>	
4.1	Aluminum Introduction and its properties & Applications	8
4.2	Aluminum alloys its properties & Applications	
4.3	Copper Introduction and its properties & Applications	
4.4	Copper alloys its properties & Applications	
4.5	Lead Introduction and its properties & Applications	
4.6	Lead alloys its properties & Applications	
4.7	Zinc Introduction and its properties & Applications	
4.8	Zinc alloys its properties & Applications	
4.9	Nickel Introduction and its properties/application	
4.10	Tungsten Introduction and its properties & Applications	
4.11	Powder metallurgy Introduction and process	
<b>5</b>	<b>Heat Treatment of Steel</b>	
5.1	Introduction, definition & objectives	8
5.2	Describe Iron Carbon Phase Diagram	
5.3	Structures of Steel	
5.4	Heat treatment process	
5.5	Annealing	
5.6	Normalizing	
5.7	Hardening	
5.8	Tempering	
5.9	Case/surface hardening(Carburizing process)	
<b>6</b>	<b>Mechanical Tests</b>	
6.1	Definition and types of mechanical test	8
6.2	Definition and types of Destructive tests	
6.3	Compression test	
6.4	Tensile Test	
6.5	Fatigue	
6.6	Bend Test	
6.7	Hardness testing	
6.8	Impact test	
6.9	Definition and types of Non destructive tests	
6.10	Visual examination	
6.11	Magnetic particle test	
6.12	X-ray test	
6.13	Radiographic test	
6.14	Ultra sonic test	
6.15	Dye penetrate test	
<b>7</b>	<b>Corrosion</b>	
7.1	Introduction of corrosion	6
7.2	Specific types of corrosion	
7.3	Atmospheric corrosion	
7.4	Underground corrosion	
7.5	Microbiological corrosion	
7.6	Uniform corrosion	
7.7	Crevice corrosion	
7.8	Stress corrosion	
7.9	Control and prevention of corrosion Metal and alloys, Cathode precaution,	
<b>8</b>	<b>Non Metals</b>	
8.1	Introduction to Non metals	
8.2	Polymers: properties, classification and uses	
8.3	Plastics: properties, classification and uses	

8.4	Rubber: properties, classification and uses	<b>8</b>
8.5	Ceramics: properties, classification and uses	
8.6	Composite materials: properties, classification and uses	
8.7	Glass: properties, classification and uses	
<b>9</b>	<b>Abrasives &amp; Bonds</b>	<b>6</b>
9.1	Define & application of abrasive	
9.2	Types of abrasive (Natural & artificial abrasive)	
9.3	Aluminum oxide	
9.4	Silicon carbide	
9.5	Diamond	
9.6	Define bonds	
9.7	Rubber and Shellac bond	
9.8	Vitrified and silicate bond	
9.9	Resionioide bond	
<b>Total</b>		<b>78</b>

**BIBLIOGRAPHY:**

S.N.	Name	Author	Publication
1	Technology of the metal trade,	Appold, Feiler, Reinhard, Schmidt,	Deutsche Gesellschaft fur Technische Zusammenarbeit (GTZ) GmbH
2	Callister's Material Science and Engineering	Adapted by R. Balsubramaiyam, Rajendra Sing	New Age International Publishers
3	Manufacturing process	Vikas Upadhyay & Vikas Agrawal	S.K. Kataria & Sons

## Trade Technology

Course Nature: Theory  
Full Marks: 100

Class per Week: 2 hrs.  
Total Time: 156 hrs.

<b>Subject 9: Trade Technology</b>	
<b>Description:</b>	This subject provides to equip selected general SLC graduates with Trade Technology knowledge required for performing measuring instruments, drilling, lathe, shaper/planer, grinding, sawing, shearing & milling machines along with the their uses, parts, operation, care & safety in the mechanical engineering sector.
<b>Objectives:</b>	<p><b>At the end of the course the participants will be able to:</b></p> <ul style="list-style-type: none"> <li>▪ Understand &amp; apply safety rules in the workshop.</li> <li>▪ Identify the cutting tools, measuring instruments, machines &amp; equipments.</li> <li>▪ Use cutting tools, measuring instruments, equipments &amp; machines.</li> <li>▪ Hold the instruments &amp; tools for the marking, measuring &amp; cutting the metal in the shape.</li> <li>▪ Know the basic operation related to lathe, drill, cut, grind, shape, mill according to the specification.</li> <li>▪ Operate Lathe, Drills, Shaper, Planer, Grinder, Power hacksaw, Shearing &amp; Milling machines.</li> <li>▪ Describe the advantages &amp; disadvantages of the devices &amp; its functions.</li> <li>▪ Differentiate between coolants &amp; lubricants, shaper &amp; planer, external &amp; internal threads, nuts &amp; bolts.</li> <li>▪ Calculate the feed, rpm &amp; cutting speed of the lathe &amp; drills machines.</li> </ul>

Unit	Areas and Topics	Total (hrs.)
<b>1</b>	<b>Measuring Instruments</b>	<b>2</b>
1.1	Introduction	
1.1.2	Types of scale and rule	
<b>1.2</b>	<b>Calipers</b>	
1.2.1	Introduction	
1.2.2	Types of Calipers( Odd leg, inside & Outside)	
<b>1.3</b>	<b>Vernier Calipers</b>	<b>2</b>
1.3.1	Introduction	
1.3.2	Safety precautions	
1.3.3	Main parts	
1.3.4	Least Count	
<b>1.4</b>	<b>Dial Calipers</b>	<b>1</b>
<b>1.5</b>	<b>Gauges</b>	<b>2</b>
1.5.1	Introduction	
1.5.2	Types and Use of (feeler gauge, radius gauge, Pitch gauge wire gauge and height gauge ) limit and Adjustable	
<b>1.6</b>	<b>Introduce angle measuring instruments</b>	<b>1</b>
1.6.1	Introduction	
1.6.2	Types and Use of (Adjustable bevel, protractor, Try square, Combination set)	
<b>2</b>	<b>Drills and Drilling</b>	<b>4</b>
2.1	Introduction	
2.2	Safety precautions	
2.3	Drills and Drilling	

2.4	Types of drills	
2.5	Elements of twisted drill	
2.6	Drill chucks, Keys and Drift	
2.7	Drill Sleeves and Sockets	
<b>2.8</b>	<b>Drilling machines</b>	<b>8</b>
2.8.1	Types of drilling machines	
2.8.2	Main parts of drilling machines	
2.8.3	Cutting speed, feed and RPM, Calculation	
2.8.4	Drilling operations	
<b>2.9</b>	<b>Work holding devices</b>	<b>4</b>
2.9.1	T-bolt and Clamps	
2.9.2	Drill press vice	
2.9.3	Step block	
2.9.4	V-block	
2.9.5	Angle plate	
2.9.6	Drill jigs	
<b>3</b>	<b>Lathe Machine</b>	<b>4</b>
3.1	Lathe machine( Working principles and main parts)	
3.2	Safety precautions	
<b>3.3</b>	<b>Types of machine</b>	<b>7</b>
3.3.1	Introduction of Engine Lathe	
3.3.2	Introduction of Capstan & Turret Lathe	
3.3.3	Introduction of Speed Lathe	
3.3.4	Introduction of Bench Lathe	
3.3.5	Introduction of Vertical Lathe	
3.3.6	Introduction of copy Lathe	
3.3.7	Introduction of Special purpose Lathe	
3.3.8	Introduction of NC/CNC lathe machine.	
<b>3.4</b>	<b>Sizes of machine</b>	<b>1</b>
<b>3.5</b>	<b>Parts and function of machine</b>	<b>3</b>
3.5.1	Head Stock	
3.5.2	Tail stock	
3.5.3	Carriage	
3.5.4	Bed	
3.5.5	Feed gear box	
3.5.6	Main spindle	
3.5.7	Tool post	
3.5.8	Elements of Tool post	
<b>3.6</b>	<b>Accessories of machine</b>	<b>7</b>
3.6.1	Work holding devices	
3.6.2	Chucks : 3 Jaws and 4 Jaws ( Self centering & independent)	
3.6.3	Different between 3 jaws & 4 jaws chuck	
3.6.4	Face plate	
3.6.5	Dog plate	
3.6.6	Mandrels ,types of mandrels	
3.6.7	Sleeves adaptors	
3.6.8	Centers ,Types of centers and their Uses	
3.6.9	Steady Rest , follower & fixed steady rest	
<b>3.7</b>	<b>Types of Tool</b>	<b>5</b>
3.7.1	Left hand and Right hand	
3.7.2	Solid and Tipped	
3.7.3	Form tool	

3.7.4	Thread Cutting	
3.7.5	Parting off / Grooving	
3.7.6	Knurling tool	
3.7.7	Boring tool	
<b>3.9</b>	<b>Lathe operation</b>	<b>6</b>
3.8.1	Facing	
3.8.2	Turning , Plain turning	
3.8.3	Step Turning	
3.8.4	Centre Drilling	
3.8.5	Drilling	
3.8.6	Boring / Counter boring	
3.8.7	Chamfering	
3.8.8	Grooving	
3.8.9	Thread Cutting	
3.8.10	Knurling , Types of knurling	
3.8.11	Centre to centre turning	
3.8.12	Parting off	
3.8.13	Eccentric turning	
3.8.14	Shoulders	
<b>3.9</b>	<b>Taper Turning</b>	<b>6</b>
3.9.1	Introduction	
3.9.2	Types of taper turning	
3.9.3	Uses	
3.9.4	Advantages and dis- advantages	
3.9.4	Calculation ( compound slide and Tail stock off set)	
3.9.5	Cutting speed, feed and RPM, Calculation	
<b>4</b>	<b>Metal cutting saw</b>	<b>2</b>
4.1	Introduction	
4.2	Safety precautions	
<b>4.3</b>	<b>Power hacksaw</b>	<b>2</b>
4.3.1	Introduction	
4.3.2	Main parts	
<b>4.4</b>	<b>Horizontal band saw</b>	<b>1</b>
<b>4.5</b>	<b>Circular saw</b>	<b>1</b>
<b>4.6</b>	<b>Abrasive cut off machine</b>	<b>1</b>
<b>4.7</b>	<b>Power hacksaw blades</b>	<b>1</b>
4.7.1	Specification of power hacksaw blade	
4.7.2	Blade clearance	
4.7.3	Clamping arrangement	
4.7.4	Fixing the blade	
<b>5</b>	<b>Fasteners</b>	<b>2</b>
5.1	Introduction	
5.2	Types of fasteners	
5.3	uses	
<b>5.4</b>	<b>Bolts and nuts</b>	<b>2</b>
5.4.1	Introduction	
5.4.2	Types of nuts and uses	
5.4.3	Fitted bolts	
5.3.4	Self-locking devices	
5.3.5	Materials of manufacture and strength	
<b>5.5</b>	<b>Studs</b>	<b>1</b>

5.5.1	Introduction	
5.5.2	Uses	
<b>5.6</b>	<b>Washers</b>	<b>1</b>
5.6.1	Introduction	
5.6.2	Types of washers and uses	
<b>5.7</b>	<b>Locking devices</b>	<b>2</b>
5.7.1	Split pin	
5.7.2	Lock nut	
5.7.3	Wire locking nut	
5.7.4	Lock plate	
5.7.5	Tab washer	
5.7.6	Spring washer	
5.7.7	Serrated Washer	
<b>5.8</b>	<b>Keys</b>	<b>3</b>
5.8.1	Introduction	
5.8.2	Types of keys	
5.8.3	Hollow key	
5.8.4	Flat saddle key	
5.8.5	Circular taper key	
5.8.6	Sunk key	
5.8.7	Gib -head key	
5.8.8	Feather key	
5.8.9	Woodruff key	
<b>6</b>	<b>Shear and Shearing</b>	<b>4</b>
6.1	Introduction	
6.2	Types	
6.3	Uses of shearing tools ( hand and press)	
6.4	Different processes involved in shearing	
6.5	Safety rules	
6.6	Care of the tool	
<b>7</b>	<b>Lubrication and Coolant</b>	<b>3</b>
7.1	Introduction	
7.2	Characteristic of Lubricants	
7.3	Types and Application	
7.4	Characteristic of Coolants	
7.5	Types and Application	
7.6	Advantages of cutting fluid	
<b>8</b>	<b>Cutting Tool Geometry</b>	<b>3</b>
8.1	Introduction	
8.2	Angles of cutting tool	
8.3	Effects of angles on cutting tool	
8.4	Cutting Tool material	
8.5	Recommended angles for cutting different materials	
<b>9</b>	<b>Precision Instrument</b>	<b>6</b>
9.1	Introduction	
9.2	Dial test Indicator and uses	
9.3	Slip gauge	
9.4	Ring gauge and plug gauge	
9.5	Telescopic gauge and Vernier height gauge	
9.6	Micrometer	
<b>10</b>	<b>Shaper machine</b>	<b>8</b>
10.1	Introduction and Safety	



10.2	Types of machine	
10.3	Parts and their function	
10.3.1	Ram	
10.3.2	Column	
10.3.3	Tool Post	
10.3.4	Clapper box	
10.3.5	Table	
10.3.6	Base	
10.4	Stroke adjustment /feed mechanism	
10.5	Quick return mechanism	
10.6	Work holding devices	
10.6.1	Machine Vice	
10.6.2	Shaping tool	
10.6.3	Roughing tool	
10.6.4	Corner tool	
10.7	Shaper Operation	
10.7.1	Plain Shaping	
10.7.2	Groove Shaping	
10.7.3	Angular Shaping	
<b>11</b>	<b>Milling Machine</b>	<b>15</b>
11.1	Introduction	
11.1.1	Introduction milling machine ( Conventional)	
11.2	Machine safety	
11.3	Types of machine	
11.3.1	Column and knee type	
11.3.2	Horizontal, Vertical, Universal	
11.4	Main parts and their function of the machine	
11.4.1	Over Arm	
11.4.2	Column	
11.4.3	Table	
11.4.4	Knee	
11.4.5	Saddle	
11.4.6	Base	
11.4.7	Elevating Shaft	
11.5	Milling Accessories	
11.5.1	Work holding devices	
11.5.1.1	Machine Vice	
11.5.1.2	T-bolts and Clamp	
11.5.1.3	V-blocks	
11.5.1.4	Angle Plate	
11.5.2	Cutter mounting devices	
11.5.2.1	Short arbor, Stub arbor	
11.5.2.2	Long arbor	
11.5.2.3	Adopter/ Sleeve	
11.5.3.4	Collects	
11.6	Milling Attachments	
11.6.1	Vertical Head	
11.6.2	Slotting Head	
11.6.3	Rotary Head	
11.6.4	Indexing Head and its types	
11.6.5	Indexing methods	
11.7	Cutting speed ,feed and depth of cut	

11.8	Milling Fundamentals	
11.8.1	Up milling and down milling	
11.8.2	Face and Peripheral milling-methods & operation	
11.9	Milling cutters and operations	
11.9.1	Shank type cutter	
11.9.2	Bore type cutter	
11.9.3	Fly cutter	
11.10	Milling Operations	
11.10.1	Plain milling by shell end/ Plain milling cutter	
11.10.2	Step milling by end mill/ Shell end	
11.10.3	Slot milling by end mill/ key way / T-slot	
11.10.4	Angular milling by single and double angular milling cutter	
11.10.5	Key way cutting by key way cutter	
11.11	Gear milling and gear cutter (Gear wheel dimension)	
11.12	Indexing calculation	
<b>12</b>	<b>Planning machines</b>	<b>7</b>
12.1	Introduction and working principle	
12.2	Classification of planer machines	
12.3	Planer mechanism	
12.4	planer operation	
12.5	Cutting speed ,feed and depth of cut	
<b>13</b>	<b>Grinding</b>	<b>4</b>
13.1	Introduction and Safety	
13.2	Types of grinding	
13.3	Emery sheet/paper	
13.4	Oil stone	
13.5	Hand surface grinder	
13.6	Cutting off grinder	
13.7	Pedestal / Bench grinder	
<b>14</b>	<b>Threads</b>	<b>6</b>
14.1	Introduction and size	
14.2	Types of threads	
14.3	Uses and application	
14.4	Terminology	
14.5	Producing of thread	
14.6	Calculations	
<b>15</b>	<b>Gear</b>	<b>6</b>
15.1	Introduction	
15.2	Terminology	
15.3	Types of gear and uses	
15.4	Dimension and materials	
15.5	Advantages and dis-advantages	
<b>16</b>	<b>Drives</b>	<b>5</b>
16.1	Introduction	
16.2	Types of drives	
16.3	Belt drive, Rope drive, Chain drive, Gear drive, Couplings & Clutches	
16.4	Advantages and dis-advantages	
16.5	Uses and calculation	
<b>17</b>	<b>Machine Elements</b>	<b>7</b>
17.1	Introduction of shaft and axle	
17.2	Application of shaft and axle	

17.3	Shaft and axle repair	
17.4	Introduction of pulleys	
17.5	Application of pulleys	
17.6	Introduction of bearing, pins and keys	
17.7	Types of bearing ,pins and keys	
<b>Total hours</b>		<b>156</b>

**Reference Books:**

- B.S. Raghuwanshi, A Course in Workshop Technology (Vol. I, II and III, Dhanpat Rai and Co.
- S.k. Hajra Chaudhary, Workshop Technology (Vol. I, II) Media promoters
- Henp Fort, Shop Theory (Vol. I, II and III). Trade school
- W.A.J. Chapman, Workshop Technology (Vol. I, II and III), Elsevier Science
- Heinrich Gerling, Elementary Metal Course Training Section 1
- ETHIO, Arbeitsstelle fur Unterricht and Technik, GERMAN Technical Institute, Holetta
- Heinrich Gerling, All about MACHINE TOOLS.NEW, Wiley Eastern Ltd India, 1965
- R.S. Khurmi /J.K. Gupta. A Textbook of Workshop Technology, Manufacturing processes
- Dhanpat Rai & CO.A Course in workshop Technology, (Vol. I & II) ,Educational and Technical publishers.

## Entrepreneurship Development

**Course Nature: Theory**  
**Full Marks: 50**

**Class/week: 1**  
**Total: 78 hrs.**

### Description:

This course is designed to impart the knowledge and skills on formulating business plan and managing small business in general. This course intends to deal with exploring, acquiring and developing enterprising competencies, identification of suitable business idea and developing of business plan.

### Course objectives

After completion of this course students will be able to:

1. Define business and entrepreneurship.
2. Explore entrepreneurial competencies.
3. Analyze business ideas and viability.
4. Formulate business plan.
5. Learn to manage small business.

S.N.	Skills	Contents	Time (hrs)		
			Th.	Pr.	Total
<b>Unit 1: Introduction to Entrepreneurship</b>					
1	Introduce business	Introduction of business: <ul style="list-style-type: none"> <li>• Definition of business/enterprise</li> <li>• Types of business</li> <li>• Classification of business</li> <li>• Overview of MSMEs(Micro, Small and Medium Enterprises) in Nepal</li> </ul>	1.5	0	1.5
2	Define entrepreneur/entrepreneurship	<u>Definition of entrepreneur:</u> <ul style="list-style-type: none"> <li>• Definition of entrepreneur</li> <li>• Definition of entrepreneurship</li> <li>• Entrepreneurship development process</li> </ul>	1.0	0	1.0
3	Describe entrepreneur's characteristics	<u>Entrepreneur's characteristics:</u> <ul style="list-style-type: none"> <li>• Characteristics of entrepreneurs</li> <li>• Nature of entrepreneurs</li> </ul>	1.5	0	1.5
4	Assess entrepreneur's characteristics	<u>Assessment of entrepreneur's characteristics:</u> <ul style="list-style-type: none"> <li>• List of human characteristics</li> <li>• Assessment of entrepreneurial characteristics</li> </ul>	1.5	0	1.5
5	Compare entrepreneur with other occupations	<u>Entrepreneur and other occupations:</u> <ul style="list-style-type: none"> <li>• Comparison of entrepreneur with other occupations</li> </ul>	1.0	0	1.0

		<ul style="list-style-type: none"> <li>Types and styles of entrepreneurs</li> </ul>			
6	Differentiate between entrepreneur and employee	<b><u>Entrepreneur and employee:</u></b> <ul style="list-style-type: none"> <li>Difference between entrepreneur and employee</li> <li>Benefit of doing own business</li> </ul>	1.0	0	1.0
7	Assess “Self”	<b><u>“Self” assessment:</u></b> <ul style="list-style-type: none"> <li>Understanding “self”</li> <li>Self disclosure and feedback taking</li> </ul>	0.5	0.5	1.0
8	<b><u>Entrepreneurial personality test:</u></b> <ul style="list-style-type: none"> <li>Assess “Self” inclination to business</li> </ul>	<b><u>Entrepreneurial personality test:</u></b> <ul style="list-style-type: none"> <li>Concept of entrepreneurial personality test</li> <li>Assessing self entrepreneurial inclination</li> </ul>	0.75	0.75	1.5
<b>Unit 2: Creativity and Assessment</b>					
9	Create viable business idea	<b><u>Creativity:</u></b> <ul style="list-style-type: none"> <li>Concept of creativity</li> <li>Barriers to creative thinking</li> </ul>	1.5	0.5	2.0
10	Innovate business idea	<b><u>Innovation:</u></b> <ul style="list-style-type: none"> <li>Concept of innovation</li> <li>SCAMPER Method of innovation</li> </ul>	0.75	0.75	1.5
11	Transfer ideas into action	<b><u>Transformation of idea into action:</u></b> <ul style="list-style-type: none"> <li>Concept of transferring idea into action</li> <li>Self-assessment of creative style</li> </ul>	1.0	0.5	1.5
12	Assess personal entrepreneurial competencies	<b><u>Personal entrepreneurial competencies:</u></b> <ul style="list-style-type: none"> <li>Concept of entrepreneurial competencies</li> <li>Assessing personal entrepreneurial competencies</li> </ul>	1.0	0.5	1.5
13	Assess personal risk taking attitude	<b><u>Risk taking attitude:</u></b> <ul style="list-style-type: none"> <li>Concept of risk</li> <li>Personal risk taking attitude</li> <li>Do and don’t do while taking risk</li> </ul>	1.5	1	2.5
14	Make decision	<b><u>Decision making:</u></b> <ul style="list-style-type: none"> <li>Concept of decision making</li> <li>Personal decision making attitude</li> <li>Do and don’t do while making decision</li> </ul>	1.0	0.5	1.5
<b>Unit 3: Identification and Selection of Viable Business Ideas</b>					
15	Identify/ select potential business idea	<b><u>Identification and selection of potential business:</u></b> <ul style="list-style-type: none"> <li>Sources of business ideas</li> </ul>	1	3.5	4.5

	<ul style="list-style-type: none"> <li>Analyze strength, Weakness, Opportunity and Threat (SWOT) of business idea</li> </ul>	<ul style="list-style-type: none"> <li>Points to be considered while selecting business idea</li> <li>Business selection process</li> <li>Potential business selection among different businesses</li> <li>Strength, Weakness, Opportunity and Threats (SWOT) analysis of business idea</li> <li>Selection of viable business idea matching to “self”</li> </ul>			
<b>Unit 4: Business Plan</b>					
16	Assess market and marketing	<b><u>Market and marketing:</u></b> <ul style="list-style-type: none"> <li>Concept of market and marketing</li> <li>Marketing and selling</li> <li>Market forces</li> <li>4 Ps of marketing</li> <li>Marketing strategies</li> </ul>	1.5	0.5	2.0
17	<b>Business exercise:</b> Explore small business management concept	<b><u>Business exercise:</u></b> <ul style="list-style-type: none"> <li>Business exercise rules</li> <li>Concept of small business management</li> <li>Elements of business management             <ul style="list-style-type: none"> <li>Planning</li> <li>Organizing</li> <li>Executing</li> <li>Controlling</li> </ul> </li> </ul>	2.75	0.5	3.25
18	Prepare market plan	<b><u>Business plan/Market plan</u></b> <ul style="list-style-type: none"> <li>Concept of business plan</li> <li>Concept of market plan</li> <li>Steps of market plan</li> </ul>	2.0	2.0	4.0
19	Prepare production plan	<b><u>Business plan/Production plan:</u></b> <ul style="list-style-type: none"> <li>Concept of production plan</li> <li>Steps of production plan</li> </ul>	1.75	1	2.75
20	Prepare business operation plan	<b><u>Business plan/Business operation plan:</u></b> <ul style="list-style-type: none"> <li>Concept of business operation plan</li> <li>Steps of business operation plan</li> <li>Cost price determination</li> </ul>	5.0	0	5.0
21	Prepare financial plan	<b><u>Business plan/Financial plan:</u></b> <ul style="list-style-type: none"> <li>Concept of financial plan</li> <li>Steps of financial plan</li> <li>Working capital estimation</li> <li>Pricing strategy</li> <li>Profit/loss calculation</li> <li>BEP and ROI analysis</li> <li>Cash flow calculation</li> </ul>	12.0	0	12.0

22	Collect market information /prepare business plan	<p><b><u>Information collection and preparing business plan:</u></b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Market survey <ul style="list-style-type: none"> <li>• Precaution to be taken while collecting information</li> <li>• Sample questions for market survey</li> <li>• Questions to be asked to the customers</li> <li>• Questions to be asked to the retailer</li> <li>• Questions to be asked to the stockiest/suppliers</li> </ul> </li> <li>• Preparing business plan</li> </ul>	2.0	13.0	15.0
23	Appraise business plan	<p><b><u>Business plan appraisal:</u></b></p> <ul style="list-style-type: none"> <li>• Return on investment</li> <li>• Breakeven analysis</li> <li>• Cash flow</li> <li>• Risk factors</li> </ul>	3.0	3.0	6.0
24	Maintain basic book keeping	<p><b><u>Basic book keeping:</u></b></p> <ul style="list-style-type: none"> <li>• Concept and need of book keeping</li> <li>• Methods and types of book keeping</li> <li>• Keeping and maintaining of day book and sales records</li> </ul>	1.5	1.5	3.0
<b>Total:</b>			<b>48</b>	<b>30</b>	<b>78</b>

**Text book:**

- क) प्रशिक्षकहरुकालागिनिर्मित निर्देशिकातथा प्रशिक्षण सामग्री, प्राविधिकशिक्षातथाव्यावसायिकतालीम परिषद्, २०६९  
ख) प्रशिक्षार्थीहरुकालागिनिर्मित पाठ्यसामग्रीतथाकार्यपुस्तिका, प्राविधिकशिक्षातथाव्यावसायिकतालीम परिषद् (अप्रकाशित), २०६९

**Reference book:**

Entrepreneur's Handbook, Technonet Asia, 1981.

## Industrial Practice

**Course Nature: Practical**  
**Full Marks: 1200**

**Class Per week: 24 hrs.**  
**Total Class: 1872 hrs.**

<b>Subject 11: Industrial Practice</b>	
<b>Description:</b>	This is completely the different type of subject and this is the core subject of the apprenticeship training program. In this subject all important skills are enlisted. The trainees will have to practice during staying in sponsoring industries. This course is 100% practical nature. Industrial Practice is 1872 hours apprenticeship training program that aims to provide trainees an opportunity for meaningful career related experience by working fulltime in industries where they can practice and expand their classroom based knowledge and skills before graduating. It will also help trainees gain a clear sense of their future opportunity to build professional networks. The first assessment will be evaluated by the institute. The three assessments will be evaluated by the industry.
<b>Objectives:</b>	<p>The overall objective of the Industrial Practice is to make trainees familiar with firsthand experience of the real work of industrial world as well as to provide them an opportunity to enhance skills. At the end of the course the participants will be able to:</p> <ul style="list-style-type: none"> <li>• Apply knowledge and skills learnt in the classroom to actual work settings or conditions and develop practical experience before graduation.</li> <li>• Familiarize with working environment.</li> <li>• Work effectively with professional colleagues and share experiences of their activities and functions.</li> <li>• Strengthen portfolio or resume with practical experience and projects.</li> <li>• Develop professional/work culture.</li> <li>• Broaden professional contacts and network.</li> <li>• Develop entrepreneurship skills on related occupation.</li> </ul>

S.N.	Skill	Tasks	Time Hours		
			Th./Demo	Pr.	Total
<b>1</b>	<ul style="list-style-type: none"> <li>• <b>Introduction</b></li> </ul>	<ul style="list-style-type: none"> <li>▪ Introduction of Industry</li> <li>▪ Objectives</li> <li>▪ Rules &amp; regulations</li> <li>▪ Job description</li> <li>▪ Level of employees</li> <li>▪ Facilities for trainees</li> <li>▪ Importance of industry</li> <li>▪ Production</li> <li>▪ <b>Quality Control</b></li> </ul>		<b>39</b>	
	<ul style="list-style-type: none"> <li>• <b>Provide for orientation class and workshop safety</b></li> </ul>	<ul style="list-style-type: none"> <li>▪ Maintain work area</li> <li>▪ Maintain shop equipment</li> <li>▪ Utilize personal protection equipment</li> <li>▪ Provide safety instructions</li> <li>▪ Recognize &amp; control hazards</li> <li>▪ Perform safety-related administrative functions</li> <li>▪ Perform emergency procedures</li> <li>▪ Demonstration</li> </ul>			



	<ul style="list-style-type: none"> <li>• <b>Understanding drawing projects</b></li> </ul>	<ul style="list-style-type: none"> <li>• Prepare a project plan sheet including bill of materials &amp; plan of procedure</li> <li>• Recording monthly project</li> <li>• Report to Institute</li> <li>• Verification by Industry</li> </ul>			
2	<b>Handle Measuring Instruments</b>	<ul style="list-style-type: none"> <li>• Measure dimensions by using measuring tape &amp; steel ruler</li> <li>• Measure dimensions using bevel protector</li> <li>• Check square by using try square</li> <li>• Measure dimensions by using vernier calipers</li> <li>• Demonstration</li> <li>• Exercises</li> </ul>		78	
3	<b>Perform measuring instruments</b>	<ul style="list-style-type: none"> <li>• Check squareness and flatness with try square</li> <li>• Check with radius, filler gauge, wire gauge &amp; screw pitch gauge</li> <li>• Measure angular surface using bevel protector</li> <li>• Measure the dimension using Vernier caliper.</li> <li>• Measure the dimension by using inside and outside micrometers</li> <li>• Check surface with a dial indicator</li> <li>• Demonstration</li> <li>• Exercises</li> </ul>		78	
4	<b>Perform measuring, marking and punching</b>	<ul style="list-style-type: none"> <li>• Measure and mark on the work piece</li> <li>• Stamp letter and number on work pieces</li> <li>• Punch Dot and Center</li> <li>• Exercises</li> </ul>		39	
5	<b>Perform filing</b>	<ul style="list-style-type: none"> <li>• File flat surfaces</li> <li>• File external radius</li> <li>• File internal profiles</li> <li>• Exercises</li> </ul>		39	
6	<b>Perform sawing</b>	<ul style="list-style-type: none"> <li>• Saw metal by hand hacksaw &amp; power hacksaw</li> <li>• Demonstration</li> <li>• Exercises</li> </ul>		78	
7	<b>Perform drilling</b>	<ul style="list-style-type: none"> <li>• Drill holes in different metals different positions</li> <li>• Drill countersunk on hole</li> <li>• Perform Counter bore on</li> </ul>		195	

		<ul style="list-style-type: none"> <li>drilled hole</li> <li>• Ream on drilled hole</li> <li>• Demonstration</li> <li>• Exercises</li> </ul>			
<b>8</b>	<b>Set up Lathe machine</b>	<ul style="list-style-type: none"> <li>• Set up machine control</li> <li>• Set work piece in three jaws chucks</li> <li>• Set work piece in four jaws chucks</li> <li>• Set turning tools on tools post</li> <li>• Set machine control</li> <li>• Set up work piece center to center with dog &amp; clamp</li> <li>• Set up irregular work piece on face plate</li> <li>• Set up work piece with fixed &amp; follower rest</li> <li>• Demonstration</li> <li>• Exercises</li> </ul>		<b>78</b>	
<b>9</b>	<b>Perform Lathe Machine operation</b>	<ul style="list-style-type: none"> <li>• Perform plain turning</li> <li>• Perform facing</li> <li>• Perform centre drilling</li> <li>• Perform drilling</li> <li>• Perform steps turning</li> <li>• Perform chamfering</li> <li>• Perform boring</li> <li>• Perform external grooving</li> <li>• Perform internal grooving</li> <li>• Perform external &amp; internal taper turning</li> <li>• Perform knurling</li> <li>• Perform parting off operation</li> <li>• Perform simple eccentric turning</li> <li>• Demonstration</li> <li>• Exercises</li> </ul>		<b>351</b>	
<b>10</b>	<b>Perform Threads cutting</b>	<ul style="list-style-type: none"> <li>• Cut threads by die/taps</li> <li>• Cut external v-threads on a lathe</li> <li>• Cut internal v-threads on a lathe</li> <li>• Demonstration</li> <li>• Exercises</li> </ul>		<b>39</b>	
<b>11</b>	<b>Perform off-hand grinding</b>	<ul style="list-style-type: none"> <li>• Grind single point cutting tools</li> <li>• Grind drill bits</li> <li>• Part off stock</li> <li>• Grind horizontal surfaces</li> <li>• Grind vertical surfaces</li> </ul>		<b>195</b>	

		<ul style="list-style-type: none"> <li>• Grind angular surfaces</li> <li>• Grind external cylindrical surfaces</li> <li>• Re-sharpen twist drills</li> <li>• Grind facing or corner tool in HSS bit</li> <li>• Grind roughing tool in HSS bit</li> <li>• Grind grooving tool</li> <li>• Grind threads cutting tool</li> <li>• Prepare boring tool</li> <li>• Grind center punch</li> <li>• Demonstration</li> <li>• Exercises</li> </ul>			
12	<b>Perform sheet metal work</b>	<ul style="list-style-type: none"> <li>• Cut metal sheet in straight and curve shape by snip</li> <li>• Fold/Roll metal sheet by folding machine</li> <li>• Perform soldering joint</li> <li>• Perform Riveting joint</li> <li>• Develop Pattern of rectangular box, Cylindrical Container &amp; cone</li> <li>• Exercises</li> </ul>		39	
13	<b>Perform Repair and maintenance</b>	<ul style="list-style-type: none"> <li>• Perform preventive &amp; Schedule maintenance</li> <li>• Repair machine elements</li> <li>• Replace machine elements</li> <li>• Exercises</li> </ul>		78	
14	<b>Perform Shaper Machine Operation</b>	<ul style="list-style-type: none"> <li>• Set up machine control</li> <li>• Set up shaper vice on machine table</li> <li>• Hold single point cutting tool</li> <li>• Adjust stroke length and position of the ram</li> <li>• <b>Perform plain surface:</b></li> <li>• Produce flat surface</li> <li>• <b>Perform step surface:</b></li> <li>• Produce 90<sup>0</sup> step surface</li> <li>• Perform angular surface tilting by tool post</li> <li>• Perform plane slot</li> <li>• Demonstration</li> <li>• Exercises</li> </ul>		78	
15	<b>Perform Flat Position Welding</b>	<ul style="list-style-type: none"> <li>• Perform striking</li> <li>• Perform surface weld</li> <li>• Grind off welding surfaces</li> <li>• Perform straight multi run beads</li> <li>• Perform tack weld for</li> </ul>		78	

		<ul style="list-style-type: none"> <li>• joints</li> <li>• Weld corner joint, edge joint &amp; Lap joint</li> <li>• Exercises</li> </ul>			
	<b>Perform Horizontal, Vertical, Flat Position Pipe Welding</b>	<ul style="list-style-type: none"> <li>• Perform surface weld in horizontal &amp; vertical position</li> <li>• Perform fillet weld in horizontal &amp; vertical position</li> <li>• Perform fillet weld</li> <li>• Weld pipe to pipe joint in flat position by rotated</li> <li>• Weld pipe to flat metal joint in flat position</li> <li>• Exercises</li> </ul>			
<b>16</b>	<b>Perform Steel Fabrication</b>	<ul style="list-style-type: none"> <li>• Cuts the material by Oxy acetylene gas cutting</li> <li>• Perform off hand grinding</li> <li>• Perform Bending</li> <li>• Perform Twisting</li> <li>• Perform Forging</li> <li>• Clean with emery paper</li> <li>• Clean with surface grinding</li> <li>• Clean with wire/emery wheel</li> <li>• Perform enamel coating by brush painting</li> <li>• Perform spray painting</li> <li>• Exercises</li> </ul>		<b>78</b>	
<b>17</b>	<b>Perform Mechanical Project Works</b>	<ul style="list-style-type: none"> <li>▪ <b>Inform &amp; plan the requirements in process planning:</b> <ul style="list-style-type: none"> <li>▪ Description of the product to be manufactured</li> <li>▪ Specifications &amp; standards</li> <li>▪ Working drawing of the job to be manufactured</li> <li>▪ Availability of manpower</li> <li>▪ Date of starting &amp; ending</li> </ul> </li> <li>▪ <b>Determine &amp; describe steps in process planning:</b> <ul style="list-style-type: none"> <li>▪ Function of the part</li> <li>▪ Study &amp; analyze the working drawing</li> <li>▪ Determine the parts</li> <li>▪ Prepare a list of raw materials</li> <li>▪ Select the most economical process</li> <li>▪ Determine the best</li> </ul> </li> </ul>		<b>312</b>	

		sequence of operation <ul style="list-style-type: none"> <li>▪ Select the machines, tools, accessories &amp; equipments</li> <li>▪ Layout the equipments &amp; workplace</li> <li>▪ Determine the setup time &amp; standard time</li> <li>▪ Determine the kind of labour</li> <li>▪ Determine the estimated cost of the product</li> <li>▪ <b>Exercises on industries' mechanical project works</b></li> </ul>			
<b>Grand Total</b>			-	<b>1872</b>	<b>1872</b>

## Experts Involved in Curriculum Revision

- |                                |   |
|--------------------------------|---|
| 1. Mr. P. L. Shrestha          | - Executive Director-BTI, Butwal                                      |
| 2. Mr. Dilip Kumar Thapa       | - Deputy Director-BTI, Butwal   |
| 3. Mr. Chandra Bahadur Chhetri | - Chief, Business & Admin. Deptt. - BTI, Butwal                       |
| 4. Mr. Man Kaji Kumal          | - Training Officer-BTI, Butwal  |
| 5. Mr. Prakash Acharya         | - Computer Administrator-BTI, Butwal                                  |
| 6. Mr. Dor Bahadur Bhandari    | - TSLC Programme Coordinator- BTI, Butwal                             |
| 7. Mr. Ramesh Kumar Yadav      | - Mechanical Instructor-BTI, Butwal                                   |
| 8. Mr. Chola Kanta Kandel      | - Asst. Welding Instructor, BTI, Butwal                               |
| 9. Mr. Purna Bahadur Thapa     | - Nepal Hydro & Elect. Ltd., Butwal                                   |
| 10. Mr. Lal Bahadur Basnet     | - Mechanical Instructor, Korean Nepal Institute of Technology, Butwal |
| 11. Mr. Bom Bahadur Thapa      | - Orient Hydro P. Ltd., Butwal  |
| 12. Mr. Sushil Bashyal         | - Mechanical Asst. Engineer, Nepal Electricity Authority, Butwal      |
| 13. Mr. Yadav Prasad Bhandari  | - CEO, Rupandehi Chamber of Industries, Butwal                        |