CURRICULUM

TSLC

Mechanical Engineering

(Pre-SLC Intake)

Council for Technical Education and Vocational Training

Curriculum Development Division

Sanothimi, Bhaktapur

(Developed in 1991, First Revision 1999, Second Revision 2007)

Third Revision 2014

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Introduction:

The TSLC 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.

Aims:

- To produce competent lower level workforce in the field of mechanical engineering who will be able to provide services in different related plants and industries.
- To produce competent workforce who will get an opportunity to be self or wage employed in the related national and international market.

Objectives:

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

- Perform basic mechanical works carried out in mechanical workshops.
- Perform basic computer applications
- Perform mechanical drawings/drafting.
- Design and perform sheet metal, steel and aluminum fabrications.
- Operate lathe, milling and shaping machines.
- Repair and maintain mechanical devices

Course Description:

This curriculum includes skills and knowledge related to the core subjects like applied English, mathematics, and Nepali as well as disciplinary subjects like Bench work, Engineering drawing, lathe operation, material science, sheet metal, welding technology, computer aided drafting, milling and shaping operation, structural fabrication and repair and maintenance. This course also imparts with computer application and entrepreneurship development.

This course also includes on the job training (OJT) so as to provide exposure of the world of work. The place for OJT assignment will be related to mechanical workshops and industries.

Target group:

Class 10 passed individual

Group size:

Maximum 35 in a batch

Entry Requirements: -

a. 10^{th} class pass.
b. Candidates will be selected on the basis of entrance examination as per CTEVT rule.

Medium of instruction: Nepali and/or English

Duration:

2 Years (3120 hrs + 5 months (800 hrs) = 3920 hrs

This course will be completed within 2 yrs (3120 hrs.) in formal setting. The 5 months OJT will be compulsory after the final exam. The total hours for the course will be 3120+800 (OJT) = 3920 hrs.

Patterns of Attendance:

40 hrs. per week for 39 weeks per year and 90 % attendance is required.

Certificate Requirements: -

CTEVT will award the certificate in **TSLC in Mechanical Engineering** to the students who gain marks of 60% in practical test and 40% in knowledge test.

Evaluation Details:

a. Regular internal evaluation of the trainees has to be conducted by the related instructors to ensure the proficiency over each task/skill in each subject.

b. Related technical knowledge of the tasks learnt by the trainees is to be evaluated through the written test. Internal assessment will be conducted 3 times by the institute every year during the institutional training period.

c. 80% marks is allotted to the practical work and 20 % is allotted to the related technical knowledge (trade technology) in each subject.

d. The Controller of Examination of CTEVT will conduct final examination after completion of the course.

e. For each subject 60 % of the weight age will be allotted to the internal assessment and the rest of the 40 % to the final examination.

f. The overall mark comes from adding the weight age score from the internal assessment and mark from the assessment. Only the trainees who have passed the internal assessment can appear in the final exam.

g. A candidate who fails in the final exam can appear in the re-test scheduled by CTEVT.

h. After completion of the final examination On the Job (OJT) will be administered.

The course grading will be as follows:-

	Overall Marks	**Grading**
a.	80% and above	Distinction
b.	75% to < 80%	First Division
c.	65% to <75 65%	Second Division
d.	Passed below 65%	Pass Division

Trainers' qualification:

- BE in mechanical engineering or equivalent for instructor
- Diploma in mechanical engineering for assistant instructor
- TSLC in mechanical engineering for workshop assistant/teaching aid.

The objective of the on- the-job training

1. To gin knowledge and skills related to mechanical engineering by engaging the reel world of work.
2. To practice skills acquired from school in the real field.
3. To develop self-confidence in the skills acquired in the training institutions
4. To ensure the standard of the training to keep pace with the requirement of the employer.

The total marks for on-the-job training is distributed as:

1. 200 marks will be awarded by the supervisor of the user agency.
2. 200 marks will be awarded by the related training institute.
3. 100 marks will be awarded by CTEVT.
4. OJT conduction and evaluation scheme will be as per the guidelines of CTEVT.

Basic Requirements

Office Equipment

There should be well-arranged equipment for training and office management.

a. Desk top Computer
b. Scanner
c. Multi – media projector
d. Laser color / mono printer
e. Fax mail
f. Photo Copy Machine (color / mono)

Classroom Equipment

There should be well-arranged modern facilities for training and instruction management.

1. White Board
2. Soft Board
3. Multi media projector
4. Chair and desks.
5. Overhead projector

Library facilities

Essential furniture chair, table, racks, books, journal and periodicals.

Curriculum structure

TSLC IN MECHANICAL ENGINEERING (PRE-SLC INTAKE), 2014

First year

S. No.	Course Title	Nature	Class/ Week			Total Class/Year			Full Marks		
			T	P	Total	T	P	Total	T	P	Total
1.	Applied English	T	2	0	2	78	0	78	50	0	50
2.	Applied Math - I	T	2	0	2	78	0	78	50	0	50
3.	Applied Nepali	T	2	0	2	78	0	78	50	0	50
4.	Bench Work	P	0	11	11	0	429	429	0	275	275
5.	Computer Application	P	0	2	2	0	78	78	0	50	50
6.	Engineering Drawing	P	0	3	3	0	117	117	0	75	75
7.	Lathe Operation - I	P	0	4	4	0	156	156	0	100	100
8.	Material Science - I	T	1	0	1	39	0	39	25	0	25
9.	Sheet Metal Fabrication	P	0	4	4	0	156	156	0	100	100
10.	Welding Technology - I	P	0	6	6	0	234	234	0	150	150
11.	Workshop Technology - I	T	3	0	3	117	0	117	75	0	75
	Total		**10**	**30**	**40**	**390**	**1170**	**1560**	**250**	**750**	**1000**

Second year

S. No.	Course Title	Nature	Class/Week			Total Class/Year			Full Marks		
			T	P	Total	T	P	Total	T	P	Total
1.	Applied Math - II	T	2	0	2	78	0	78	50	0	50
2.	Computer Aided Drafting	P	0	2	2	0	78	78	0	50	50
3.	Engineering Drawing - II	P	0	2	2	0	78	78	0	50	50
4.	Entrepreneurship Development	T+P	1	1	2	30	48	78	20	30	50
5.	Lathe Operation -II	P	0	6	6	0	234	234	0	150	150
6.	Material Science - II	T	1	0	1	39	0	39	25	0	25
7.	Milling & Shaping Operation	P	0	8	8	0	312	312	0	200	200
8.	Repair & Maintenance	P	0	4	4	0	156	156	0	100	100
9.	Structural Fabrication	P	0	5	5	0	195	195	0	125	125
10.	Welding Technology – II (Gas/TIG/MIG)	P	0	6	6	0	234	234	0	150	150
11.	Workshop Technology - II	T	2	0	2	78	0	78	50	0	50
	Sub Total		**6**	**34**	**40**	**225**	**1335**	**1560**	**145**	**855**	**1000**

On-The-Job Training

S.No.	Subjects	Nature	Hours/Weeks	Total Hours	Full Marks
1	On-the-job training	P	20	800	500
Grand Total (1st year + 2nd year +OJT)				**3920**	**2500**

First Year

Subjects

1. Applied English
2. Applied Math - I
3. Applied Nepali
4. Bench Work
5. Computer Application
6. Engineering Drawing
7. Lathe Operation - I
8. Material Science - I
9. Sheet Metal Fabrication
10. Welding Technology - I
11. Workshop Technology - I

Applied English

Total 78 hrs
Class/week: 2 hrs

Unit/sub unit	Areas and Topics	Time (hrs)
1	**Introduction**	**2**
1.1	Noun, Verb, Adjective, and Adverb words.	
2	**Auxiliary and main verbs – uses**	**2**
2.1	Word identification and practical use	
3	**Subject verb agreement**	**3**
3.1	S + V + O	
4	**Drill mechanical words**	**2**
4.1	Glossaries of mechanical	
5	**Tense and sentence structure**	**4 + 4**
5.1	Simple, Present and Continuous	
5.2	When + Simple Past + Past Continuous	
5.3	When + Simple Past + Past perfect + Present Perfect + Present Continuous.	
6	**Causative Verb**	**2**
7	**Punctuation**	**2**
7.1	Rules and Examples	
8	**Affirmative / Negative Sentences**	**2**
8.1	Concept + Practical Exercises	
9	**'Yes / No' question**	**2**
9.1	Concept + Practical Exercises	
10	**'WH' question**	**3**
10.1	Concept + Practical Exercises	
11	**'Tag' question**	**3**
11.1	Concept + Practical Exercises	
12	**Letter writing**	**4**
12.1	Parts of a letter	
12.2	Types of letter	
12.2.1	Social letter	
12.2.2	Application	
12.2.3	Complaint letter	
12.2.4	Business letter	
13	**Memorandum writing**	**3**
13.1	Definition important points	
13.2	Skill in writing a memo	
14	**Report writing**	**3**
14.1	Definition and methods of writing a report	
15	**Read, understand and use the technical terms**	**2**
16	**Practical job reports**	**3**
16.1	Filling work	
16.2	Drilling activities	
16.3	G.I. Pipe cutting	
16.4	Sawing	
17	**Read short technical publications**	**2**
18	**Read &Follow English language instruction**	**3**
18.1	Techniques of writing instruction	
19	**Going to Future**	**2**
19.1	Concept and Uses	
20	**Prepare a Speech**	**2**
20.1	5 minute speech on birth control, Pollution, HIV Aids.	
21	**Voice – Active & Passive**	**4**
21.1	Introduction	
21.2	Kinds	
21.3	Rules of changing active into passive voice	
22	**Reported speech**	**3**

22.1	Introduction		
22.2	Rules of changing direct into indirect speech		
22.3	Statement		
22.4	Imperative		
22.5	Interrogative		
23	**Rearrangement of words**		**2**
23.1	Techniques		
23.2	Illustration and Practical exercises		
24	**Conditional sentences**		**2**
24.1	Types		
24.2	Structure		
24.3	Examples		
24.4	Practice Exercises		
25	**Relative clauses**		**2**
25.1	Defining relative clause, sentences examples.		
26	**Joining sentences**		**2**
26.1	Joining sentences with why, what, which, whom, and How.		
27	**Articles**		**2**
27.1	Types		
27.2	Rules of using it		
27.3	Practice exercises		
28	**Preposition – place and time**		**2**
28.1	Definition		
28.2	Places and time preposition		
29	**Situational understanding**		**2**
29.1	Definition		
29.2	Types		
30	**Comprehension Practice**		**2**
		Total	***78***

प्रयोगात्मक नेपाली

जम्मा : ७८ घण्टा
कक्षा : २ घण्टा/हप्ता

कोर्ष वर्णन :

प्राविधिक शिक्षालयहरूमा दुइ वर्षे प्राविधिक एस.एल.सी. मा तालीम लिने प्रशिक्षार्थीहरूका लागि नेपालीका व्यावहारिक पक्षमा आवश्यक पर्ने भाषिक सीपको विकासका लागि देहाय बमोजिमको व्यावहारिक नेपाली अध्यापनका लागि तयार गरिएको छ । यसमा व्यावहारिक नेपाली व्याकरण र सामान्य रचना तथा सब-ओभरसियरको कामको सिलसिलामा आवश्यक पर्ने व्यावहारिक कार्यसंग सम्बन्धित विषयहरू समावेश गरिएका छन् ।

विषय	पाठ्यघण्टा
१ व्याकरण	
• पदविचार सम्बन्धी ज्ञान (नाम, सर्वनाम, क्रिया, विशेषण र अव्यय)	४
• शब्द निर्माण प्रक्रिया (उपसर्ग, प्रत्यय र समास)	३
• वाक्य निर्माण सम्बन्धी ज्ञान	२
• वाक्यका किसिम (सामान्य, मिश्र र संयुक्त)	३
• वाक्य परिवर्तन सम्बन्धी ज्ञान (आज्ञार्थक, इच्छार्थक, प्रश्नार्थक, सम्भावनार्थक आदि)	३
• वाच्य परिवर्तन सम्बन्धी ज्ञान र प्रयोग	४
• मेकानिकल सम्बन्धी पारिभाषिक शब्दको ज्ञान र तिनको प्रयोग	४
• विपरीतार्थक, पर्यायवाची, श्रुतिसम भिन्नार्थक शब्दको ज्ञान र प्रयोग	४
• नेपाली समाजमा प्रचलित मेकानिकल विषय संग सम्बन्धित शब्द र	
• वाक्पद्धतिको ज्ञान र प्रयोग	८
२ भाषा र अभिव्यक्ति	
• अनुच्छेद लेखन प्रक्रियाको ज्ञान र प्रयोग ।	५
• निबन्ध लेखन प्रक्रियाको ज्ञान र प्रयोग ।	५
• पत्र लेखन (घरायसी पत्र, कार्यालयीय पत्र, व्यापारिक पत्र, व्यावसायिक पत्र, संस्मरण (Memo) पत्रको ज्ञान र प्रयोग ।	५
• यान्त्रिक (मेकानिकल) सम्बन्धी जनचेतना शिक्षा (यसमा यान्त्रिक/मेशिनको महत्व तथा त्यसबाट हुनसक्ने कमजोरीका विषयमा १ पेजको लेख लेखाई त्यसबारे आफ्नो कक्षामा बोल्न लगाउने जस्ता सीप दिने र त्यसमा अभ्यास गराउने) ।	४
• मेकानिकल कार्यका कारण हुने वातावरण प्रदुषण र ती प्रदुषणबाट हुने खराबी र मेकानिकल काम गर्दा ध्यान दिनु पर्ने विषयमा जनचेतना शिक्षा ।	१

- बूँदा र सारांश लेखनको ज्ञान र प्रयोग ३
- प्रश्नको आधारमा उत्तर लेखन प्रक्रियाको ज्ञान र अभ्यास २

३ प्रतिवेदन लेखन

- सामान्य प्रश्नावली तयारी सम्बन्धी ज्ञान र प्रयोग ३
- कार्य प्रतिवेदन सम्बन्धी ज्ञान र प्रयोग ३
- कार्यालय व्यवस्थापन सम्बन्धी ज्ञान (व्यावसायिक कार्यशालाको स्थापनाका लागि आवश्यक योजना तयारी गर्ने, यान्त्रिक सम्बन्धी कामका लागि कार्य योजनाको तयारी गर्ने, योजना गरिएको कार्यक्रमका लागि वजेटिङ्ग गर्ने) विषयको ज्ञान र प्रयोग ५
- मासिक तथा वार्षिक प्रगति प्रतिवेदन सम्बन्धी ज्ञान र प्रयोग । २

४ उद्योगबाट उत्पादित सामग्रीको जानकारी/ज्ञान

- उद्योगबाट उत्पादित वस्तुको प्रयोग अघि त्यसको गुणस्तर बनोट, प्रयोग विधि आदिको विषयमा जानकारी गर्न सामग्री प्रयोग पन्जिका (Catalogue) अध्ययन र प्रयोग गर्ने ज्ञान र अभ्यास । ४
- टेण्डर तथा बोलपत्र सम्बन्धी ज्ञान २

Applied Mathematics - I

Total: 78 hrs
Class/week: 2 hrs

Areas and Topics	Time (hrs.)
1. Calculate SI units / conversion factors	4
1.1. Basic Units	
1.2. Derived SI units and relationship	
1.3. Decimal, multiples and parts of units	
1.4. Example and Exercises	
2. Calculate other system of units(FPS system, CGS system, Metric system)	**2**
2.1. Conversion and Comparative table of previous technical units and SI units	
2.2. Example and Exercises	
3. Calculate fractions	**4**
3.1. Concept and Value of a fraction	
3.2. Multiplication	
3.3. Division	
3.4. Addition	
3.5. Subtraction	
3.6. Example and Exercises	
4. Calculate square root	**2**
4.1. Square number	
4.2. Splitting up	
4.3. Procedure	
4.4. Example and Exercises	
5. Calculate percentage	**2**
5.1. Conversion of the percentage into actual number	
5.2. Conversion of the real number into percentage	
5.3. Example and Exercises	
6. Calculate conversion of length measurement	**2**
6.1. Metric System	
6.2. SI System	
6.3. Examples and Exercises	
7. Calculate circumferences	**4**
7.1. Definition of circumference	
7.2. Circumference	
7.3. Sector	
7.4. Polygons	
7.5. Examples and Exercises	
8. Calculate Pythagoras' Theorem	**4**
8.1. Terms used in Pythagoras' Theorem	
8.2. Pythagoras formula	
8.3. Summary	
8.4. Examples and Exercises	
9. Calculate by unitary method	**4**
9.1. Concept of Unitary method	
9.2. Variance and types	
9.3. Chain rule	
9.4. Estimate time, money and number of worker for any job	
9.5. Examples and Exercise	
10. Calculate stretched lengths	**2**
10.1. Stretched length	
10.2. Complete ring	
10.3. Partial ring	
10.4. Angular frames	
10.5. Examples and Exercises	
11. Calculate Trigonometric functions	**4**

11.1. Dependency
11.2. Side ratio
11.3. Relationships
11.4. Examples and Exercises

12. Calculate areas regular quadrilaterals **4**
12.1. Square
12.2. Rhombus
12.3. Rectangle
12.4. Parallelogram
12.5. Examples and Exercises

13. Calculate Areas **4**
13.1. Triangle
13.2. Trapezium
13.3. Circle
13.4. Sector
13.5. Circular ring
13.6. Examples and Exercises

14. Calculate Sheet metal requirements and wastage **4**
14.1. Division
14.2. Wastage
14.3. Examples and Exercises

15. Calculate rivets **4**
15.1. Calculate the length of rivet shank for riveting
15.2. Shearing force of rivet
15.3. Bearing pressure of rivet
15.4. Examples and Exercises

16. Calculate volume of right bodies **4**
16.1. Concept of cube, prism and cylinder
16.2. Cube
16.3. Prism
16.4. Cylinder
16.5. Examples and Exercises

17. Calculate volume of pointed and truncated bodies **4**
17.1. Cone / Pyramid
17.2. Truncated cone / Pyramid
17.3. Summary
17.4. Examples and Exercises

18. Calculate taper and inclination **4**
18.1. Concept of taper and taper ratio
18.2. Taper ratio
18.3. Ratio of inclination
18.4. Setting angles
18.5. Taper length
18.6. Examples and Exercises

19. Calculate mass **4**
19.1. Concept of mass and Density
19.2. Mass
19.3. Density
19.4. Examples and Exercises

20. Calculate mass and weight force **4**
20.1. Concept of weight and force
20.2. Weight
20.3. Force
20.4. Examples and Exercises

21. Calculate stress **4**
21.1. Concept of stress
21.2. Types of stress
21.3. Tensile strength
21.4. Factor of Safety

21.5.Load
21.6.Examples and Exercises

22. Calculate thermal expansion **2**

22.1.Introduction of thermal expansion
22.2.Coefficient of linear expansion
22.3.Change in length
22.4.Final length
22.5.Examples and Exercises

23. Calculate heating and fuel consumption **2**

23.1.Heat input or specific calorific capacity
23.2.Fuel consumption or amount of heat require for work done
23.3.Examples and Exercises

Total ***78***

Book and References

1. H.P. Dahal ,*United's Math in action grade-10* ,United Nepal publication
2. R Awasthi,B.H. Subedi,B. B. Subedi ,*UNIQUE Mathenatics book-9* ,Unique Educational Publishers pvt. Ltd.
3. Technical Mathematics book for metal Trade **,**GTZ

Bench Work

Total: 429 hrs
Class/week: 11 hrs

Duty/Task	Duties and Tasks	Time (hrs.)		
		Demo	**Practical**	**Total**
Duty 1	**Perform Filling**	**10**	**90**	**100**
Task 1	Familiarize with mechanical hand tools and equipments	2	4	6
Task 2	File flat surface (Plain)	4	50	54
Task 3	File external radius	2	20	22
Task 4	File internal profiles	2	16	18
Duty 2	**Perform Marking/ Punching**	**4**	**21**	**25**
Task 1	Measure and Mark on the work piece	2	4	6
Task 2	Stamp Letters and Numbers on metal plate	1	12	13
Task 3	Punch: Dot and Center	1	5	6
Duty 3	**Perform Cutting.**	**7**	**51**	**58**
Task 1	Saw metal by hand hack saw	2	18	20
Task 2	Chisel flat surface.	2	12	14
Task 3	Chisel grooved surface	1	11	12
Task 4	Cut internal thread using hand taps(Tapping)	1	5	6
Task 5	Cut external thread using threading dies(Dieing)	1	5	6
Duty 4	**Perform Drilling.**	**5**	**17**	**22**
Task 1	Drill a hole	2	6	8
Task 2	Countersunk on hole	1	3	4
Task 3	Counter bore on hole	1	3	4
Task 4	Ream drilled hole using hand reamers	1	5	6
Duty 5	**Perform Off Hand Grinding**	**4**	**10**	**14**
Task 1	Grind center punch.	1	3	4
Task 2	Grind flat chisel	1	3	4
Task 3	Grind marking scriber	1	2	3
Task 4	Grind twist drills	1	2	3
Duty 6	**Handle Measuring Instrument**	**5**	**25**	**30**
Task 1	Check square ness using back square	1	5	6
Task 2	Check radius with radius gauge	1	5	6
Task 3	Take angular measurements using bevel protector	1	5	6
Task 4	Measure the dimensions using Vernier caliper.	2	10	12
Duty 7	**Perform Project Works**		**180**	**180**
Task 1	Manufacture a drill plate includes counterbore and reamed holes.	-	15	15
Task 2	Manufacture steel hammer of 500gm	-	30	30
Task 3	Manufacture C – clamp	-	20	20
Task 4	Manufacture back square of 120mm	-	15	15
Task 5	Manufacture Center square	-	20	20
Task 6	Manufacture Divider	-	30	30
Task 7	Manufacture Hand Hacksaw Frame	-	50	50
	Total	***34***	***395***	***429***

TASK ANALYSIS

Duty: 1. PERFORM FILLING

Task: 1 Familiarize with mechanical hand tools and equipments

Time:-6 hrs
Theory:-2 hrs
Practical:-4 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain tools / materials and equipment as per list. 2. Introduce tools / materials and equipment. 3. Explain objectives. 4. Explain working principle 5. Explain safety precaution. 6. Explain care and maintenance. 7. State work using tools / material/ equipments. 8. Store the tools.	**Condition (Given):** • Tool/ materials and Equipments as per given list. • Well equipped workshop. **Tasks (What):** • Familiarize with mechanical tools, materials and Equipments. **Standard (How well):** • Tools, equipments and material should be identified as per given list. • Applied different tools equipment and materials safely • Explained the functions of different tools equipment and materials	• Bench work tools and equipments • Definition • Objective • Working principle • Uses • Importance • Handling and caring • Safety precaution

Tools and Equipments:- Steel rule, Different types of file, Back square, Marking scriber, Center punch, Hammers, Hand hack saw,
Materials: Mild steel, Carbon steel, Tool steel
Safety:-

- Handle the tools carefully.
- Store the tools and material systematically.

Duty: 1. PERFORM FILLING

Task: 2 File flat surface (Plain)

Time:-50 hrs
Theory:-4 hr
Practical:-46 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain required drawing. 2. Read drawing thoroughly. 3. Obtain rough flat file. 4. Obtain material as per drawing. 5. Clean up the vice and working area. 6. Obtain steel rule, marking scriber and back square. 7. Mark on the work piece as per drawing. 8. Clamp the work-piece centrally so that the big flat surface can be file down on Bench vice. 9. Hold the file by one hand with griping the file handle so that the end of the handle presses against the ball of the thumb. 10. Press the file blade with the ball of the thumb by the other hand. 11. Position the feet to safe distance during filling. 12. Position the body to speedy and regular movements of the body. 13. Put the file on top of the work-piece pressing and pushing from one hand and pressing only from other hand. 14. Return the file without pressure. 15. Apply the same motion to produces even removal of filling surface. 16. Apply full length of file. 17. Check the flatness in cross and diagonally with back square 18. Check measurement by steel rule 19. Repeat the same motion of filling across and diagonally until produce even surface. 20. De-burr the work piece. 21. Punch the roll no on work piece. 22. Oil the surface of the work piece. 23. Store the work piece and tools. 24. Clean the vice and work shop.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** File flat surface (Plain) **Standard (How well):** • Filing work piece should be match given drawing. • Tolerances of filing work piece is within the ±0.5 mm	• Material of w/p • Material of files and introduction • w/p clamping devices • care and safety features of files, bench vices, steel rule, try square • Type of file • Proper way of holding file while filing • Position of feet and body while filing • Measuring and marking tools. • State basis units of length, measurements and its multiples • Techniques of flat filing i.e. straight, cross and draw filing **Safety:** General, personal, machine, tool and equipment, workshop

Tools and Equipments:- Flat files, steel scale, Back square (try square),Marking scriber, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan

Materials: MS Flat, Oil

Safety:-

1. Follow safety rule.
2. The height of bench vice should be set before filing.
3. The handle of file should be fixed tightly.
4. Avoid using broken files on files without handle

5. Do not leave files remained above work pieces on bench vice
6. Don't touch the surface by naked fingers.
7. Full length of file should be used.
8. De-burr the edge of the material

Duty: 1. PERFORM FILLING

Task: 3 File external radius

Time:-25 hrs
Theory:-2 hrs
Practical:-23 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain required drawing. 2. Read drawing thoroughly. 3. Obtain rough, medium and fine flat files. 4. Obtain work-piece material. 5. Obtain a radius gauge of the required size. 6. Obtain a centre punch and hammer. 7. Obtain a steel rule. 8. Obtain a divider/compass. 9. Clean up the bench vice and work area. 10. Mark the centre point of the radius by divider. 11. Make the radius by compass. 12. Clamp the w/p projecting the corner part which has to be made radius. 13. File down to make flat surface close to the marked radius line using rough file. 14. Change medium flat file and start filling in SEE SAW motion along the curved line until all marked line touches. 15. Check periodically with radius gauge. 16. Remove the w/p and check the measurement 17. File down further in see saw motion with fine flat file until required radius is obtained 18. Remove the w/p and check the final measurement. 19. Punch the roll no on work piece. 20. Oil the surface of the work piece. 21. Store the work piece and tools. 22. Clean the vice and work shop.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** File external radius. **Standard (How well):** • Filing work piece should be match given drawing. • Tolerances of filing work piece is within the ±0.1 mm	• Introduction of making and layout using steel rule, compass. • Radius gauge. • Method of filing radius surface. • State the feature of compass. • Radius filing procedure

Tools and Equipments:- Flat files (Rough, medium, fine), radius gauge, Marking scriber, Center punch, Number punch, Steel rule, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan

Materials: MS Square, Oil

Safety: - Refer the same safety precautions of the task "File flat surface.

Duty: 1: PERFORM FILLING

Task: 4 File internal profile.

Time:-19 hrs
Theory:-1 hrs
Practical:-18 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain required drawing. 2. Read drawing thoroughly. 3. Obtain rough, medium and fine flat files. 4. Obtain needle file if necessary 5. Obtain work-piece material. 6. Obtain a internal radius gauge of the required size. 7. Obtain a centre punch and hammer. 8. Obtain a steel rule. 9. Obtain a divider/compass. 10. Clean up the bench vice and surrounding. 11. Mark the centre point of the radius by divider. 12. Make the radius by compass. 13. Drill 5 mm small holes than that require for profile size in chain drill if necessary 14. De-burr the hole ends 15. Clamp the workpiece on bench vice so that the holes can be filed out 16. Take a small round file and file out the chain holes (try to make internal flat) 17. Change the file as per required shape then file out 18. Check out the sizes of the hole with internal radius gauge or self made gauge 19. Check periodically with radius gauge. 20. Remove the w/p and check the measurement 21. Punch the roll no on work piece. 22. Oil the surface of the work piece. 23. Store the work piece and tools. 24. Clean the vice and work shop.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** File internal Profile. **Standard (How well):** • Filing work piece should be match given check list. • Tolerances of filing work piece is within the ±0.5 mm	• Internal Radius filing procedure

Tools and Equipments:- Flat files (Rough, medium, fine), radius gauge, Marking scriber, Center punch, Number punch, Steel scale Oil can, Number punch, Bench cleaning brush, File brush, Dust pan

Materials: MS Square, Oil

Safety: - Refer the same safety precautions of the task "File flat surface and Drill a hole".

Duty: 2: PERFORM MARKING/PUNCHING

Task 1: Measure and Mark on the work piece.

Time:-6 hrs
Theory:-2 hrs
Practical:-4 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain required drawing. 2. Study the drawing thoroughly. 3. Obtain required tools and materials. 4. Measure the work piece according to given drawing. 5. Mark the work piece according to drawing. 6. Punch the roll no on work piece. 7. Oil the surface of the work piece. 8. Store the work piece and tools. 9. Clean the vice and work shop.	**Condition (Given):** • Working bench and Bench vice with fully equipped workshop. • Drawing **Tasks (What):** Measure and mark on the work piece. **Standard (How well):** The measured and marked work piece should be within the given drawing.	**Measuring and Marking** • Definition • Importance • Tool and equipment • Method • Safety

Tools and Equipments:- Steel scale, Steel Protractor, Marking scriber, Center punch, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan

Materials: MS Sheet, Oil

Safety:- Hold marking tools carefully because of sharpen tip of marking tools.

Duty: 2: PERFORM MARKING/PUNCHING

Task 2: Stamp letters and numbers on metal plate

Time:-13 hrs
Theory:-1 hr
Practical:-12 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain the w/p drawing. 2. Read drawing thoroughly. 3. Obtain w/p material. 4. Obtain letter and number punch of required size. 5. Prepare the material flat and in required dimensions. 6. Layout the base lines as per drawing. 7. Make the centre line to locate the position of the middle letter. 8. Place the work piece on anvil block facing up the surface to be stamped. 9. Check and Select the number or letter to be stamped. 10. Stamp the middle letter on the centre column line by holding the punch with three fingers of one hand and striking the hammer on head of punch by other hand. 11. Check the impressions. 12. Stamp the remaining letters to the right of centre and then to the left of centre. 13. Punch the roll no on work piece. 14. Oil the surface of the work piece. 15. Store the work piece and tools. 16. Clean the vice and work place.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Stamp letters and numbers on metal plate. **Standard (How well):** • Stamping work piece should be match with given drawing. • Tolerances of marking line is within the ±0.5 mm	• Letter and number punches. • Stamping process. • Three step stroking procedure

Tools and Equipments:- Steel rule, Steel hammer, Marking scriber, Letter & number punch, Flat anvil, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan

Materials: MS Sheet, Oil

Safety:-

1. Assure the head of the punch in flat.

2. Avoid mushroom head punch.
3. Wipe off oily substance, if any from the face of the hammer.
4. Make sure that the face of the hammer strikes on punch head, use on fingers.
5. While punching remove bangles and wrist watches.

Duty: 2: PERFORM MARKING/PUNCHING

Task 3: Punch dot center on the object

Time:-6 hrs
Theory:- 1 hrs
Practical:-5 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain the w/p drawing. 2. Read drawing thoroughly. 3. Obtain the w/p material. 4. Obtain steel rule, marking scriber, steel hammer, centre or dot punch. 5. Prepare the w/p material flat as per required dimension. 6. Mark the symmetrical lines as per drawing using steel rule and marking scriber. 7. Place the w/p on flat anvil. 8. Hold the dot/centre punch by three fingers of one hand and the hammer on other hand. 9. Place the tip of the centre punch at the cross of symmetrical lines. 10. Apply trial stroke. 11. Assess that the punch is at the correct centre. 12. Align if required. 13. Punch further stroke to get good impression. 14. Take next cross line and punch the centre. 15. Move center from self-ward while punching numerous dotted in same line. 16. Repeat the same steps for other cross lines until finished. 17. Punch the roll no on work piece. 18. Oil the surface of the work piece. 19. Store the work piece and tools. 20. Clean the vice and work shop.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Punch dot centre on the object. **Standard (How well):** • Check trial stroke. • Punching work piece should be match with given drawing. • Tolerances of marking line is within the ±0.5 mm	• Introduction of punch and its types • Dot punch, its included angle and its uses. • Dots punch material. • Centre punch, its included angles and its uses. • Centre punches material.

Tools and Equipments:- Steel rule, marking scriber, steel hammer, centre punch or dot punch, anvil, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan
Materials: MS Sheet, Oil

Safety:-

1. Assure the head of the punch is flat.
2. Avoid mushroom head punch.
3. Wiper off oily substance, if any, from the face of the hammer.
4. Look at the punch tip, not at the head while punching.
5. While punching remove bangles and wrist watches.

Duty: 3: PERFORM CUTTING.

Task :1 Saw metal by hand hack-saw

Time:-20 hrs
Theory:-2 hrs
Practical:-18 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain the w/p drawing. 2. Read drawing thoroughly. 3. Obtain the w/p material. 4. Obtain required hand tools i.e.; steel rule, marking scriber, dot punch, hammer and hacksaw frame with blade). 5. Make symmetrical line. 6. Punch dotted on marked line. 7. Clamp the work piece so that the marked line must be outside the vice. 8. Set the hand hack saw blade on hacksaw frame making teeth pointing towards forward. 9. Check the tightness of the blade in frame. 10. Take a small triangular file. 11. Mark a small Vee-notch by triangular file on start point. 12. Hold the hacksaw frame firmly as per file handling. 13. Start cutting slowly moving the blade forward. 14. Apply pressure only during the forward stroke. 15. Release pressure during the return stroke. 16. Repeat the strokes. 17. Check the cutting line to be straight. 18. Move slowly while finishing the cut. 19. Apply cutting on the blade frequently while sawing. 20. Check the part that has been sawed. 21. Punch the roll no on work piece. 22. Oil the surface of the work piece. 23. Store the work piece and tools. 24. Clean the vice and work shop.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Saw the metal by hand hack saw. **Standard (How well):** • Sawing work piece should be match with given drawing. • Tolerances of dimensions are within the ±0.5 mm	• Introduction of hacksaw. • Types of hacksaw. • Parts of hack saw. • Hacksaw blades and their types and material. • Selecting blade for different materials and sections. • Holding different sections of w/p for hack sawing. • Procedure of sawing the metal by hand.

Tools and Equipments:- Hand Hacksaw frame, Hacksaw blade, steel rule, marking scriber, steel hammer, flat anvil, dot punch/center punch, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Triangular file, Finishing file

Materials: MS Flat or MS Angle, Oil

Safety:-

1. Hold the job so as to cut on flat side rather than edge.
2. The teeth of the hacksaw blade should point towards the forwards direction.
3. The cutting movement should be steady and straight.
4. The full length of the blade should be engaged per stroke.
5. Avoid moving the blade too fast; slow down while finishing the cut.
6. Neither the blades too much neither tighten nor loose.
7. Avoid clamping the w/p over hang.

Duty: 3: PERFORM CUTTING.

Task :2 Chisel flat surface.

Time:-14 hrs
Theory:2 hrs
Practical:-12 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain the w/p and drawing. 2. Read drawing thoroughly. 3. Obtain work-piece material. 4. Obtain flat chisel, steel rule, height gauge, marking scriber, center punch, Steel hammer. 5. Prepare rectangular block as per drawing referring / following the same steps of previous task. 6. Mark the chipping depth using height gauge as per drawing. 7. Punch dotted on chipping depth line. 8. Clamp the work-piece securely in the vice. 9. Install chip guard. 10. Hold flat chisel in left hand. 11. Position the chisel at about 60°.angle 12. Hold the hammer at the end of the handle for maximum leverage. 13. Strike on chisel head starting from edge of the work-piece. 14. Stop chipping at the very close to end of the surface. 15. Turn the work-piece to chip at the end from the opposite direction. 16. Repeat the chipping until required surface quality and dimension obtain. 17. Punch the roll no on work piece. 18. Oil the surface of the work piece. 19. Store the work piece and tools. 20. Clean the vice and work shop.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Chisel flat surface. **Standard (How well):** • Chiseled work piece should be match with given drawing. • Tolerances of dimensions are within the ±0.5 mm	• Introduction of chisel and its types. • Fundamental of chipping. • Use of chisels. • Procedure of chipping flat

Tools and Equipments:- Hand Hacksaw frame, Hacksaw blade, steel rule, marking scriber, steel hammer, flat anvil, Chisels, dot/center punch, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Triangular file, Finishing file

Materials: MS Flat or MS Square bar, Oil
Safety:-

1. While chipping remove bangles and wrist watches.
2. Wear safety goggles.
3. The chisel head must be free from mushroom formation.
4. While chipping, look at the cutting edge of the chisel and not at the head of the chisel.
5. Wipe off oily substances, if any from the face of the hammer.

Duty: 3: PERFORM CUTTING.

Task :3: Chisel grooved surface.

Time:-12 hrs
Theory:-1 hrs
Practical:-11 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain drawing. 2. Read drawing thoroughly. 3. Obtain work-piece material. 4. Obtain Cross cut chisel, Concave chisel, Height gauge, Center punch, Steel rule, marking scriber, Center punch, Steel hammer. 5. Prepare rectangular block as per drawing referring / following the same steps of previous filing task. 6. Mark the chipping depth using height gauge as per drawing. 7. Punch dotted on chipping depth line. 8. Clamp the work-piece securely in the vice. 9. Install chip guard. 10. Hold cross cut chisel in left hand. 11. Position the chisel at about 60°.angle 12. Repeat the chiseling process as for flat surface from Step 13 to 18. 13. Hold concave chisel. 14. Repeat the chipping process as for step 14. 15. Repeat the chipping until required grooving dimension obtain. 16. Punch the roll no on work piece. 17. Oil the surface of the work piece. 18. Store the work piece and tools. 19. Clean the vice and work shop.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Chisel grooved surface. **Standard (How well):** • Chiseled work piece should be match with given check list. • Tolerances of dimensions are within the ±0.5 mm	• Introduction of chisel and its types. • Fundamental of chipping. • Use of chisels. • Procedure of chipping on groove .

Tools and Equipments:- Steel rule, marking scriber, dot/center, steel hammer, flat anvil, Cross cut Chisels, Concave chisel, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, files, Finishing file

Materials: MS Flat or MS Square bar, Oil

Safety:-

Refer as same as "Chisel flat surfaces".

Duty: 3: PERFORM CUTTING.

Task :4: Cut internal thread using hand taps(Tapping)

Time:-6 hrs
Theory:-1 hrs
Practical:-5 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain w/s drawing. 2. Read drawing thoroughly. 3. Obtain pre-machined work material. 4. Obtain drill size and required tools for internal threads. 5. Obtain sets of taps and tap handle/wrench. 6. Mark and punch on centre to drill hole. 7. Drill hole of required tap drill size. 8. Countersink the hole. 9. De-burr the hole. 10. Re-clamp the w/p on bench vice in horizontal position slightly above the vice jaws. 11. Fix the first tap in the tap handle/wrench. 12. Position the tap (90° with horizontal surface) in the countersinked hole. 13. Hold the tap handle closer to the centre. 14. Exert steady downward pressure and turn the tap handle in clockwise direction to start the thread. 15. Ensure the thread as well as check the tap alignment removing the tap handle. 16. Check the tap alignment with Back Square to ensure the tap being 90 º with the w/p surface. 17. Make corrections, if necessary by exerting slightly more pressure downward in the side having angle greater than 90º 18. Fit the tap handle without disturbing the tap alignment. 19. Make 1-2 clockwise turn and re-check the alignment. 20. Turn the tap handle lightly without exerting any downward pressure. 21. Turn anticlockwise quarterly after every clockwise full turn. 22. Apply cutting oil frequently. 23. Cut thread until the tap is fully inside the hole being threaded. 24. Remove the first tap. 25. Repeat the steps (18) to (23) for intermediate (Tap no 2) and bottoming tap (Tap no 3). 26. Remove the chips from thread. 27. Clean oil and chips. 28. Clean the vice. 29. Punch the roll no on work piece. 30. Oil the surface of the work piece. 31. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Cut internal thread using hand taps (Tapping). **Standard (How well):** • Tapping work piece should be match with given drawing.	• Introduction thread and its types • Introduction of tap and tapping • Types of tap • Thread nomenclature • Selection of drill bit for required tapping

Tools and Equipments:- Drill m/c, Sets of twist drills, Bench vice, Set of hand tap, Cutting oil can, Countersink 60º and 90º, Centre punch, Steel hammer, Number punch, Bench cleaning brush, File brush, Dust pan, files, tap handle, checking bolt

Materials: MS Flat, Oil

Safety:-

1. Use cutting fluid while cutting threads to avoid heat.
2. Avoid applying side pressure without giving turning motion to tap.
3. Tap alignment should be correct since starting of thread to avoid breaking of taps.
4. Tap handle should be chosen as per tap size.
5. Chips after cutting threads must be cleaned out from the hole and vice.

Duty: 3: PERFORM CUTTING.

Task:5: Cut external thread using threading dies (Dieing)

Time:-6 hrs
Theory:-1 hrs
Practical:-5 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain w/p drawing. 2. Read drawing thoroughly. 3. Obtain w/p material. 4. Obtain required hand tools: file, caliper, threading die, die handle, check nut. 5. Mark square at the end face as per thread diameter. 6. File roughly using the procedure of filing a square block. 7. File round bar of black using the steps of taste "File external radius". 8. Check the blank size with hole gauge. 9. Re-file until the blank diameter is obtained. 10. Chamfer 45º at the end of the blank. 11. Fix the die in die handle 12. Re-clamp the w/p on vice projecting the blank upward above the vice in 90º with the horizontal. 13. Place the leading side of the die on the chamfer of the w/p 14. Ensure the die is fully open by tightening the centre screw. 15. Hold the die handle close to the centre. 16. Apply pressure on die handle evenly and turn clockwise to advance the die on the bolt blank. 17. Ensure the thread starts by the time reverse frequently at about every quarter turn. 18. Cut thread until the die is fully down the length to be threaded. 19. Increase the depth of cut gradually by adjusting the outer screw and repeat above steps (16-19). 20. Check the thread with check nut. 21. Clear the die and the bench vice. 22. Clean oil and chips. 23. Punch the roll no on work piece. 24. Oil the surface of the work piece. 25. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Cut external thread using threading dies. **Standard (How well):** • Dieing work piece should be match with given drawing. • Tolerances of dimensions are within the ±0.5 mm	• Introduction of Dies and Dieing. • Required blank size for external thread.

Tools and Equipments:- Set of files, Check nut, caliper, Set of threading dies, Die handle, oil can with cutting oil, Bench vice, Centre punch, Steel hammer, Number punch, Bench cleaning brush, file set, file brush, Dust pan

Materials: MS rod, Oil

Safety:-

1. Check screws on the die handle before starting.
2. Check the depth of cut too much depth can damage die and threads.
3. Apply cutting fluid frequently to reduce heat and wash out the chips avoid clogging.
4. Keep the die handle at right angle to the job.

Duty: 4: PERFORM DRILLING.

Task:1: Drill a hole

Time:-8 hrs
Theory:-2 hrs
Practical:-6 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain the w/s drawing. 2. Read drawing thoroughly. 3. Obtain pre-finished w/p material. 4. Obtain drill bit as per the required size. 5. Mark layout line on the w/p. 6. Punch the centre. 7. Clamp the w/p on m/c vice of m/c table. 8. Clamp the drill bit on drill chuck by drill chuck key. 9. Set the RPM as per the drill bit size and the w/p material. 10. Start the machine. 11. Set the coolant housing pipe. 12. Give hand feed. 13. Apply the coolant on the rotating drill bit. 14. Reduce the feeding pressure at the bottom to the end. 15. Make sure the drill passes through. 16. Stop the machine. 17. Remove the w/p from m/c vice. 18. De-burr the drilled hole. 19. Clean oil and chips. 20. Punch the roll no on work piece. 21. Oil the surface of the work piece. 22. Store the work piece and tools. 23. Clean the vice and work shop.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Drill a hole. **Standard (How well):** • Drilling work piece should be match with given drawing. • Tolerances of dimensions are within the ±0.1 mm except drill hole	• Introduction of drill m/c. • Types of drill m/c • Parts of drill machine • Twist drills and its types. • Parts of drill bit • Cutting speed, feed and RPM. • RPM calculation according to the drill size and w/p material. • Handling of drill m/c(Operation and changing of belt) • Safety

Tools and Equipments:- Drill m/c with drill chuck key and drill bits, centre punch, steel hammer, Drill vice, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, files.

Materials: MS Flat, Oil, Coolant

Safety:-

1. Tighten the table lock to avoid dislocation of the w/p.
2. Use parallel block to prevent drilling on m/c vice or table.
3. Check the cutting edge of drill before drilling.
4. Mount the drill shank to its maximum length inside the drill chuck.
5. Check the drill centre alignment to avoid breading of drill.
6. Apply coolant fluently.
7. Use cleaning brush to clean out the chips.

Duty: 4: PERFORM DRILLING.

Task:2: Countersink a hole

Time:-4 hrs
Theory:-1 hrs
Practical:-3 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain workshop drawing. 2. Read drawing thoroughly. 3. Obtain previously drilled w/p material. 4. Obtain countersink as per the required size. 5. Mount the same size of twist drill on drill spindle on drill chuck. 6. Clamp the w/p in drill vice or hold by hand placing at the m/c table. 7. Align the centre of m/c spindle with the drilled hole to cut uniform angle. 8. Change countersink on drill machine chuck. 9. Set the RPM 10. Start machine. 11. Check the alignment giving feed by hand. 12. Re-align if necessary. 13. Give feed as per depth required. 14. Stop the machine. 15. Remove the work piece from vice. 16. Chamfer (De-burr) if necessary. 17. Check the final measurement. 24. Clean oil and chips. 25. Punch the roll no on work piece. 26. Oil the surface of the work piece. 27. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Countersink a hole. **Standard (How well):** • Countersinked work piece should be match with given check list. • Tolerances of dimensions are within the ±0.1 mm	• Introduction to countersink. • Types of countersink. • Importance of countersinking. • Safety

Tools and Equipments:- countersink 60º and 90º, Drill m/c with drill chuck key and drill bits, centre punch, steel hammer, Drill vice, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, files.

Materials: MS Flat, Oil

Safety:-

1. Check the cutting edge of the countersink.
2. Use drift to remove taper shank from drill spindle.
3. Use cleaning brush to clear out the chips.
4. Refer to the safety precaution of taste "drill a hole"

Duty: 4: PERFORM DRILLING.

Task:3: Counter Bore on Hole

Time:-4 hrs
Theory:-1 hrs
Practical:-3 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain workshop drawing. 2. Read drawing thoroughly. 3. Obtain countersink as per the required size. 4. Mount the same size of twist drill on drill spindle on drill chuck. 5. Clamp the w/p in drill vice or hold by hand placing at the m/c table. 6. Align the centre of m/c spindle with the drilled hole to cut uniform angle. 7. Change countersink on drill machine chuck. 8. Set the RPM 9. Start machine. 10. Check the alignment giving feed by hand. 11. Re-align if necessary. 12. Give feed as per depth required. 13. Stop the machine. 14. Remove the w/p 15. Chamfer (De-burr) if necessary. 16. Check the final measurement. 17. Clean oil and chips. 18. Punch the roll no on work piece. 19. Oil the surface of the work piece. 20. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Counterbore on hole. **Standard (How well):** • Counterbore work piece should be match with given check list. • Tolerances of dimensions are within the ±0.1 mm	• Introduction to countebore. • Types of countebore. • Importance of counterbore. • Safety

Tools and Equipments:- Drill m/c with drill chuck key, drill bits, centre punch, steel hammer, Drill vice, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, files, counter bore tool set.

Materials: MS Flat, Oil

Safety:-

1. Refer to the safety precaution of taste "Counter sink on hole"

Duty: 4: PERFORM DRILLING.

Task:4: Ream drilled hole using hand reamers

Time: 5 hrs.
Theory: 1 hrs
Practical: 6 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain workshop drawing. 2. Obtain pre-machined work-piece material. 3. Obtain guide drills, drill size for reamer and Countersink 90°. 4. Clamp the work-piece on machine vice. 5. Drill a hole referring the same steps of previous task from guide hole to drill size for reamer hole. 6. Change countersink and RPM 7. Countersunk the hole just as chamfer. 8. Stop the machine. 9. Fix the work-piece in the bench vice. 10. Hold tap handle on square end. 11. Place the reamer vertically on drilled hole. 12. Align the reamer with Try square. 13. Re-align if necessary. 14. Turn the tap handle in a clockwise direction applying a slight downward pressure at the same time. 15. Apply pressure evenly at both ends of the tap handle. 16. Ream the hole through. 17. Ensure that the taper lead length of the reamer comes out well and clear from the bottom of the work. 18. Remove the reamer with an upward pull until the reamer clear the hole. 19. Clean the hole. 20. Check the accuracy with the required cylindrical pins 21. Check the final measurement. 22. Clean oil and chips. 23. Punch the roll no on work piece. 24. Oil the surface of the work piece. 25. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Ream Drilled Hole Using Hand Reamers. **Standard (How well):** • Reaming work piece should be match with given drawing. • Tolerances according to the basic hole system.	• Introduction of reamer. • Determine the drill size for reamer • Procedure of using hand reamer.

Tools and Equipments:- countersink 60º and 90º, Drill m/c with drill chuck key and drill bits, centre punch, steel hammer, Reamer,Countersink,Drill vice, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file

Materials: MS Flat, Oil

Safety:-

- Turn the tap handles steadily and slowly, maintaining the downward pressure.
- Avoid turning the reverse direction for it will scratch the reamed hole.
- Use Vice covers to protect the finished surfaces.
- Apply oil to get good surface finish.
- Refer also the safety precautions of task Drill a hole.

Duty: 5: PERFORM OFF HAND GRINDING.

Task:1: Grind Center Punch.

Time: 4 hrs.
Theory: 1.0 hrs
Practical: 3 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain workshop drawing. 2. Read drawing thoroughly. 3. Obtain Bench or Pedestrian grinding machine. 4. Obtain blunt center punch. 5. Obtain Safety goggles, Bevel protractor or grinding gauge. 6. Check the grinding wheel abrasive type, trueness of wheel and cracks. 7. Dress the wheel, if necessary. 8. Check the tool-rest, set up if necessary. 9. Hold blunt center punch left hand side pointing the tip towards wheel. 10. Wear safety goggles 11. Run the machine. 12. Touch the angular part of tip on face of wheel, holding left hand side so that it can be turn freely by right hand side. 13. Give feeding slightly. Rotating the punch. 14. Check the angle with gauge or Bevel protractor. 15. Repeat the grinding until desired angle and sharpened tip obtained. 16. Check the final measurement. 17. Clean oil and chips. 18. Punch the roll no on work piece. 19. Oil the surface of the work piece. 20. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Grind Center Punch. **Standard (How well):** • Center punch should be match with given drawing. • Tolerances of dimensions are within the limit provided.	• Introduction of center punch • Uses of Center punch. • Procedure of grinding center punch. • Introduction of off- hand grinding • Type of grinding wheel • Material Component of grinding wheel

Tools and Equipments:- Bench or Pedestrian grinding machine, Safety goggles, Bevel protractor or grinding gauge**,** Blunt centre punch, steel hammer, Oil can, Number punch, Bench cleaning brush, Dust pan, Finishing file

Materials: Blunt center punch, Oil

Safety:-

- Make sure the grinding wheel guards are in place.
- Always wear safety goggles.
- Avoid working on grinding wheels which are loaded or glazed.
- It is dangerous to working cracked or improperly balanced wheels.
- Adjust the tool-rest as close to the wheels as possible. The maximum recommended gap is 2mm.
- Small jobs should be held with pliers or other suitable tools.
- Never holds jobs with cotton waste or similar materials.
- Use gloves while grinding heavy jobs.
- Avoid grinding on the side of the grinding wheels.

Duty: 5: PERFORM OFF HAND GRINDING.

Task:2: Grind Flat Chisel.

Time: 4 hrs.
Theory: 1.0 hrs
Practical: 3 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain workshop drawing. 2. Read drawing thoroughly. 3. Obtain Bench or Pedestrian grinding machine. 4. Obtain blunt Flat chisel. 5. Obtain Safety goggles, Bevel protractor or grinding gauge. 6. Check the grinding wheel abrasive type, trueness of wheel and cracks. 7. Dress the wheel, if necessary. 8. Set up tool-rest if necessary. 9. Hold Flat chisel by both hand pointing the tip towards wheel. 10. Wear safety goggles 11. Run the machine. 12. Position the angular part of tip up ward on face of wheel, fronting left hand side so that it can be move freely by right hand side. 13. Give feeding slightly moving across the full face. 14. Check the angle with gauge or Bevel protractor. 15. Repeat the grinding until desired angle and sharpened tip obtained. 16. Check the final measurement. 17. Clean oil and chips. 18. Punch the roll no on work piece. 19. Oil the surface of the work piece. 20. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Grind Flat Chisel. **Standard (How well):** • Chisel should be match with given check list. • Tolerances of dimensions are within the limit provided.	• Introduction of Chisels • Distinguish the features of chisels. • Procedure of re-sharpen the flat chisel.

Tools and Equipments:- Bench or Pedestrian grinding machine, Safety goggles, Bevel protractor or grinding gauge**,** Blunt flat chisel, steel hammer, Drill vice, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file

Materials: Flat chisel, Oil

Safety:-

- Move the work across the full face of the wheel to prevent uneven wearing off of the grinding wheel.
- Refer the same safety precautions of the task grind center punch.

Duty: 5: PERFORM OFF HAND GRINDING.

Task:3: Grind marking scriber.

Time: 4 hrs.
Theory: 1 hrs
Practical: 3 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain workshop drawing. 2. Read drawing thoroughly. 3. Obtain Bench or Pedestrian grinding machine. 4. Obtain blunt Marking Scriber. 5. Obtain Safety goggles, Bevel protractor or grinding gauge. 6. Check the grinding wheel abrasive type, trueness of wheel and cracks. 7. Dress the wheel, if necessary. 8. Set up tool-rest if necessary. 9. Hold Marking Scriber by left hand pointing the tip towards wheel. 10. Wear safety goggles 11. Run the machine. 12. Position the angular part of tip up ward on face of wheel, fronting left hand side so that it can be rotate freely by right hand side. 13. Give feeding slightly, rotating the Marking Scriber. 14. Check the angle with gauge or Bevel protractor. 15. Repeat the grinding until desired angle and sharpened tip obtained. 16. Check the final measurement. 17. Clean oil and chips. 18. Punch the roll no on work piece. 19. Oil the surface of the work piece. 20. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Grind marking scriber. **Standard (How well):** • Marking scriber should be match with given check list. • Tolerances of dimensions are within the limit provided.	• Features of Marking Scriber • Procedure of re-sharpen marking scriber

Tools and Equipments:- Bench or Pedestrian grinding machine, Safety goggles, Bevel protractor or grinding gauge**,** Blunt Marking Scriber, Oil can, Number punch, Bench cleaning brush, Dust pan
Materials: Blunt marking scriber, Oil
Safety:-

- Move the work across the full face of the wheel to prevent uneven wearing off of the grinding wheel.
- Refer the same safety precautions of the task grind center punch.

Duty: 5: PERFORM OFF HAND GRINDING.

Task:4: Re-sharpen twist drills.

Time: 6 hrs.
Theory: 1 hrs
Practical: 5 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain workshop drawing. 2. Read drawing thoroughly. 3. Obtain Bench or Pedestrian grinding machine. 4. Obtain blunt drill bits. 5. Obtain Safety goggles, Bevel protractor or grinding gauge. 6. Check the grinding wheel abrasive type, trueness of wheel and cracks. 7. Dress the wheel, if necessary. 8. Set up tool-rest if necessary. 9. Hold twist drills lightly between the thumb and the first finger, pointing the tip towards wheel. 10. Wear safety goggles 11. Run the machine. 12. Hold the drill level and turn it to 59° to the face of the wheel so that the cutting edge is horizontal and parallel to the grinding wheel - face. 13. Swing the shank of the drill slightly downward and towards the left. 14. Rotate the drill to the right by turning it between the thumb and the finger. 15. Apply a slight forward motion while swinging down; this will help to form the clearance angle. 16. Repeat the process from step no. 13 to 16 to re-sharpen the second cutting edge. 17. Check both the cutting edges with a drill angle gauge or Bevel protractor, for correctness of the lip angle and equality of the lip length. 18. Repeat the grinding until desired angle and sharpened tip obtained. 19. Check the final measurement. 20. Clean oil and chips. 21. Punch the roll no on work piece. 22. Oil the surface of the work piece. 23. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Re-sharpen Twist Drills. **Standard (How well):** • Twist drill bit should be match with given drawing. • Tolerances of dimensions are within the ±0.5 mm	• Introduction of drill bit and its types • Angle of drill bit • Procedure of re-sharpen drill bit

Tools and Equipments:- Bench or Pedestrian grinding machine, Safety goggles, Bevel protractor or grinding gauge**,** Blunt twist drill bit, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan

Materials: Twist drills, Oil

Safety:-

- Move the work across the full face of the wheel to prevent uneven wearing off of the grinding wheel.
- Refer the same safety precautions of the task grind center punch.

Duty: 6: HANDLE MEASURING INSTRUMENTS.

Task:1: Check square-ness using back square

Time:-6 hrs
Theory:-1 hrs
Practical:-5 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain work shop drawing. 2. Read drawing thoroughly. 3. Obtain pre-machined w/p material. 4. Obtain a back square of required size. 5. Hold the w/p in one hand and place the stock of the square against the vertical surface. 6. Slide the stock down the vertical surface until the blade touches the flat surface of work piece. 7. Position the work so that the light falls on it from behind. 8. Check whether any light passes between the work-piece and the blade if not, the surfaces of w/p are 90º to each other. 9. If yes correct the surface by re-filing. 10. Check other adjacent angles as same as the first one. 11. Wipe the back square. 12. Clean any oil and chips from the work piece. 13. Punch the roll no on work piece. 14. Oil the surface of the work piece. 15. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Check square- ness using back square. **Standard (How well):** • Adjacent sides must be 90º to each other i.e. no light should pass between the blade and the surface. • Work piece should be match with given drawing.	• Introduction of back square. • Features of back square. • Checking back Square before use. • Care of back square.

Tools and Equipments:- Back square, Steel rule, marking scriber, steel hammer, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, file set, center punch

Materials: MS Flat, Oil

Safety:-

- Ensure that blade and the stock of back square are not damaged and are 90º to each other.
- Clean the w/p and de-burr before checking with back square.
- Hold the stock firmly against the w/p while sliding it down.
- Avoid placing back square where there is chance of falling and damaging.

Duty: 6: HANDLE MEASURING INSTRUMENTS.

Task:2: Check radius with radius gauge.

Time:-6 hrs
Theory:-1 hrs
Practical:-5 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain drawing. 2. Read drawing thoroughly. 3. Obtain pre- filed work-piece. 4. Obtain radius gauge as required size. 5. Hold the radius gauge in one hand & work-piece in other hand. 6. Held radius gauge perpendicular to the radius to be checked. 7. Observe the contact surfaces of any light passing through. 8. Move along the filed length of the radius for checking. 9. File and adjust the radius gradually according to the radius gauge 10. Wipe them clean with a clean cloth and apply a light film of oil before storing. 11. Clean any oil and chips from the work piece. 12. Punch the roll no on work piece. 13. Oil the surface of the work piece. 14. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Check Radius with Radius Gauge. **Standard (How well):** • No light should pass between the gauge and the surface.	• Introduction of the radius gauge. • Features of radius gauge. • Self made radius gauge. • Procedure of checking radius surface.

Tools and Equipments:- Radius gauge, Steel rule, marking scriber, steel hammer, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, file set, center punch

Materials: MS Flat, Oil

Safety:-

- Ensure that surface of radius gauge are not damaged.
- Hold the stock firmly against the w/p while sliding it down.
- Before checking with a radius gauge ensure the radius gauge is perfectly clean.
- Remove burrs, if any from the work-piece.

Duty: 6: HANDLE MEASURING INSTRUMENTS.

Task:3: Take angular measurements using bevel protractor.

Time:-6 hrs
Theory:-1 hrs
Practical:-5 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain work shop drawing. 2. Read drawing thoroughly. 3. Obtain pre-machined work-piece material. 4. Obtain Bevel protractor. 5. Set the angle that has to be measure. 6. Hold the work-piece in one hand and place the bevel of the protractor against the adjacent surface. 7. Slide the bevel down the vertical surface until the protractor blade touches the angular surface. 8. Position the work so that a bright light, such as a window or an electric light, is behind the work-piece. 9. Look at between work-piece and protractor to see if any light shows between the blade and the work-piece. If no light can be seen, the surfaces of the work-piece are at required angle. 10. Wipe the Bevel protractor clean and put it in its storing place. 11. Clean any oil and chips from the work piece. 12. Punch the roll no on work piece. 13. Oil the surface of the work piece. 14. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Take Angular Measurements Using Bevel Protractor. **Standard (How well):** • No light should pass between the blade of protractor and the surface. • Work piece should be match with given drawing.	• Introduction of Bevel protractor. • Features of bevel protractor. • Uses of Bevel protractor. • Importance of measuring angular surface.. • Procedure of taking angular measurements

Tools and Equipments:- Bevel protractor, Steel rule, marking scriber, steel hammer, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file

Materials: MS Flat, Oil

Safety:-

- Refer same safety precautions of the task of "Check square-ness using back square".

Duty: 6: HANDLE MEASURING INSTRUMENTS.

Task:4: Measure the dimensions using Vernier Caliper.

Time:-12 hrs
Theory:-2 hrs
Practical:-10 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain pre-machined work-piece material. 2. Obtain Vernier caliper. 3. Clean the caliper with a clean cloth. 4. Check that the caliper reads correctly by moving the jaws together, so that they touch & checking that scale reads zero. 5. Clean the work-piece, remove burrs. 6. <u>Measuring outside dimensions.</u> 7. Set the outside measuring jaws to a dimension larger than that to be measured. 8. Place the fixed jaw against the w/p. 9. Move the sliding jaw so that the work piece is gripped by the caliper. 10. Make sure that the jaws are in full contact and not just their tips. 11. Read the number of millimeters on the main scale which show in front of the zero of the vernier scale. 12. Then read the tenths of mm (0.1) or twentieths (0.05) on the vernier scale. 13. <u>Measuring inside dimensions.</u> 14. Set the inside measuring jaws of the caliper to a dimension smaller than the dimension to be measured. 15. Place the fixed jaw against the w/p. 16. Move the sliding jaw so that the caliper grips the work-piece. 17. Read the measurement as for the outside dimension.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Measure the dimensions using Vernier Caliper. **Standard (How well):**. • Tolerances of dimensions are within the ±0.02mm	• Introduction of Vernier caliper. • Features of Vernier caliper. • Reading the scale. • Uses of vernier caliper. • Least count of vernier caliper. • Care and maintain of Vernier caliper. • Procedure of Using Vernier Caliper

Tools and Equipments:- Vernier caliper, Steel rule, marking scriber, steel hammer, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, file set, drill bit set,

Materials: MS Flat, Oil

Safety:-

- Clean the work-piece and remove any burrs before taking any measurement.
- Vernier calipers are precision measuring instruments and must be cared for accordingly.
- Avoid leaving the caliper in a place where it could fall, contact with sharp cutting tools and thus get damaged.
- Wipe the vernier caliper clean and place it in its correct storage place.
- Vernier calipers should be used only for measuring.

Duty: 7: PERFORM PROJECT WORK.

Task:1: Manufacture a Drill plate includes Counter-bore & Reamed hole.

Time:-15 hrs
Theory:-0 hrs
Practical:-15 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain workshop drawing 2. Obtain workpiece material 3. Obtain necessary tool and equipments 4. Measure rough dimension and file one side (marrow) plane for reference plane 5. Based on marrow file out all six surface maintaining dimensions and right angle. 6. Mark layout line on workpiece for necessary drilling. 7. Punch dots on marking lines 8. Checked the drill machine and clamping vice. 9. Make a drill hole according to the given drawing on punched dots. 10. Counter bore on required holes. 11. Counter sunk on all holes as its requirement. 12. Reamed the drilled hole as its requirements. 13. Check the final measurement. 14. Clean any oil and chips from the work piece. 15. Punch the roll no on work piece. 16. Oil the surface of the work piece. 17. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Manufacture a Drill plate includes Counter-bore & Reamed hole. **Standard (How well):**. • Tolerances of dimensions are within the ±0.1 mm	

Tools and Equipments:- Vernier caliper, Counter-bore , Reamer, Drill bits Steel rule, marking scriber, steel hammer, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, file set, center punch

Materials: MS Flat, Oil

Safety:-

- Tighten the table lock nut to prevent the setting from being disturbed.
- Use parallel block to prevent being drill on drill vice or machine table.
- Check the cutting edge of drill bit before drilling a hole.
- Mount the drill shank as much as possible.
- Be ensuring the drill center is as you wish.
- Apply fluent coolant.
- Use cleaning brush to clean out the chips.

Duty: 7: PERFORM PROJECT WORK.

Task:2: Manufacture a Steel Hammer of 500mm.

Time:-30 hrs
Theory:-0 hrs
Practical:-30 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain workshop drawing 2. Obtain workpiece material 3. Obtain necessary tool and equipments 4. Measure rough dimension and file one side (marrow) plane for reference plane 5. Mark layout line on workpiece for necessary sawing and filing 6. Punch dots on marking lines 7. Saw the side portion for steep length 8. Make rectangular block of required size according to the given drawing 9. File radius on pin side 10. File next radius on bottom side 11. Drill a hole for wooden handle 12. File a hole of circular to oval 13. Enlarge side by side on both side in all periphery 14. Chamfer and deburr all sharp edges 15. Check the final measurement. 16. Clean any oil and chips from the work piece. 17. Punch the roll no on work piece. 18. Oil the surface of the work piece. 19. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Manufacture a Steel Hammer of 500mm. **Standard (How well):**. • Tolerances of dimensions are within the ±0.1 mm	

Tools and Equipments:- Vernier caliper, Counter-bore , Reamer, Drill bits Steel rule, marking scriber, steel hammer, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, file set, center punch

Materials: MS rod, Oil

Safety:-

- Refer the task File flat surface, Punch dot and center, Saw the metal by hand, and Drill a hole and Radius filing.

Duty: 7: PERFORM PROJECT WORK.

Task:3: Manufacture a C - Clamp.

Time:-20 hrs
Theory:-0 hrs
Practical:-20 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain workshop drawing 2. Obtain workpiece material 3. Check rough dimension and file out one side (marrow) plane as a reference plane 4. Mark a layout for necessary dimension to saw 5. Punch dots on marking lines 6. Drill holes to get internal radius R7mm 7. Drill chain holes to cut out unnecessary metal 8. Remove stock material by chiseling the webs 9. Maintain the thickness of 15mm with correct flatness and squareness in geometrical tolerances 10. Drill a hole Ø8,5mm for M10 thread 11. Make diamond surface on the drill surface 12. Make radius of R12 and R7.5 on two corners as per given drawing 13. Chamfer and finish the workpiece 14. Check final measurements 15. Chamfer and deburr all sharp edges 16. Check the final measurement. 17. Clean any oil and chips from the work piece. 18. Punch the roll no on work piece. 19. Oil the surface of the work piece. 20. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Manufacture a C - Clamp. **Standard (How well):**. • Tolerances of dimensions are within the ±0.1 mm	

Tools and Equipments:- Vernier caliper, **d**rill bits, Steel rule, marking scriber, steel hammer, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, file set, center punch, tap set, tap handle, drill machine

Materials: MS Flat, Oil

Safety:-

- Refer the task Drilling, Sawing, Thread cutting by using taps and Plain filing.

Duty: 7: PERFORM PROJECT WORK.

Task:4: Manufacture a Back Square of 120mm.

Time:-15 hrs
Theory:-0 hrs
Practical:-15 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
Position 1: 1. Obtain workshop drawing 2. Obtain workpiece material as per required number 3. Obtain necessary tool and equipment 4. Measure rough dimension and file out side by side to prepare a square block with geometrically 90° 5. Mark a layout line on workpiece 6. Punch dots on marking line 7. Saw the metals to cut out unnecessary parts 8. File out the flat even surface 9. File out opposite flat even surface 10. Maintain the thickness required and flat even surface 11. File out the width of blade with geometrically 90° 12. Drill the holes on side as per given drawing 13. Chamfer and deburr all sharp edges 14. Perform internal thread using hand taps 15. Check the final measurements **Position 2:** 1. Refer and follow the step of Pos. 1 from 4 to 11 2. Mark the layout line for drilling the holes 3. Punch center on drilling marks 4. Drill the holes as per required size 5. Counter sunk the holes with 60° 6. Chamfer and deburr all sharp edges 7. Check the final measurements	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Manufacture a Back Square of 120mm. **Standard (How well):**. • Tolerances of dimensions are within the ±0.1 mm	

Tools and Equipments:- Vernier caliper, drill bits, Steel rule, marking scriber, steel hammer, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, file set, back square, drill machine, drill vice

Materials: MS Flat, Oil

Safety:-

- Refer the task File flat surface, Saw the metal by hand, Drill a hole, internal thread using hand taps and Countersink the hole.

Duty: 7: PERFORM PROJECT WORK.

Task:5: Manufacture a Center Square.

Time:-20 hrs
Theory:-0 hrs
Practical:-20 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
Position 1: 1. Obtain workshop drawing 2. Obtain workpiece material as per required number 3. Obtain necessary tool and equipment 4. Measure rough dimension and file out side by side to prepare a square block with geometrically 90° 5. Mark a layout line on workpiece 6. Punch dots on marking line 7. Saw the metals to cut out unnecessary parts 8. File out the flat even surface 9. File out opposite flat even surface 10. Maintain the thickness required and flat even surface 11. File out the width of blade with geometrically 90° 12. Drill the holes on side as per given drawing 13. Chamfer and deburr all sharp edges 14. Perform internal thread using hand taps 15. Check the final measurements **Position 2:** 1. Refer and follow the step of Pos. 1 from 4 to 11 2. Mark the layout line for drilling the holes 3. Punch center on drilling marks 4. Drill the holes as per required size 5. Counter sunk the holes with 60° 6. Chamfer and deburr all sharp edges 7. Check the final measurements ***Assemble the both parts with countersunk head screws***.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Manufacture a Center Square. **Standard (How well):**. • Tolerances of dimensions are within the ±0.1 mm	

Tools and Equipments:- Vernier caliper, **d**rill bits Steel rule, marking scriber, steel hammer, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, file set, drill machine, drill vice, center punch

Materials: MS Flat, Oil

Safety:-

- Refer the task File flat surface, Punch dot and center, Saw the metal by hand, and Drill a hole and Radius filing.

Duty: 7: PERFORM PROJECT WORK.

Task:6: Manufacture a Divider.

Time:-30 hrs
Theory:-0 hrs
Practical:-30 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
Position 1: 1. Obtain workshop drawing 2. Obtain workpiece material 3. Obtain necessary tool and equipments 4. Measure rough dimension and file one side (marrow) plane for reference plane 5. Based on marrow, file out all six surface maintaining dimensions and right angle. 6. Mark layout line on workpiece for necessary sawing and filing 7. Saw the side portion for steep length 8. Make rectangular block of required size according to the given drawing 9. Chamfer and deburr all sharp edges 10. Check the final measurement **Position 2:** 1. Refer and follow the step of Pos. 1 from 1 to 10 2. Mark the layout line for drilling the holes 3. Punch center on drilling marks ***Assemble the both parts with countersunk head screws***.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Manufacture a Divider. **Standard (How well):**. • Tolerances of dimensions are within the ±0.1 mm	

Tools and Equipments:- Vernier caliper, drill bits Steel rule, marking scriber, steel hammer, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, file set, center punch, drill machine, drill vice

Materials: MS rod, Oil

Safety:-

- Refer the task File flat surface, Punch dot and center, Saw the metal by hand, and Drill a hole and Radius filing.

Duty: 7: PERFORM PROJECT WORK.

Task:7: Manufacture a Hand Hacksaw Frame.

Time:-50 hrs
Theory:-0 hrs
Practical:-50 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
Position Frame: 1. Obtain workshop drawing 2. Obtain workpiece material 3. Obtain necessary tool and equipments 4. Measure rough dimension and file one side (marrow) plane for reference plane 5. Mark layout line on workpiece for necessary sawing and filing 6. Punch dots on marking lines 7. Saw the side portion for steep length 8. Make rectangular block of required size according to the given drawing 9. File radius on pin side 10. File next radius on bottom side 11. Drill a hole for wooden handle 12. File a hole of circular to oval 13. Enlarge side by side on both side in all periphery 14. Chamfer and deburr all sharp edges 15. Check the final measurement **Position :** 16. Obtain workshop drawing 17. Obtain workpiece material 18. Obtain necessary tool and equipments 19. Measure rough dimension and file one side (marrow) plane for reference plane 20. Mark layout line on workpiece for necessary sawing and filing 21. Punch dots on marking lines 22. Saw the side portion for steep length ***Assemble the welding parts.***	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Manufacture a Hand Hacksaw Frame. **Standard (How well):**. • Tolerances of dimensions are within the ±0.1 mm	

Tools and Equipments:- Vernier caliper, **d**rill bits Steel rule, marking scriber, steel hammer, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, file set, center punch, drill machine, welding rod, tap set, die set, handles (tap and die)

Materials: MS square, Oil

Safety:-

- Refer the task File flat surface, Punch dot and center, Saw the metal by hand, and Drill a hole and Radius filing.

BOOK AND REFERENCES

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- Henp Fort, *Shop Theory (Vol. 1),* Trade School
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- 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.

Computer Application

Total: 78 hrs
Class/week: 2 hrs

Course Description:
This course intends to impart the competencies required to prepare document, spreadsheets, presentations slides and database management sheets by using different computer application packages.

Module: 1 Maintain Computer System

S.N.	Task Statements	Related Technical Knowledge	Time (hrs)	
			T	P
1.	Install Computer Peripheral	▪ Introduction ▪ Identify input devices (keyboard, mouse, joystick, and scanner), output devices (monitor, printer/plotter, sound card, and speaker), central processing unit, memory unit, and auxiliary storage devices (hard disk, CD/DVD/Blue Ray, Pen drive, memory card). ▪ Explain different types of ports (Parallel, Serial, USB, IEEE 1394 and Slots) ▪ Explain the precaution to be taken while installing computer peripheral.	0.50	1.00
2.	Install Operating System	▪ Explain operating system including its role. ▪ Describe different types of operating systems (MS-DOS, Windows, Unix, Linux) ▪ Enlist the function of DOS Commands (COPY, REN, DIR, TYPE, CD, MD and BACKUP). ▪ Explain precautions to be taken while installing operating system. ▪ Make a list of tasks to be performed before, during and after installation of MS Window operating system.	0.50	4.00
3.	Install Application/Driver Software	▪ Differentiate application software and driver software. ▪ Describe the uses of antivirus program. ▪ Explain the procedure for	0.5	2.00

S.N.	Task Statements	Related Technical Knowledge	Time (hrs)	
			T	P
		installing application/driver software ▪ Describe the features of Control Panel		
4.	Uninstall Software/Application			1.00
5.	Format External Mass Storage			0.50
	Sub total		**1.50**	**8.5**

Module: 2 Prepare Documents using Word Processing Package

S.N.	Task Statements	Related Technical Knowledge	Time (hrs)	
			T	P
6.	Perform Typing Practice	▪ Explain the interface of Word Processing including different tools/menu. ▪ Describe how to open, save document and exit. ▪ Explain the procedure to type document in word processing software ▪ Demonstrate systematic way of typing.	0.50	2.00
7.	Setup Page in Word Processing.	▪ Explain different features and attributes of “Page Setup” Box. ▪ Explain how to setup margins, orientation, size and columns. ▪ Define Breaks, Line numbers and Hyphenation. ▪ Explain the procedure to setup page.	0.25	1.00
8.	Insert Object/Picture/Photo			1.00
9.	Insert Header/Footer	▪ Differentiate Header and Footer. ▪ Explain the procedure to insert different header and footer in different pages.	0.25	1.00
10.	Insert Table	▪ Explain row and column. ▪ State the procedure to insert table ▪ Describe table formatting procedure (Border and Color).	0.50	1.00
	Sub total		**1.50**	**6.00**

Module: 3 Prepare Spreadsheets using Spreadsheet Package

S.N.	Task Statements	Related Technical Knowledge	Time (hrs)	
			T	P
11.	Create workbook.	▪ Explain the concept and uses of Spreadsheet. ▪ Interpret Spreadsheet's Interface. ▪ Differentiate among column, row, cell, workbook, worksheet, labels, values, dates and formulas.	0.50	2.00
12.	Analyze data using basic formula/function	▪ Interpret "Insert Function" Box. ▪ Differentiate Relative and Absolute Cell Reference ▪ Explain the procedure to insert formula/function	0.50	1.00
13.	Create Chart/Graph	▪ Explain differentiate types of charts/Graph. ▪ State the procedure to create chart/graph.	025	1.00
14.	Filter Data	▪ Differentiate between filtering and sorting. ▪ Explain the purpose of filtering. ▪ Interpret filtered data.	0.25	1.00
15.	Sort Data	▪ Explain the purpose of sorting. ▪ Interpret sorted data.	0.25	1.00
16.	Setup Page in Spreadsheet	▪ Explain different features and attributes of "Page Setup" Box. ▪ Explain how to setup margins, orientation, size and columns. ▪ Explain the procedure to setup page.	0.25	1.00
	Sub total		**2.00**	**7.00**

Module: 4 Create Presentation using Presentation Package

S.N.	Task Statements	Related Technical Knowledge	Time (hrs)	
			T	P
17.	Prepare Master Slide	▪ Interpret Presentation package interface including tools/menu. ▪ Differentiate among slides, master slide, outline, notes page, handout master, notes master and slide sorter. ▪ Explain the purpose of preparing master slide. ▪ Enlist the procedure to prepare	1.00	1.00

S.N.	Task Statements	Related Technical Knowledge	Time (hrs)	
			T	P
		master slide including formatting and editing.		
18.	Prepare Slides	▪ Explain the procedures to insert Text, Pictures/Objects/ Sound and Charts/Graphs.	0.50	2.00
19.	Animate the content of slide.	▪ Define animation. ▪ Explain the procedure to apply animation to the content of slide. ▪ Differentiate between transition and animation.	0.50	1.00
20.	Perform On-screen Presentation	▪ Explain the procedure to perform on-screen presentation. ▪ State the precautions to be taken while connecting computer with Multimedia Projector for presentation.	0.50	2.00
	Sub total		**2.50**	**6.00**

Module: 5 Maintain Database Management System using Database Package.

S.N.	Task Statements	Related Technical Knowledge	Time (hrs)	
			T	P
21.	Create Database Table	▪ Define Database. ▪ Explain the purpose of Database Management System ▪ Interpret the interface of Database Package including tools/menu. ▪ Differentiate Table, Query, Form and Report. ▪ Enlist the procedure to create database table.	1.00	2.00
22.	Create Query	▪ Explain the procedure to create query.	0.50	1.00
23.	Generate report	▪ State the procedure to generate report. ▪ Explain the procedure to print report.	0.50	1.00
	Sub total		**2.00**	**4.00**

Module: 6 Manage e-mail/internets.

S.N.	Task Statements	Related Technical Knowledge	Time (hrs)	
			T	P
24.	Browse Information through Internet	▪ Differentiate among web server, web browser, web site, domain name system (DNS), WWW, search engine and internet service provider. ▪ State the precaution to be taken while browsing through internet. ▪ List the steps for information browsing through internet.	0.50	1.00
25.	Send mail through internet.	▪ Explain the concept of e-mail. ▪ Differentiate Web based e-mail and POP e-mail. ▪ Explain the procedure to send mail through internet.	0.50	1.00
	Sub total		**1.00**	**2.00**

Project works

26.	Following projects are to be prepared and submitted (e-copy) using different packages. • Create a Bio-Data in Word Processing giving Educational and Personal Details. • Create a Spreadsheet Worksheet entering marks of five subjects of 20 students. Perform sorting according to their rank and generate a suitable graph for the same data. • Design a presentation with not less than 10 slides on trade specific topic. • Create a Database in Database package with not less than 20 entries. Query and then generate the report.		34.00
	Sub total	**0**	**34.00**
	Total	**10.50**	**67.5**
	Grand total	**78**	

Engineering Drawing - I

Total: 117 hrs
Class/week: 3 hrs

Unit/sub unit	Duties and Tasks	Time - hrs	
		Th.	**Pr.**
1	**Handle Instruments**		
1.1	Set up paper in drawing board	1	1
1.2	Draw title box using T set and Set square or Mini draft	1	2
1.3	Draw representative lines	1	2
1.4	Write engineering letter.	1	1
2	**Construct Geometrical Figures**		
2.1	Bisect Straight line / divide line	0.5	1.5
2.2	Bisect an angle	0.5	1.5
2.3	Draw circle using compass	0.5	1.5
2.4	Draw square/rectangle	0.5	1.5
2.5	Draw triangle using set-square & protractor	0.5	1.5
2.6	Construct ellipse	0.5	3.5
3	**Draw in Scale**		
3.1	Represent the drawing in scale.	1	2
3.2	Represent the dimension in detail	1	3
3.3	Determine the tolerances	1	3
3.4	Draw the symbols	2	2
4	**Draw Pictorial Projection**		
4.1	Draw isometric projection	2	14
4.4	Draw oblique projection	2	6
5	**Draw Orthographic Projection**		
5.1	Draw three view in first angle projection	2	16
5.2	Draw three view in Third angle projection	1	7
5.3	Find and draw missing views.	-	8
6	**Draw Sectional Drawing**		
6.1	Draw full section views	2	8
6.2	Draw half section views		4
6.3	Draw partials section views	-	6
	sub Total	***21***	***96***
	Total	***117***	

TASK ANALYSIS

Duty: 1.HANDLE INSTRUMENTS

1.1 Set up Paper in Drawing Board

Time: 2.0 hrs.
Exercise: 1 hrs
Demo: 1 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Place the drawing board straightness to the left side 2. Clean up the drawing board 3. Set up base paper over drawing board 4. Place drawing paper over the base paper 4. Set the T-set on the drawing board 5. Align drawing paper with T-set 6. Hold on drawing paper with drawing tape	**Condition:** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task:** Set up paper in drawing board. **Standards:** • The bottom edge of paper should be parallel to the T-set drawing edge. • Hold the drawing paper without stretch.	- Paper size for drawing and designing work. - Drawing board - material, sizes and application. - Uses of T-set. - Overview of drafter/mini drafter

Safety Precautions :

- Avoid using damaged drawing board.
- Avoid using damaged T-set.

Duty: 1. HANDLE INSTRUMENTS

1.2 Draw Title Box Using T Set and Set Square

Time: 3 hrs.
Exercise: 2 hrs
Demo: 1 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Set up paper in drawing board 2. Mark a point at top remaindering margin with scale by pencil 3. Attach the T-set on ebony working edge so that a horizontal line can draw on the marked point 4. Draw a line of full length. 5. Mark the point at both sides remaindering margins 6. Place the Set square aligning the working edge of T-set so that a vertical line can draw on side marked point 7. Draw a line of full length 8. Repeat the same steps for next vertical line 9. Repeat the steps of top horizontal line for bottom horizontal line 10. Erase the lines over-drawn on every corner 13. Decide the information column and rows 14. Decide the dimensions of column and rows 15. Draw respectively from the bottom. 16. Write titles of the column. 17. Give darkness of all drawn lines with HB pencil 18. Clean up the drawing sheet.	**Condition:** Fully equipped Classroom with Drawing board, T-set, Setsquare and drawing instrument. **Task:** Prepare a drawing sheet using T - set and Set square. **Standards:** • All the columns and row for drawing information's should be allocatd. • Title box should be within given area. • Title block should be made in standard format.	- Set square and its uses - Drawing sheet Title Box. - Paper size - Layout the drawing sheet - Particulars of title blocks

Safety Precautions :

- Avoid using damaged drawing board.
- Avoid using damaged instruments.

Duty: 1. HANDLE INSTRUMENTS

1.3. Draw Engineering Lines

Time: 3.0 hrs.
Exercise: 2 hrs
Demo: 1 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Set paper in drawing board 2. Prepare a drawing sheet 3. Scaled and mark the drawing sheet into spacing 10 mm leaving the margin in side boarder 4. Attach the ebony working edge of T-set 5. Bring the working edge on the marked point 6. Draw a continuous thick line 7. Move T-set to next marked point and draw the line 8. Repeat the step 7 and draw the lines in full of the drawing sheet 9. Write continuous thick line and dates in information column 10. Change drawing paper 11. Repeat same steps till step 5 12. Draw invisible line 13. Repeat the step 7 and draw the lines in full of the drawing sheet	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task :** Draw representative lines. **Standards:** • Line thickness should be according to international standard. • Neatness and cleanliness is maintained.	• Introduction of drawing Engineering lines • Types of Engineering lines and its applications. • Introduction of Pencil and its uses and types in engineering drawing

Safety Precautions :

- Rotate the pencil while drawing the lines to maintain the same thickness.

Duty: HANDLE INSTRUMENTS

1.4 Write Engineering Letter

Time: 2.0 hrs.
Exercise: 1 hrs
Demo: 1 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Set paper in drawing board 2. Prepare a drawing sheet 3. Scaled and mark on the drawing sheet for spacing height 4. Draw horizontal lines for approximately 26 letters and 10 numbers 5. Set up the compass for 70 ° inclined line 6. Draw dividend lines 7. Hold the pencil vertically and start writing the Capital letters "A to Z" and numbers "1 to 10" along the inclined line 8. Write the small letters "a to z" along the inclined line same as above step 9. Ensure the letters and numbers are dark enough 10. Clean up the drawing sheet.	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument **Task :** Write engineering letter. **Standards:** • Letter should be block, uniform, neat and clean.	- Importance of writing engineering letter. - Method of writing engineering letters. - Types of case in letter writing.

Safety Precautions :

Duty: 2. CONSTRUCT GEOMETRICAL FIGURES

2.1. Bisect Straight line / Divide line

Time: 2.0 hrs.
Exercise: 1.5 hrs
Demo: 0.5 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Set paper in drawing board 2. Prepare a drawing sheet 3. Decide the length of Straight line to be bisect 4. Scaled and mark on the drawing sheet 5. Draw straight line AB, with centre A and radius greater than half AB, draw arcs on both sides. 6. Draw arcs intersecting the each other at C and D. 7. Draw a line joining C and D and cutting AB at E. 8. Obtain the line AB (AE=EB) 9. Bisect CD at right angle.	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task :** To Bisect Straight line **Standards:** • Line should be according to provided dimension, uniform, neat and clear edge.	- - Introduction of Geometrical Elements - Uses of Compass in workshop drawings. - Instruments that uses to draw arcs in drawing.

Safety Precautions :

Duty: 2. CONSTRUCT GEOMETRICAL FIGURES

2.2 Bisect an angle

Time: 2.0 hrs.
Exercise: 1.5 hrs
Demo: 0.5 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Set paper in drawing board 2. Prepare a drawing sheet 3. Decide an angle to be bisect 4. Scaled and mark on the drawing sheet 5. Draw an angle ABC, with B as centre and any radius 6. Draw an arc cutting AB at D and BC at E. 7. Draw the arcs with centers D and E any convenient radius 8. Draw arcs intersecting each other at F. 9. Join the line BF.BF bisects the angle ABC.	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task :** To Bisect an angle. **Standards:** • Dimension should be according to criteria.	- Uses of Compass and in workshop drawings. - Instruments that uses to draw circles in drawing.

Safety Precautions :

Duty: 2. CONSTRUCT GEOMETRICAL FIGURES

2.3 Draw Circle Using Compass

Time: 2.0 hrs.
Exercise: 1.5 hrs
Demo: 0.5 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Set paper in drawing board 2. Prepare a drawing sheet 3. Decide the diameter of circle to be draw 4. Scaled and mark on the drawing sheet 5. Draw cross line and center line in each and every marked centers 6. Obtain a compass, set the radius length in scale as the circle to be draw 7. Place a needle of compass on the center 8. Hold rotator of compass, rotate it in clockwise direction compressing towards a pencil 9. Ensure the circle drawn is dark enough	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task :** Draw circle using compass. **Standards:** • Start and end point should not seen. • All lines should be uniform. • Radius/dimeter should be in given dimension.	- Uses of Compass and representative of circles in workshop drawings. - Instruments that uses to draw circles in drawing.

Safety Precautions :

- Handle compass carefully.
- Keep the compass in proper place.

Duty: 2.CONSTRUCT GEOMETRICAL FIGURES

2.4. Draw Square / Rectangle

Time: 2.0 hrs.
Exercise: 1.5 hrs
Demo: 0.5 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Set paper in drawing board 2. Prepare a drawing sheet 3. Decide the dimension of square or rectangle to be draw 4. Scaled and mark on the drawing sheet 5. Refer and follow the steps of drawing sheet preparation for construction lines. 6. Erase the projection lines if drawn 7. Ensure the rectangle or square drawn is dark enough 8. Clean up the drawing sheet.	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task :** Draw square / rectangle. **Standards:** • Corner should meet equally. • All lines should be uniform. • Opposite line should be parrallel.	- Measuring. - Drawing shapes. - Instruments that uses to draw square / rectangles in drawing

Safety Precautions :

- Avoid using damaged drawing board.
- Avoid using damaged T-set.

Duty: 2. CONSTRUCT GEOMETRICAL FIGURES

2.5. Draw Triangle Using T set, Set Square and Protractor

Time: 2.0 hrs.
Exercise: 1.5 hrs
Demo: 0.5 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Set paper in drawing board 2. Prepare a drawing sheet 3. Decide the dimension of equilateral triangle to be draw 4. Scaled and mark on the drawing sheet 5. Draw a bottom horizontal line as decided length 6. Draw a vertical perpendicular line at the center of the line 7. Set the protractor as decided angle and mark with pencil point 8. Align the set square with end point of line and pencil point 9. Repeat it for another side inclined line. 10. Joint the corners 11. Erase projection lines if draw it 12. Give darkness for necessary lines	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument **Task :** Draw triangle using T set, set square and protractor. **Standards:** • Dimension should be meet according to given. • Line thickness should be in standard.	- Drawing geometrical shapes. - Taking a measurement of angles and triangles.

Safety Precautions :

- Avoid using damaged drawing board.
- Avoid using damaged T-set.

Duty: 2.CONSTRUCT GEOMETRICAL FIGURES

2.6. Construct Ellipse

Time: 4.0 hrs.
Exercise: 3.5 hrs
Demo: 0.5 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Draw a rhombus that side is diameter of circle in 30 2. Draw a line from the obtuse corner to center point of both side (so that the drawn line should made 90 ° to the rhombus side) 3. Draw a line from other obtuse corner to center point of side 4. Obtain compass and set the leg along with obtuse corner to center point of both opposite sides 5. Draw an arc 6. Draw another arc with same compass set up from opposite corner to center point of sides 7. Re-set the compass from cross point of center line to both center point of sides 8. Draw another arc 9. Draw another arc with same compass set up from opposite crossed point of center line to center point of sides 10. Erase the rhombus and center lines 11. Give darkness for drawn ellipse.	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument **Task :** Construct ellipse **Standards:** • Ormity of line thickness. • Maintain the line joints. • Maintain the neatness and cleanliness.	- Drawing ellipse type - Construct methods of ellipse

Safety Precautions :

- Keep the compass in safe position to other people.
- Do not drop the compass on the ground.
- Do not over press on the needle leg of the compass while drawing an arc.

DUTY 3: DRAW IN SCALE

3.1 Represent the Drawing in scale.

Time: 3.0 hrs.
Exercise: 2.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Set paper in drawing board 2. Prepare a drawing sheet 3. Decide the drawing for proper scale. 4. Calculate the drawing measurement. 5. Scaled and mark on the drawing sheet 6. Refer and follow the steps of drawing three view, isometric, or sectional view to draw the view as needed 7. Write the actual dimensions including tolerances if any) 8. Write the name of using scale in title bock. 9. Erase projection lines if draw it 10. Give darkness for necessary lines 11. 10. Clean up the drawing sheet	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task :** Represent the drawing in scale. **Standards:** • Draw the views and dimension representation with given scale.	- Definition of scale - General principles and rules of scale. - Types of scale

Safety Precautions :

- Avoid using damaged drawing board.
- Avoid using damaged T-set.

DUTY 3: DRAW IN SCALE

3.2. Represent the Dimension in Detail

Time: 4.0 hrs.
Exercise: 3.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Set paper in drawing board 2. Prepare a drawing sheet 3. Decide the drawing that has to be draw with dimension in detail 4. Scaled and mark on the drawing sheet 5. Refer and follow the steps of drawing three view, isometric, or sectional view to draw the view as needed 6. Draw the dimension lines and arrow heads in all independent shape and sizes which included in the object (it may required to present in many views) 7. Write the dimensions including tolerances if any 8. Erase projection lines if draw it 9. Give darkness for necessary lines 10. Clean up the drawing sheet	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task :** Represent the dimension in detail. **Standards:** • Draw the views and dimension representation with given scale and tolerance.	- Introduction of Dimension and terms of dimensions - General principles and rules in dimensioning. - Method of execution - Arrows (depth and length of arrow head)

Safety Precautions :

- Avoid using damaged drawing board.
- Avoid using damaged T-set.

DUTY 3: DRAW IN SCALE

3.3 Be familier with limit, fits and tolerances

Time: 4.0 hrs.
Exercise: 3.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
• Introduce tolerences. • Define limit, fits and tolerences. • Differenciate hole basis and shaft basis. • Calculate tolerences. Brief tolerences. *Sample exercise referring the steps of Dimension in detail.*	**Condition :** Fully equipped drawing class room. **Task :** Be familier with limits, fits and tolerances. **Standards:** • Tolerence should be allocated according to the nature of workpiece.	- Introduction. - Limit, fit & allowance. - Surface tolerance. - Geometrical tolerance.

Safety Precautions :

DUTY 3: DRAW IN SCAL

3.4. Draw the Symbols.

Time: 4.0 hrs.
Exercise: 2.0 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Set paper in drawing board 2. Prepare a drawing sheet 3. Decide the drawing that has to be draw which symbol 4. Scaled and mark on the drawing sheet 5. Erase the unnecessary lines in draw 6. Give darkness for necessary lines 17.Clean up the drawing sheet	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument **Task :** Draw the symbols. **Standards:** • Symbol should be clear and appropriate for the representation.	- First angle and third angle projection symbol. - Dimensioning symbols. - Welding symbols. - Surface symbols. - Machine element symbols.

Safety Precautions :

Duty: 4 DRAW PICTORIAL PROJECTION

Time: 16.0 hrs.
Exercise: 14.0 hrs
Demo: 2.0 hrs

4.1 Draw Isometric Projection

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Obtain sample or drawing of object to draw isometric view 2. Determine the position in which draw isometric view to be able to show all the details 3. Draw a horizontal base line 4. Mark a point on the base line 5. Draw projection lines in both direction of 30 angle from marked point 6. Draw a vertical line from the base point 7. Mark the divisional points towards width upto end point 8. Mark the divisional points towards length upto end point 9. Draw parallel vertical lines on all division points 10. Mark the divisional points on vertical line upto total height 11. Draw the parallel lines with 30 angle on all divisional points 12. Draw other lines to figure out on the layout 13. Erase projection lines 14. Give darkness for necessary lines.	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task :** Draw isometric projection. **Standards:** • Line thickness should be uniform. • Maintained symmetry and line joints. • Angle of the view should be in standard.	- A type of drawing represents. - Pictorial views. - Trimetric and oblique projections and their applications.

Safety Precautions :

Duty: 4. DRAW PICTORIAL PROJECTION

Time: 8.0 hrs.
Exercise: 6.0 hrs
Demo: 2.0 hrs

4.2 Draw Oblique Projection

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Obtain sample or drawing of object to draw oblique view 2. Determine the position in which draw oblique view to be able to show all the details 3. Draw a horizontal base line 4. Mark a point on the base line 5. Draw projection lines in one direction of 180 angle and other direction is 30 or 45 or 60 angle from marked point 6. Draw a vertical line from the base point 7. Mark the divisional points towards width up to end point 8. Mark the divisional points towards length up to end point 9. Draw parallel vertical lines on all division points 10. Mark the divisional points on vertical line up to total height 11. Draw other lines to figure out on the layout 12. Erase projection lines 13. Give darkness for necessary lines.	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task :** Draw oblique projection. **Standards:** • Line should be uniform and joint should be crossed. • Neatness and cleanliness is maintained.	- A type of drawing represents. - Pictorial views. - Oblique projections and their applications. - Concept of trimetric projection.

Safety Precautions :

Duty: 5. DRAW ORTHOGRAPHIC PROJECTION

5.1 Draw Three View Drawings in First Angle Projection

Time: 18.0 hrs.
Exercise: 16.0 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Obtain sample or drawing of object to draw three view 2. Prepare a drawing sheet 3. Determine the front, side and top view 4. Calculate the space from drawing area. (so that the drawing should come in the center of the sheet) 5. Draw front view referring the steps of draw isometric view drawing. 6. Draw side view 7. Draw top view 8. Erase projection lines if draw it 9. Give darkness for necessary lines	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task :** Draw three views drawing in first angle projection. **Standards:** • Maintained symmetry. • Projected line should be visible. • Line should be approprite.	- Method of obtaining orthographic projections in first angle. - Layout of three view drawing. - Introduction of third angle projection. - Introduction of types of projection in drawing. -

Safety Precautions :

- Avoid using damaged drawing board.
- Avoid using damaged T-set.

Duty: 5. DRAW ORTHOGRAPHIC PROJECTION

5.2 Draw Three View Drawings in Third Angle Projection

Time: 8.0 hrs.
Exercise: 7.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Obtain sample or drawing of object to draw three view 2. Prepare a drawing sheet 3. Determine the front, side and top view 4. Calculate the space from drawing area. (so that the drawing should come in the center of the sheet) 5. Draw front view referring the steps of draw isometric view drawing. 6. Draw side view 7. Draw top view 8. Erase projection lines if draw it 9. Give darkness for necessary lines	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task :** Draw three views drawing in third angle projection. **Standards:** • Maintained symmetry. • Projection line should be visible. • Line should be appropriate. • Third angle projection symbol should be placed.	- Method of obtaining orthographic projections in third angle. - Layout of three view drawing. - Introduction of third angle projection. - Introduction of types of projection in drawing. -

Safety Precautions :

- Avoid using damaged drawing board.
- Avoid using damaged T-set.

Duty: DRAW ORTHOGRAPHIC PROJECTION

5.3 Find and Draw Missing Views

Time: 8 .0 hrs.
Exercise: 8.0 hrs
Demo: 0.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Obtain missing view drawing of object 2. Prepare a drawing sheet 3. Identify the missing front, side or top view 4. Draw it in rough paper 5. Check the find out view with instructor 6. Calculate the space from drawing area. (so that the drawing should come in the center of the sheet) 7. Draw all 3 views referring the steps of draw 3 view drawing in first angle projection 8. Erase projection lines if draw it 9. Give darkness for necessary lines	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task :** Find and draw missing views. **Standards:** • All the line of missing view should be drawn • Projection line should be visible. • Maintained symmetry.	• Process of finding missing view through projection line and given drawing.

Safety Precautions :

Duty: 6. DRAW SECTIONAL VIEWS

6.1 Draw Full Section Views

Time: 10.0 hrs.
Exercise: 8.0 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Set paper in drawing board 2. Prepare a drawing sheet 3. Determine the projection view in which maximum sizes can be figure out 4. Scaled and mark on the drawing sheet 5. Construct the view 6. Draw the sectional line based on center line and name it 7. Construct a sectional view 8. Draw visible outlines and edges with continuous thick line 9. Draw hidden outlines and edges if any 10. Draw hatching lines on cutting surface 11. Erase projection lines if draw it 12. Give darkness for necessary lines 13. Clean up the drawing sheet.	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task :** Draw full section views. **Standards:** • Line thickness and angle of hatching line should be according to criteria. • Maintained symmetry.	- Importance of drawing in section - Types of sectional views

Safety Precautions :

Duty: 6. DRAW SECTIONAL VIEWS

6.2 Draw Half Section Views

Time: 4.0 hrs.
Exercise: 4.0 hrs
Demo: 0.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Set paper in drawing board 2. Prepare a drawing sheet 3. Determine the projection view in which maximum sizes can be figure out 4. Scaled and mark on the drawing sheet 5. Construct the view 6. Draw the sectional line as per drawing and sectional represent based on center line and name it 7. Construct a sectional view 8. Draw visible outlines and edges with continuous thick line 9. Draw hidden outlines and edges if any 10. Draw hatching lines on cutting surface 11. Erase projection lines if draw it 12. Give darkness for necessary lines 13. Clean up the drawing sheet.	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task :** Draw half section views. **Standards:** • Line thickness and angle of hatching line should be according to criteria. • Maintained symmetry.	• Introduction of sectional views. • Types of section drawing

Safety Precautions :

Duty: 6. DRAW SECTIONAL VIEWS

6.3 Draw Part Section Views

Time: 6.0 hrs.
Exercise: 6.0 hrs
Demo: 0.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Set paper in drawing board 2. Prepare a drawing sheet 3. Determine the projection view in which maximum sizes can be figure out 4. Scaled and mark on the drawing sheet 5. Construct the view 6. Draw the sectional line as per drawing and sectional represent and name it 7. Construct a sectional view 8. Draw visible outlines and edges with continuous thick line 9. Draw hidden outlines and edges if any 10. Draw hatching lines on cutting surface 11. Erase projection lines if draw it 12. Give darkness for necessary lines 13. Clean up the drawing sheet.	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task :** Draw part section views. **Standards:** • Maintain the line spacing for hatching. • Draw the section views. • Projected representative lines. • Maintain the uniformity of line thickness. • Maintain the line joints. • Maintain the neatness and cleanliness	• Importance of part section.

Safety Precautions :

BIBLIOGRAPHY

SN	Name	Author	Publication
1.	Engineering Drawing	P S Gill,	S K Kataria & Sons
2.	Engineering Drawing for Mechanical Trade		Instructional Material for Vocational Training, India
3.	Elements of Mechanical Drafting	Samual Yaslov	Delmar Publishers
4.	Engineering Drawing	N.D. BHATT	Charotar Publishing House Pvt. Ltd.
5.	Machine Drawing (1st Angle Projection)	Er.R.K.DHAWAN	S.CHAND
6.			

Lathe Operation- I

Total: 156 hrs
Class/week: 4 hrs

Unit/sub unit	Duties and Tasks	Time (hrs.)	
		Demo	**Practical**
1	**Set Up Machine**		
1.1	Set up round work piece on three jaw chuck	2	-
1.2	Set up Round/Square Workpiece on Four Jaw Chuck	3	-
1.3	Set up Machined Workpiece on Collet Chuck	2	-
1.4	Set up turning tool on tool post	2	-
1.5	Set up machine controls	2	-
2	**Perform Turning Operations**		
2.1	Perform facing	1	4
2.2	Perform center drilling	1	2
2.3	Perform drilling	1	4
2.4	Perform plain turning	2	13
2.5	Perform step turning	2	14
2.6	Perform grooving	2	7
2.7	Perform chamfering	2	4
2.8	Perform taper turning	2	14
2.9	Perform plain boring	2	6
3	**Perform Project**		
3.1	Manufacture bush	-	10
3.2	Manufacture shaft with stepped surface	-	16
3.3	Manufacture fittings of stepped parts	-	22
3.4	Manufacture a spindle with bearing journal.	-	14
	sub Total	***26***	***130***
	Total	***156***	

TASK ANALYSIS

Duty: SET UP MACHINE

1.1 Set up Round Workpiece on Three Jaw Chuck

Time: 2.0 hrs.
Exercise: 0.0 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Obtain round workpiece 2. Obtain chuck key 3. Set the speed change gear lever into neutral position 4. Clean the jaws with cotton waste 5. Bring the jaws slightly bigger than workpiece diameter with the help of chuck key. 6. De-burrs the workpiece if necessary 7. Insert the workpiece on three jaw leaving the working length outside 8. Tighten the jaws slightly 9. Obtain height gauge 10. Set the pointer of height gauge to workpiece diameter 11. Turn the chuck freely by hand 12. Observe concentricity 13. Hammer on the side as necessary 14. Check the concentricity again and align same process till the workpiece turn truly. 15. Tighten all the jaws equally.	**Condition :** Fully equipped workshop with Center lathe machine and Three jaw chuck. **Task :** Set up round workpiece on three jaw chuck. **Standards:** • Aligned the concentricity in clamping. • Clamped equal force in all 3 jaw chuck. • Clamped workpiece on 3 jaw leaving the working length outside.	- Introduction of Lathe machine. - Construction of Three jaw chuck. - Process of clamping & truing the work piece

Safety Precautions:

- Avoid leaving Chuck key on the three jaw chuck.
- Always remove burrs before clamping the workpiece.
- Keep the carriers away from the head stock.
- Switch off the main electrical line while setting up the workpiece.
- Pre-set enough lighting in machine area.
- Always keep the machine and its surroundings neat and clean.

Duty: SET UP MACHINE

1.2 Set up Round/Square Workpiece on Four Jaw Chuck

Time: 3.0 hrs.
Exercise: 0.0 hrs
Demo: 3.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain round/square workpiece 2. Obtain chuck key 3. Set the speed change gear lever into neutral position 4. Clean the jaws with cotton waste 4. Bring the jaws slightly bigger than workpiece size in the center of spindle with the help of chuck key individually 5. De-burrs the workpiece if necessary 6. Insert the workpiece inside the jaws leaving the working length outside 7. Tighten the jaws slightly one by one 8. Obtain height gauge 9. Set the pointer of height gauge to the periphery of workpiece 10. Turn the chuck freely by hand 11. Observe concentricity 12. Open the jaw where the pointer is far 13. Tighten the opposite jaw where the pointer is beyond. 14. Align the work piece opening and tightening the opposite jaws checking concentricity with height gauge pointer 15. Tighten all the jaws equally.	**Condition :** Fully equipped workshop with Center lathe machine, Four jaw chuck and Height gauge. **Task :** Set up round/square workpiece on four jaw chuck. **Standards:** • Concentricity set with hight gauge points. • Clamped equal force in all 4 jaw chuck. • Clamped workpiece on 4 jaw leaving the working length outside.	- Uses of four jaw independent chuck. - Construction of four jaw chuck. - Process of clamping and truing a workpiece on 4 jaw independent chuck.

Safety Precautions:

- Avoid opening the adjacent jaws together.
- Avoid projecting the part of jaws beyond the chuck periphery.
- Use a wooden block on lathe bed when installing / removing the chuck.
- Follow the same safety precautions of the task setting up round workpiece on three jaw chuck.

Duty: SET UP MACHINE

1.2 Set up Machined Workpiece on Collet Chuck

Time: 2.0 hrs.
Exercise: 0.0 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	RelatedKnowledge
1. Obtain machined workpiece 2. Identify the diameter as per size of the collect chuck 3. Obtain collect chuck with draw bar 4. Set the speed change gear lever into low speed position 5. Remove the lathe chuck if necessary 6. Clean the spindle nose with cotton waste 7. Insert draw bar from behind the head stock. 5. Insert collect chuck on spindle nose holding draw bar wheel from left hand 6. Turn draw bar wheel few round to hold the collet chuck 7. Insert the workpiece on collet chuck until desired machined surface 8. Turn draw bar wheel in same direction as it hold until completely clamped the workpiece 9. Set the rpm lever in neutral position 10. Turn the draw bar wheel freely by hand to check the concentricity. 11. Re-clamp if necessary	**Condition :** Fully equipped workshop with Center lathe machine, Set of collet chuck and Draw bar. **Task :** Set up machined workpiece on collet chuck. **Standards:** • Workpiece is clamped determining same diameter of collect chuck. • Tightened the collect chuck on machine spindle.	- Introduction of collect chuck. Adapter and Draw in bar. - Importance of using collect chucks. - Process of clamping work on collect chuck.

Safety Precautions:

- Follow the same safety precautions of the task setting up round workpiece on three jaw chuck.
- Use a wooden block on lathe bed when installing / removing the chuck.

Duty: SET UP MACHINE

1.4. Set up Turning Tool on Tool Post

Time: 2.0 hrs.
Exercise: 0.0 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Identify the shape and size of the tool to be clamp 2. Obtain tool post key 3. Check the cutting edge of the tool 4. Stone it if necessary 5. Collect and set the packages if necessary 6. Open up all bolts as required size of tool 7. MountDead center on Tailstock spindle 8. Bring Dead center near to the tool post 9. Hold tool on Tool post projecting 15mm out 10. Tighten slightly all the bolts respecting with the tool 11. Compare the center of cutting edge with center tip of Dead center 12. Tighten all bolts 13. Open the bolts and place the packages until the center of cutting edge shows parallel to the Dead center tip. 14. Adjust the screw to set the center for cutting edge if the tool post is single as Multi fix tool post.	**Condition :** Fully equipped workshop with Center lathe machine, Tool holder, Tool tightening key and cutting tools. **Task :** Set up turning tool on tool post. **Standards:** • Aligned cutting edge with the center of the dead center. • Tool length is project as determined length. • Cutting tool is according to the lathe operation.	- Types of available Tool posts. - Lathe tool settings.

Safety Precautions:

- Always use same size of wrench or keys when tightening the tool.
- Avoid projecting over length of the tool.
- Always set up the cutting edge with the spindle center.
- Use Quick fixed Tool post as far as possible.
- Always keep the machine and its surroundings neat and clean.
- Pay attention when aligning anything in front of the tighten tool.

Duty: SET UP MACHINE

1.5. Set Up Machine Control.

Time: 2.0 hrs.
Exercise: 0.0 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Identify the material to be machine 2. Identify the diameter to be turn 3. Identify the operation to be perform 4. Calculate the RPM to be set 5. Calculate the feed to be set 6. Recognize the levers to set the RPM as per calculated 7. Recognize the levers to set the feed as per calculated 8. Calculate and set the levers of RPM and feed every time before starting to machining any operation	**Condition :** Fully equipped workshop with Center lathe machine. **Task :** Set up machine control. **Standards:** • Set gear lever as calculated RPM according to workpiece and cutting tool material. • Control machine parts as per its functions. • Set Norton gear box as per workpiece, cutting tool material and depth of cut.	• Main parts and their functions of the lathe machine

Safety Precautions :

- Always set the RPM as per the workpiece material, cutting tool material and operation to be performed.
- Always shift the gear lever stopping the machine completely.
- Set the lever in neutral position when not in use.

Duty: PERFORM TURNING OPERATIONS

2.1 Perform Facing from the center of workpiece.

Time: 5.0 hrs.
Exercise: 4.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Set up workpiece on chuck following the same steps of set up workpiece on three or four jaw chuck 2. Set up facing tool on tool post 3. Swivel tool post in facing position 4. Set up machine control 5. Run the machine 6. Bring the tool at the center of the rotating workpiece by top slide 7. Tighten the carriage lock 8. Give little depth of cut from cross slide 9. Turn back the tool slowly observing the cutting surface 10. Go ahead on center, give depth of cut, turn back the tool slowly 11. Repeat the steps until required surface obtained 12. Cut from the outside edge to the center for rough facing and reducing work length.	**Condition :** Fully equipped workshop with Center lathe machine and Facing tool. **Task :** Perform facing from the center of workpiece. **Standards:** • Determine the in-center / out-center facing as per workpiece nature. • Perform process of facing operation. • Check surface finished.	- Importance of facing. - Process of facing operation.

Safety Precautions:

- Refer to the Set up workpiece on three and four jaw chuck and set up turning tool.
- Always set higher RPM than normal for turning.
- Always wear safety goggles.
- Apply fluent coolant.
- Swivel the tool post slightly in opposite direction to the facing surface.

Duty: PERFORM TURNING OPERATIONS

2.2 Perform Center Drilling

Time: 3.0 hrs.
Exercise: 2.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Refer and follow all the tasks and steps to perform facing operation 2. Obtain center drill, drill chuck and key of the Tailstock spindle taper size 3. Mount drill chuck on Tailstock spindle 4. HoldCenter drill on drill chuck and tighten with the key 5. Bring tailstock that the center drill touches the workpiece center and tighten it on the lathe bed 6. Set up the RPM gear lever as center drill size 7. Run the machine 8. Arrange coolant flow over center drill 9. Give feed from tailstock hand wheel until bigger taper diameter mark on the work piece 10. Take off the tailstock, stop the machine, and then go to further operation.	**Condition :** Fully equipped workshop with Center lathe machine, Facing tool, Drill chuck and Center drill. **Task :** Perform center drilling **Standards:** • Depth of center drill is in standard. • Center drilled surface is finished.	- Center drill. - Process of center drilling.

Safety Precautions:

- Avoid giving continuos feeding while center drilling.
- Keep away the tool post from the Head stock.
- Apply coolant fluently.
- Always wear safety goggles.
- Avoid projecting the center drill tailstock spindle too long.
- Check the center of facing surface and tip of Center drill is matched.

Duty: PERFORM TURNING OPERATIONS

2.3 Perform drilling.

Time: 3.0 hrs.
Exercise: 2.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Refer and follow all the tasks and steps to perform center drilling operation 2. Hold the drill bit on drill chuck. 3. Boring tailstock near to work piece. 4. Set up RPM according to drill size. 5. Run the machine. 6. Arrange coolant flow over center drill 7. Give feed from tailstock hand wheel until required depth is not meet (1 to 12mm). 8. Remove drill chuck from tail stock. 9. Fit the taper shank drill bit to the appropriate sleeve. 10. Fix the drill bit with sleev in tailstock spindle. 11. Repeat step 3 to 7 until required diameter is not get. 12. Take off the tailstock, stop the machine, and then go to further operation.	**Condition :** Fully equipped workshop with Center lathe machine, Facing tool, Drill chuck, sleeve, drill bits and Center drill. **Task :** Perform drilling **Standards:** • Depth and diameter of the drilling is measured according to given dimension. • Drilled surface is finished.	- Types of drill machine - Types of sleeve - Process of drilling.

Safety Precautions:

- Sleeve and drill shank should be oil or grease free.
- RPM should be set according to diameter of drill bits.
- Workpiece and drill bits should be clamped tightly.

Duty: PERFORM TURNING OPERATIONS

2.4 Perform Plain Turning

Time: 18.0 hrs.
Exercise: 16.0 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Set up round workpiece on three jaw chuck 2. Set up turning tool on tool post 3. Set up machine control 4. Perform facing. 5. Perform center drilling if necessary 6. Identify the length & diameter to be machined. 7. Start the machine 8. Bring the cutting tool at the end edge of the workpiece 9. Take a first cut giving depth as facing opposite direction 10. Bring back the tool 11. Give rough depth of cut 12. Feed the tool forward to the Head stock slowly moving hand wheel of carriage. 13. Repeat cutting / turning until the require diameter obtained. 14. Apply auto feed if fine surface requires. 15.	**Condition :** Fully equipped workshop with Center lathe machine and cutting tools. **Task :** Perform plain turning. **Standards:** • Peripheral surface is fine as surface required. • Turned cylindrical parts is according to given dimeter and tolerence.	- Process of: Plain turning operation.

Safety Precautions:

- Refer all the safety precautions of the task perform center drilling and perform facing.

Duty: PERFORM TURNING OPERATIONS

2.5 Perform Step Turning

Time: 18.0 hrs.
Exercise: 16.0 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Refer and follow all the steps of task perform Plain turning 2. Identify the shoulder to be machined 3. Identify the length to be turn 4. Identify the diameter to be machined 5. Mark on the step length by tool rotating the chuck manually 6. Perform plain turning for rough cut 7. Repeat rough cutting until 2 mm left on both side and diameter 8. Reset the tool if necessary 9. Take a cut following as rough turning 10. Maintain the length turning as facing operation. 11. Measure the length and diameter 12. Perform further turning till the diameter, shoulder and step length obtained 13. Make sure the step length and diameter is as given instruction. 14. Apply auto feed if fine surface requires.	**Condition :** Fully equipped workshop with Center lathe machine and cutting tools. **Task :** Perform step turning. **Standards:** • Measurements of machined surface is checked as per diameter and length. • Stpe face is in according to given angle or 90°.	- Types of shoulder and its use. - Process of turning steps.

Safety Precautions:

- Refer all the safety precautions of the task perform center drilling and perform facing.
- Pay attention when manufacturing the shoulder.

Duty: PERFORM TURNING OPERATIONS

2.6 Perform Grooves

Time: 9.0 hrs.
Exercise: 7.0 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Refer and follow all the steps of task perform Plain turning 2. Refer and follow all the steps of task perform Step turning 3. Make only the corner shoulder 4. Obtain grooving tool according to the size of the groove 5. Reset the grooving tool on tool post so that the cutting blade is parallel to the workpiece 6. Identify and mark for groove to be cut 7. Set low RPM than turning same diameter 8. Run the machine 9. Bring the tool near to the groove to be cut 10. Touch the tool gently with workpiece 11. Set the dial scale '0' of both the top and cross slide 12. Perform cutting feeding cross slide towards the machine center reading dial scale 13. Stop feeding, turn back, Set the same '0' again 14. Slide Top slide according to wide to be cut reading dial scale. 15. Repeat step no.12. until depth obtain 16. Verify the width and depth of the groove with V. caliper. 17. Move back and for to maintain surface at the depth 18. Make sure all the dimensions are as given instruction.	**Condition :** Fully equipped workshop with Center lathe machine & grooving tool. **Task :** Perform Grooves. **Standards:** • Measurements of grooves checked. • Measurement should be according to given dimension.	- Types of grooves and its use. - Process of turning grooves.

Safety Precautions:

- Refer to the task Plain turning.
- Avoid using narrow and blunt tool.
- Avoid clamping overhanging tool.
- Avoid applying the depth on sides.

Duty: PERFORM TURNING OPERATIONS

2.7 Perform Chamfers

Time: 6.0 hrs.
Exercise: 4.0 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Refer and follow all the steps of task perform Plain turning 2. Refer and follow all the steps of task perform Step turning 3. Perform and finished the operation as required following the steps of previous tasks 4. Reset the Roughing tool on tool post 5. Identify the size of chamfering 6. Bring and touch gently the mid of cutting tip on the edge of the workpiece 7. Set the dial scale '0' of both the top and cross slide 8. Run the machine 10. Give feed as plain turning from longitude dial movement reading dial scale 11. Repeat and follow the chamfer at all corners and edges of the workpiece.	**Condition :** Fully equipped workshop with Center lathe machine and cutting tools. **Task :** Perform Chamfers. **Standards:** • The angle of chamfering is determined. • All machined corners are chamfered.	- Importance of chamfers. - Process of turning chamfers.

Safety Precaution:

Refer to the task Perform Plain turning and Step turning.

Duty: PERFORM TURNING OPERATIONS

2.8 Perform External Taper Turning

Time: 16.0 hrs.
Exercise: 14.0 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Obtain workshop drawing 2. Obtain work piece material 3. Identify the operations to be perform 4. Perform facing 5. Perform center drilling if necessary 6. Perform plain turning 7. Perform step turning if necessary 8. Identify the angle to be cut and set 9. Loosen the nuts of the swivel device on the cross slide 10. Set the required angle reading swivel scale and tighten the nuts 11. Bring and touch gently the cutting tip on the edge of the work piece 12. Reset the sliding length of top slide as per taper length 13. Run the machine and give feed from cross slide. 14. Give feed manually from top slide slowly 15. Repeat turning taper until the required dimension obtain giving feed from cross slide respectively 16. Make sure all the dimensions is as given in workshop drawing	**Condition :** Fully equipped workshop with Center lathe machine and cutting tools. **Task :** Perform taper turning. **Standards:** • Maintained surface quality. • Measurement of taper angle made is checked.	- Types of taper turning on lathe machine. - Taper calculation for setting on the machine. - Process of taper turning by cross slide method.

Safety Precautions :

- Refer to the task Facing, Plain turning, Step turning and center drilling.

Duty: PERFORM TURNING OPERATIONS

2.9 Perform Plain Boring

Time: 8.0 hrs.
Exercise: 6.0 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Obtain workshop drawing 2. Obtain work piece material 3. Obtain required tools 4. Set up work piece on three jaw chuck 5. Perform facing following the same steps 6. Perform center drilling following the same steps 7. Perform plain if necessary supporting with tailstock 8. Change center drill to guide drill 9. Drill guide hole up to 2mm remaining to the exact hole 10. Reset the boring tool centering with the center located on the tailstock 11. Bring and touch the tool tip gently on the boring surface 12. Set the dial scale '0' of cross slide 13. Bring back to its first position and give depth of cut 14. Run the machine and give feed manual 15. Ensure the cut is without any disturbed 16. Set the auto lever down and complete the cut 17. Check the diameter 18. Give remaining depth of cut leaving margin for finishing cut 19. Repeat step 16 and 17 20. Chamfer the edge 21. Measure all the dimensions to ensure the complete machining.	**Condition :** Fully equipped workshop with Center lathe machine Facing tool, tool, Center drill, Drill bits for guide hole plain boring tool. **Task :** Perform plain boring. **Standards:** • Drilling guide hole is performed. • Boring tool is set. • Performed process of plain boring. • Measurement of boring diameter is checked.	- Boring and drilling on lathe machine. - Process of boring operation.

Safety Precautions:

- Refer to the task Set up tool, Plain and Center drilling.
- Apply fluent coolant on machining surface.
- Take care when drilling the hole from tailstock.

Duty: 3. PERFORM PROJECT

3.1. Manufacture a Bush

Time: 10.0 hrs.
Exercise: 10.0 hrs
Demo: 0.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Obtain drawing 2. Obtain workpiece as per drawing 3. Obtain tools and equipments 4. Clamp the workpiece in 3 jaw chuck 5. Clamp the turning tool 6. Face up the surface 7. Drill center drill 8. Drill a hole as much as large diameter 9. Set up boring tool 10. Bore the hole until hole diameter obtain 11. Chamfer for hole 12. Change turning tool 13. Turn outside diameter 14. Reclamp the workpiece 15. Face up /reduce the length 16. Chamfer on necessary corner 17. Measure final dimensions to ensure all the dimensions are as required	**Condition :** Fully equipped workshop with Center lathe machine Facing tool, turning tool, Center drill, Drill bits for guide hole plain boring tool. **Task :** Manufacture at bush **Standards:** • Dimensions of the product is as per drawing. • Surface quality and tolerenced is as specified. • Machined corners are chamfered.	• Application of bush

Safety Precautions:

- Refer the task Perform plain boring

Duty: 3. PERFORM PROJECT

3.2. Manufacture a Shaft with Stepped Surface

Time: 16.0 hrs.
Exercise: 16.0 hrs
Demo: 0.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Follow and repeat the steps 1 to 6 of bush manufacture 2. Reclamp the workpiece, clamping min. Portion inside the chuck, supporting revolving center from tailstock 3. True concentricity 4. Turn out big diameter engaging auto feed 5. Mark small grove for shoulder length 6. Take rough cut to stepped length remains 1mm in required diameter 7. Change the tool according to the shoulder shape it necessary 8. Take a cut and shaped the shoulder as per exchanged cutting tool 9. Take final and finishing cut 10. Perform chamfers on all required corners 11. Measure dimensions to ensure all the dimensions are as required 12. Reclamp the workpiece turning inside out 13. True concentricity 14. Face the surface / reduce the length as required size 15. Turn out big diameter if required 16. Turn out shoulder if required 17. Perform chamfers on all required corners 18. Measure final dimensions to ensure all the dimensions are as required	**Condition :** Fully equipped workshop with Center lathe machine Facing tool, turning tool, Center drill, Drill bits for guide hole plain boring tool. **Task :** Manufacture a shaft with stepped surface **Standards:** • Dimensions of the product is as per drawing. • Surface qulity ad tolerence is as specified. • Machineed corners are chamfered.	• Importance and application of shaft

Safety Precautions:

- Refer the task Perform step turning

Duty: 3. PERFORM PROJECT

3.3. Manufacture a fittings of Stepped part

Time: 22.0 hrs.
Exercise: 22.0 hrs
Demo: 0.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Follow and repeat the steps 1 to 7 of bush manufacture 2. Reclamp the workpiece, clamping min. Portion inside the chuck, supporting revolving center from tailstock 3. True concentricity 4. Turn out big diameter engaging auto feed 5. Mark small groove for shoulder length 6. Take rough cut to stepped length remains 1mm in required diameter 7. Change the tool according to the shoulder shape if necessary 8. Take a cut and shaped the shoulder as per exchanged cutting tool 9. Take final and finishing cut 10. Perform chamfers on all required corners 11. Measure dimensions to ensure all the dimensions are as required 12. Reclamp the workpiece turning inside out 13. True concentricity 14. Face the surface / reduce the length as required size 15. Turn out big diameter if required 16. Turn out shoulder if required 17. Perform chamfers on all required corners 18. Measure final dimensions to ensure all the dimensions are as required	**Condition :** Fully equipped workshop with Center lathe machine Facing tool, turning tool, Center drill, Drill bits for guide hole plain boring tool. **Task :** Manufacture a fitting a stepped part. **Standards:** • Dimensions of the product is as per drawing. • Surface quality and tolerence is as per specified. • Machined corners are chamfered.	• Review the tolerence required for fitting parts.

Safety Precautions:

- Refer the task Manufacture a Shaft with Stepped Surface

Duty: 3. PERFORM PROJECT

3.4. Manufacture a spindle with bearing journal.

Time: 14 hrs.
Exercise: 14hrs
Demo: 0 hrs

Steps	Terminal Performance Objective	RelatedKnowledge
19. Follow and repeat the steps 1 to 6 of bush manufacture 20. Reclamp the workpiece, in lathe dog and center to center supporting revolving center from tailstock. 21. Turn out big diameter engaging auto feed 22. Mark small grove for shoulder at journal end. 23. Take rough cut to stepped length remains 1mm in required diameter 24. Change the tool according to the shoulder shape if necessary 25. Take final and finishing cut 26. Perform chamfers on all required corners 27. Measure dimensions to ensure all the dimensions are as required 28. Reclamp the workpiece turning inside out 29. Face the surface / reduce the length as required size 30. Turn out big diameter if required 31. Turn out shoulder if required 32. Perform chamfers on all required corners 1. Measure final dimensions to ensure all the dimensions are as required	**Condition :** Fully equipped workshop with Center lathe machine Facing tool, turning tool, Center drill, Drill bits for guide hole plain boring tool. **Task :** Manufacture a spindle with bearing journal. **Standards:** • Measurement should be as per given dimension.	

Safety Precautions :

- Refer the task Perform taper turning

References:

B. S. Raghuwanshi, A Course in Workshop Technology Vol 1 and 2, Dhanpat Rai and Co.

Material Science –I

Total: 39 hrs
Class/week: 1 hr

Unit/sub unit	Areas and Topics	Time (hrs.)
1	**Introduction to Material Science**	
1.1	**Introduction &history of material science**	**1**
1.2	**Matter**	**8**
1.2.1	Atoms, molecules and their structure	
1.2.2	Element & Periodic table	
1.2.3	Electron, Proton and Neutron	
1.2.4	Bonding of solids	
1.2.5	Forces between atoms	
1.2.6	Types of bonds and their energies	
1.2.7	Structures of solid materials	
1.2.7	Face center cubic lattice	
1.2.8	Body center cubic lattice	
1.2.9	Body center hexagonal lattice	
1.3	**Classification of materials**	**2**
1.3.1	According to state, natural and artificial, metal and non-metal	
1.3.2	Differentiate metal and non metal	
1.3.3	Differentiate ferrous and non ferrous metals	
2	**General properties of material**	**4**
2.1	Physical properties of material	
2.2	Mechanical properties of materials	
3	**Ferrous metal**	
3.1	**Iron and steel**	**6**
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, electricfrnace and duplex process)	
3.2	**Carbon steel**	**4**
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	Read iron carbon diagram	
3.2.5	Specification of steels according to code and classification(AISI/SAE/ISI specification)	
3.3	**Alloy steel**	**4**
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)	
3.4	**Cast Iron**	**4**
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	
4	**Heat treatment**	**6**
4.1	Introduction, definition & objectives	

4.2	Heat treatment process	
4.2.1	Annealing	
4.2.2	Normalizing	
4.2.3	Hardening	
4.3.4	Tempering	
4.3.5	Case/surface hardening	
	Total	***39***

Sheet Metal Fabrication

Total: 156 hrs
Class/week: 4 hrs

Duty/Task	Duties and Tasks	Time (hrs.)	
		Demo	**Practical**
Duty 1	**Perform Cutting, Folding and Rolling.**	**6**	**18**
Task 1	Cut metal sheet in straight with snip.	2	3
Task 2	Cut metal sheet in round shape with snip.	0	2
Task 3	Cut metal sheet in irregular segment with snip.	0	3
Task 4	Fold metal sheet by hand tools	1	3
Task 5	Roll metal sheet by hand tools	1	3
Task 6	Fold metal sheet by folding machine.	1	2
Task 7	Roll metal sheet by rolling machine**.**	1	2
Duty 2	**Perform Fastening, Heming and wire edging**	**8**	**40**
Task 1	Groove single seam.	1	5
Task 2	Groove edge seam (Hem).	1	2
Task 3	Perform wire edging.	1	5
Task 4	Perform Straight Beading.	1	4
Task 5	Perform Round Beading.	1	4
Task 6	Perform Bottom Flashing.	1	10
Task 7	Perform soldering joint.	1	5
Task 8	Perform Riveting joint.	1	5
Duty 3	**Develop Pattern**	**4**	**20**
Task 1	Develop Pattern of rectangular box	1	5
Task 2	Develop Pattern of Cylindrical Container.	1	5
Task 3	Develop Pattern of Truncated Cylindrical Container.	1	5
Task 4	Develop a pattern of funne**l**	1	5
Duty 4	**Perform project work**	**8**	**52**
Task 1	Fabricate a Rectangular Box	1	5
Task 2	Fabricate a Cylindrical Container	1	5
Task 3	Fabricate a Funnel.	2	16
Task 4	Fabricate a Bucket.	2	16
Task 5	Fabricate a cylindrical 90° elbow.	2	10
	Total	***26***	***130***
	Total	**156**	

TASK ANALYSIS

Duty: PERFORM CUTTING, FOLDING AND ROLLING.

Task: 1 Cut metal sheet in straight with snip.

Time:-5 hrs
Theory:-2 hr
Practical:-3 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain the work piece drawing. 2. Obtain instruction 3. Study the drawing thoroughly. 4. Obtain the piece of sheet metal as per drawing size. 5. Obtain required tools. 6. Straighten and de-burr the sheet metal. 7. Layout (Measure and mark) the notches and line for cutting. 8. Check the layout for accuracy. 9. Put the work piece on the table. 10. Place the snip on the edge of marking line. 11. Cut the metal slowly at beginning and proceeding it for required cutting. 12. Straighten and de-burr the sheet metal. 13. Check dimension of the complete job. 14. Punch the roll no on work piece. 15. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Cut metal sheet in straight with snip. **Standard (How well):** • Cutting work piece should be match with given drawing. • Tolerances of dimensions are within the ±0.5 mm	• Sheet and its types • Size and gauges of sheet metal available in marked. • Importance and use of sheet • Introduction of snips and their types i.e. straight and curve. • Marking and layout. • Hand tools, equipment and machine used in sheet metal works. • Notching • Sheet metal operation

Tools and Equipments:- Steel rule, Snips, Back square, marking scriber, steel hammer, Mallet, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file

Materials: GI Sheet

Safety:-

- Place snips and material on bench.
- De-burr the metal sheet edges.
- Avoid carrying scriber in pockets.
- Open the blades as far as possible for your hand and using the throat of the snips.

Duty: PERFORM CUTTING, FOLDING AND ROLLING.

Task: 2 Cut metal sheet in round shape with snip.

Time:-2 hrs
Theory:- 0 hr
Practical:-2 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain the work piece drawing. 2. Obtain instruction 3. Study the drawing thoroughly. 4. Obtain the piece of sheet metal as per drawing size. 5. Obtain required tools. 6. Straighten and de-burr the sheet metal. 7. Layout (Measure and mark) the notches and line for cutting. 8. Punch the center of radius/ circle by center punch 9. Check the layout for accuracy. 10. Put the work piece on the table. 11. Place the snip on the edge of marking line. 12. Cut the sheet metal according to the drawing. 13. De-burr and straighten. 14. Make a starting slit near the center of the flange with a cold chisel 15. Cut out the hole of the flange with curved snips. 16. Cut around the outside edge of the flange with snips 17. Cut the metal slowly at beginning and proceeding it for required cutting. 18. Straighten and de-burr the sheet metal. 19. Check dimension of the complete job. 20. Punch the roll no on work piece. 21. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Cut metal sheet in round shape with snip. **Standard (How well):** • Cutting work piece should be match with given drawing. • Tolerances of dimensions are within the ±0.5 mm	• As same as related knowledge of Task 1

Tools and Equipments:- Steel rule, Snips, Back square, marking scriber, steel hammer, Mallet, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, smooth file

Materials: GI Sheet, Oil

Safety:-

- Place snips and material on bench.
- De-burr the metal sheet edges.
- Avoid carrying scriber in pockets.
- Open the blades as far as possible for your hand and using the throat of the snips.
- Start the cut at the edge of the material.

Duty: PERFORM CUTTING, FOLDING AND ROLLING.

Task: 3 Cut metal sheet in irregular segment with snip.

Time:-3 hrs
Theory:-0 hr
Practical:-3 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain the work piece drawing. 2. Obtain instruction 3. Study the drawing thoroughly. 4. Obtain the piece of sheet metal as per drawing size. 5. Obtain required tools. 6. Straighten and de-burr the sheet metal. 7. Layout (Measure and mark) the notches and line for cutting. 8. Punch the center of radius/ circle by center punch 9. Check the layout for accuracy. 10. Put the work piece on the table. 11. Place the snip on the edge of marking line. 12. Cut the sheet metal according to the drawing. 13. Deburr and straighten. 14. Make a starting slit near the center of the flange with a cold chisel 15. Cut out the hole of the flange with curved snips. 16. Cut out and notch the pattern with curved snips 17. Cut the metal slowly at beginning and preceding it for required cutting. 18. Straighten and de-burr the sheet metal. 19. Check dimension of the complete job. 20. Punch the roll no on work piece. 21. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Cut metal sheet in irregular segment with snip. **Standard (How well):** • Cutting work piece should be match with given drawing. • Tolerances of dimensions are within the ±0.5 mm	• As same as related knowledge of Task 1

Tools and Equipments:- Steel rule, Snips, Back square, marking scriber, steel hammer, Mallet, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file

Materials: GI Sheet

Safety:-

- Place snips and material on bench.
- De-burr the metal sheet edges.
- Avoid carrying scriber in pockets.
- Open the blades as far as possible for your hand and using the throat of the snips.
- Start the cut at the edge of the material.
- Avoid sharp corners.
- Avoid leaving jagged edges; cut the material by closing the blades just short of their full length.

Duty: PERFORM CUTTING, FOLDING AND ROLLING.

Task: 4 Fold metal sheet by hand tools

Time:-4 hrs
Theory:-1 hr
Practical:-3 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain the work piece drawing. 2. Read drawing thoroughly. 3. Obtain the metal sheet of required size and required sheet metal tools. 4. Straighten and de-burr the sheet metal. 5. Layout the pattern. 6. Layout the folding lines by marking with marking scriber. 7. Check the layout for accuracy. 8. Notch and cut the unnecessary part. 9. Bend the open folds by mallet/soft hammer and hardies. 10. Check dimensions of the completed job. 11. Punch the roll no on work piece. 12. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Fold metal sheet by hand tools. **Standard (How well):** • Folding work piece should be match with given drawing. • Tolerances of dimensions are within the ±0.5 mm	• Introduction of folding • Hand tools (Hardies) used in folding metal sheets. • Mallet and types.

Tools and Equipments:- Steel rule, marking scriber, try square, snips, hardies, steel hammer, Mallet, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file

Materials: GI Sheet, Oil

Safety:-

- Take care of marked lines; folds must not be collecting together.
- Use only mallet hammer to bend sheet.
- To avoid damage on surface of sheet insert a protecting jaw of aluminum or vice jaw cover.

Duty: PERFORM CUTTING, FOLDING AND ROLLING.

Task: 5 Roll metal sheet by hand tools

Time:-4 hrs
Theory:-1 hr
Practical:-3 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain the work piece drawing. 2. Read drawing thoroughly. 3. Obtain the metal sheet of required size and required sheet metal tools. 4. Straighten and de-burr the sheet metal. 5. Layout the pattern. 6. Layout the folding lines by marking with marking scriber. 7. Check the layout for accuracy. 8. Notch and cut the unnecessary part. 9. Place the sheet on hollowing tool or round peaked stake. 10. Strike by hammer slightly on the sheet. 11. Continue the striking operation till the required obtained. 12. Check dimensions of the completed job. 13. Punch the roll no on work piece. 14. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Roll metal sheet by hand tools. **Standard (How well):** • Rolling work piece should be match with given drawing. • Tolerances of dimensions are within the ±0.5 mm	• Introduction of rolling • Hand tools (stakes) used in rolling metal sheets. • Mallet and types.

Tools and Equipments:- Steel rule, marking scriber, try square, snips, hardies, steel hammer, Mallet, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file, stakes

Materials: GI Sheet

Safety:-

- Take care of marked lines; folds must not be collecting together.
- Use only mallet hammer to bend sheet.

Duty: PERFORM CUTTING, FOLDING AND ROLLING.

Task: 6 Fold the metal sheet by folding machine.

Time:-3 hrs
Theory:-1 hr
Practical:-2 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain the work piece drawing. 2. Read drawing thoroughly. 3. Obtain the metal sheet of required size and required sheet metal tools. 4. Straighten and de-burr the sheet metal. 5. Layout the pattern. 6. Layout the folding lines by marking with marking scriber. 7. Check the layout for accuracy. 8. Notch and cut the unnecessary part. 9. Place the sheet metal in between the folding jaw of the machine 10. Align the marked line parallel with the upper jaw edge and bottom jaw edge 11. Clamp sheet firmly 12. Bend the sheet metal pulling the lever upward as much the machine allowed 13. Open the parallels jaw to remove job. 14. Check dimensions of the completed job. 15. Punch the roll no on work piece. 16. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Fold metal sheet by folding machine. **Standard (How well):** • Folding work piece should be match with given drawing. • Tolerances of dimensions are within the ±0.5 mm	• Hand tools (Hardies) used in folding metal sheets. • Mallet and types. • Folding m/c and application

Tools and Equipments:- Steel rule, marking scriber, try square, snips, hardies, steel hammer, Mallet, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file, Folding machine

Materials: GI Sheet

Safety:-

- Take care of marked lines; folds must not be collecting together.
- Aware from clamping the finger by machine jaw.
- To avoid damage on surface of sheet insert a protecting jaw of aluminum or vice jaw cover.

Duty: PERFORM CUTTING, FOLDING AND ROLLING.

Task: 7 Roll metal sheet by rolling machine.

Time:-3 hrs
Theory:-1 hr
Practical:-2 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain the work piece drawing. 2. Read drawing thoroughly. 3. Obtain the metal sheet of required size and required sheet metal tools. 4. Straighten and de-burr the sheet metal. 5. Layout the pattern.. 6. Check the layout for accuracy. 7. Notch and cut the unnecessary part. 8. Place the sheet metal in between the roller of the machine 9. Align the marked line parallel to the roller 10. Clamp sheet firmly 11. Roll the roller of machine by the liver 12. Repeat the rolling operation by lowering the upper roller till required shape 13. Open the upper roller to remove job. 14. Check dimensions of the completed job. 15. Punch the roll no on work piece. 16. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Roll metal sheet by rolling machine. **Standard (How well):** • Rolling work piece should be match with given drawing. • Tolerances of dimensions are within the ±0.5 mm	• Hand tools (Hardies) used in rolling metal sheets. • Mallet and types. • Rolling m/c and application

Tools and Equipments:- Steel rule, marking scriber, try square, snips, hardies, steel hammer, Mallet, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file, Rolling machine

Materials: GI Sheet

Safety:-

- Take care of marked lines; folds must not be collecting together.
- Aware from clamping the finger by machine jaw.
- To avoid damage on surface of sheet insert a protecting jaw of aluminum or vice jaw cover.

Duty: PERFORM FASTENING,HEMING AND WIRE EDGING.

Task: 8 Groove single seam.

Time:-6 hrs
Theory:-1 hr
Practical:-5 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain the work piece drawing. 2. Read drawing thoroughly. 3. Obtain the metal sheet of required size and required sheet metal tools. 4. Straighten and de-burr the sheet metal. 5. Layout the pattern. 6. Layout the folding lines by marking with marking scriber. 7. Check the layout for accuracy. 8. Notch and cut the unnecessary part. 9. Fold the edges as per drawing and form the job to shape. 10. Hook the folds together. 11. Place the work-piece on a suitable stake 12. Flatten the seam slightly with a mallet 13. Place the hand grooves over one end of the seam and strike it with a hammer 14. Groove the other end in the same manner 15. Groove the entire seam by striking the hand groover with the hammer 16. Check dimensions of the completed job. 17. Punch the roll no on work piece. 18. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Groove single seam. **Standard (How well):** • Groove single seam should be match with given drawing. • Tolerances of dimensions are within the ±0.5 mm	• Introduction of joint(Fastening) • Type of fastening • Seam joint and its type • Tools used for making seam joint

Tools and Equipments:- Steel rule, marking scriber, try square, snips, hardies, steel hammer, Mallet, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file, Seam punch(Hand groover)

Materials: GI Sheet

Safety:-

- Take care of marked lines; folds must not be collecting together.
- Aware from clamping the finger by machine jaw.
- To avoid damage on surface of sheet insert a protecting jaw of aluminum or vice jaw cover.
- Use the right number of hand groovers. Both pieces must be fitted right together.
- Avoid mushroom head seam punch.

Duty: PERFORM FASTENING,HEMING AND WIRE EDGING.

Task: 9 Groove edge seam (Hem).

Time:-3 hrs
Theory:-1 hr
Practical:-2 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain the work piece drawing. 2. Read drawing thoroughly. 3. Obtain the metal sheet of required size and required sheet metal tools. 4. Straighten and de-burr the sheet metal. 5. Layout the pattern. 6. Layout the folding lines by marking with marking scriber. 7. Check the layout for accuracy. 8. Notch and cut the unnecessary part. 9. Fold the edges as per drawing and form the job to shape. 10. Strike the folding part by light hammer as per hemming shape provided in drawing. 11. Place the work-piece on a suitable stake 12. Groove the other end in the same manner 13. Groove the entire seam by striking with the hammer 14. Check dimensions of the completed job. 15. Punch the roll no on work piece. 16. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Groove edge seam (hem). **Standard (How well):** • Edge seam should be match with given drawing. • Tolerances of dimensions are within the ±0.5 mm	• Introduction of joint • Seam joint and its type • Tools used for making seam joint • Hemming and its purpose

Tools and Equipments:- Steel rule, marking scriber, try square, snips, hardies, steel hammer, Mallet, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file, Seam punch(Hand groover)

Materials: GI Sheet

Safety:-

- Take care of marked lines; folds must not be collecting together.
- Aware from clamping the finger by machine jaw.
- To avoid damage on surface of sheet insert a protecting jaw of aluminum or vice jaw cover.

Duty: PERFORM FASTENING,HEMING AND WIRE EDGING.

Task: 10 Perform wire edging.

Time:-6 hrs
Theory:-1 hr
Practical:-5 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain the work piece drawing. 2. Read drawing thoroughly. 3. Obtain the metal sheet of required size and required sheet metal tools. 4. Straighten and de-burr the sheet metal. 5. Layout the pattern. 6. Layout the folding lines(margin for wire) by marking with marking scriber. 7. Check the layout for accuracy. 8. Notch and cut the unnecessary part. 9. Fold the edges as per drawing and form the job to shape. 10. Place the work-piece on a suitable stake 11. Strike the folding part by light hammer until its shape to be round. 12. Place the selected wire in the round shaped margin. 13. Press the un-round edge if any under the wire with the help of any pointed tool. 14. Check dimensions of the completed job. 15. Punch the roll no on work piece. 16. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Groove edge seam(hem). **Standard (How well):** • Wire edge should be match with given drawing. • Tolerances of dimensions are within the ±0.5 mm	• Introduction of wire edge • Purpose of wire edge • Margin calculation

Tools and Equipments:- Steel rule, marking scriber, try square, snips, hardies, steel hammer, Mallet, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file, Pointed tool.

Materials: GI Sheet

Safety:-

- Take care of marked lines; folds must not be collecting together.
- Aware from clamping the finger by machine jaw.
- To avoid damage on surface of sheet insert a protecting jaw of aluminum or vice jaw cover.

Duty: PERFORM FASTENING,HEMING AND WIRE EDGING.

Task: 11 Perform Straight Beading.

Time:-5 hrs
Theory:-1 hr
Practical:-4 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain the work piece drawing. 2. Read drawing thoroughly. 3. Obtain the metal sheet of required size and required sheet metal tools. 4. Straighten and de-burr the sheet metal. 5. Layout the pattern. 6. Check the layout for accuracy. 7. Notch and cut the unnecessary part. 8. Lay out the marks where beads are to be made 9. Place the single bead rolls on the beading machine and bead the work-piece 10. Place the sheet between the beading dies of the machine. 11. Clam the sheet in the die of machine. 12. Roll the dies of machine with the help of handle. 13. Straightening the work-piece 14. Check dimensions of the completed job. 15. Punch the roll no on work piece. 16. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Perform straight beading. **Standard (How well):** • Bead should be match with given drawing. • Tolerances of dimensions are within the ±0.5 mm	• Introduction beading • Purpose of bead • Introduction of beading machine • Operation of machine • Selection of dies

Tools and Equipments:- Steel rule, marking scriber, try square, snips, hardies, steel hammer, Mallet, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file, Beading machine and dies.

Materials: GI Sheet

Safety:-

- Take care of marked lines; folds must not be collecting together.
- Aware from clamping the finger by machine jaw.
- To avoid damage on surface of sheet insert a protecting jaw of aluminum or vice jaw cover.
- The mark for beading should be between the dies of machine.
- Avoid over tightening of dies which may tear sheet.
- Beads first the inside circle and finish the outside circle if it is required.

Duty: PERFORM FASTENING, HEMING AND WIRE EDGING.

Task: 12 Perform Round Beading.

Time:-5 hrs
Theory:-1 hr
Practical:-4 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain the work piece drawing. 2. Read drawing thoroughly. 3. Obtain the metal sheet of required size and required sheet metal tools. 4. Straighten and de-burr the sheet metal. 5. Layout the pattern. 6. Check the layout for accuracy. 7. Notch and cut the unnecessary part. 8. Lay out the marks where beads are to be made 9. Make a round shaped object by rolling machine or by hand tools and round peaked stake. 10. Place the single bead rolls on the beading machine and bead the work-piece 11. Place the sheet between the beading dies of the machine. 12. Clam the sheet in the die of machine. 13. Roll the dies of machine with the help of handle. 14. Straightening the work-piece 15. Check dimensions of the completed job. 16. Punch the roll no on work piece. 17. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Perform round beading. **Standard (How well):** • Bead should be match with given drawing. • Tolerances of dimensions are within the ±0.5 mm	• Introduction beading • Purpose of bead • Introduction of beading machine • Operation of machine • Selection of dies

Tools and Equipments:- Steel rule, marking scriber, try square, snips, hardies, steel hammer, Mallet, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file, Beading machine and dies.

Materials: GI Sheet

Safety:-

- Take care of marked lines; folds must not be collecting together.
- Aware from clamping the finger by machine jaw.
- To avoid damage on surface of sheet insert a protecting jaw of aluminum or vice jaw cover.
- The mark for beading should be between the dies of machine.
- Avoid over tightening of dies which may tear sheet.

Duty: PERFORM FASTENING,HEMING AND WIRE EDGING.

Task: 13 Perform Bottom Flashing.

Time:-11 hrs
Theory:-1 hr
Practical:-10 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain the work piece drawing. 2. Read drawing thoroughly. 3. Obtain the metal sheet of required size and required sheet metal tools. 4. Obtain an instruction drawing 2. Cut the sheet metal on the squaring shears from stock material 3. Straighten and Deburr the sheet metal 5. Lay out the center by marking the sheet metal piece with diagonal lines 6. Punched the centers by center punch 7. Lay out the pattern for the bottom on the metal 8. Lay out the allowance for the burred edge 9. Cut out the bottom with combination snips 10. Deburr the edge on the bottom with a mallet 11. Place the bottom in the cylinder and tack it in place with solder. 12. Solder the seam on the inside of the job 13. Check the dimensions of the completed job. 14. Punch the roll no on work piece. 15. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Perform bottom flashing. **Standard (How well):** • Bottom flash should be match with given drawing. • Tolerances of dimensions are within the ±0.5 mm	• Introduction bottom flashing • Process of flashing

Tools and Equipments:- Steel rule, marking scriber, try square, snips, hardies, steel hammer, Mallet, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file, Beading machine and dies.

Materials: GI Sheet

Safety:-

- Take care of marked lines; folds must not be collecting together.
- Aware from clamping the finger by machine jaw.
- To avoid damage on surface of sheet insert a protecting jaw of aluminum or vice jaw cover.
- The mark for beading should be between the dies of machine.
- Avoid over tightening of dies which may tear sheet.

Duty: PERFORM FASTENING,HEMING AND WIRE EDGING.

Task: 14 Perform soldering joint.

Time:-6 hrs
Theory:-1 hr
Practical:-5 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain the w/p drawing. 2. Study the drawing thoroughly. 3. Obtain the sheet metal as per required size. 4. Obtain required tools. 5. Heat the soldering iron. 6. Clean up the soldering areas with zinc chloride. 7. Apply flux in all areas to be soldered. 8. Join the areas together and support them. 9. Hold soldering lead in one hand and soldering iron in other hand. 10. Heat the parent metal. 11. Touch the lead by soldering iron until it melts and apply in the joining areas. 12. Use the soldering iron frequently to spread melted lead in all joining areas. 13. Repeat spreading lead until it covers and joins the pieces. 14. Allow the soldered area cool for solid deposition. 15. Clean up all the areas are tools after completing. 16. Check dimensions of the completed job. 17. Punch the roll no on work piece. 18. Oil the surface of the work piece. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Perform soldering. **Standard (How well):** • Soldering work piece should be match with given check list. • Tolerances of dimensions are within the ±0.5 mm	• Introduction of soldering joints. • Characteristics of soldering lead. • Soldering method. • Characteristics of soldering flux. • Causes of soldering defects.

Tools and Equipments:- Soldering iron, Soldering iron stand, Steel rule, marking scriber, try square, snips, steel hammer, Mallet, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file

Materials: Zinc chloride, soldering lead, flux

Safety:-

- Take care while using zinc chloride.
- Take care while heating the soldering iron.
- Flux should be applied in whole joining areas.
- Avoid overheating of soldering iron.
- Make proper ventilation and well lighted working areas.
- Beware from toxic fumes generated while soldering.
- Use safety goggles.
- Work safety to avoid burn.
- Apply electrical safety prcations

Duty: PERFORM FASTENING, HEMING AND WIRE EDGING.

Task: 15 Perform Riveting joint.

Time:-6 hrs
Theory:-1 hr
Practical:-5 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain the w/p drawing. 2. Study the drawing thoroughly. 3. Obtain the required number of sheet metal of required size. 4. Obtain required hand tools. 5. Straighten and de-burr the sheet metal. 6. Layout the sheet metal. 7. Cut the sheet metal accordingly if necessary. 8. Punch the centre by centre punch where holes are to be drilled. 9. Bunch the sheet metal in layer so that the holes to be drilled are aligned on above another. 10. Clamp the bunch of sheet metal with c-clamp. 11. Drill holes on every centre punched marks. 12. Remove and de-burr the pieces individually. 13. Place the drilled sheet together for riveting as per drawing. 14. Calculate rivet length and select rivet. 15. Insert the rivet. 16. Insert rivet head set for aligning on the tail of rivet. 17. Punch slightly on the rivet head until align. 18. Remove the rivet head set. 19. Strike on the tail of rivet to make mushroom head by ball pin hammer. 20. Insert rivet head cap on the tail of rivet. 21. Punch the rivet head until the required head forms and the pieces join together. 22. Repeat the same steps for next riveting. 23. Check dimensions of the completed job. 24. Punch the roll no on work piece. 25. Oil the surface of the work piece. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Perform riveting work. **Standard (How well):** • Riveting work piece should be match with given drawing. • Tolerances of dimensions are within the given drawing.	• Introduction of Rivet and types. • Different riveting joint. • Calculation of reverting length. • Calculation of Rivet hole. • Rivets available in market. • Rivet material • Causes of riveting defects

Tools and Equipments:- Rivet head set, Ball pin hammer**,** Steel rule, marking scriber, try square, snips, hardies, steel hammer, Mallet, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file

Materials: GI Sheet, Rivet (Aluminum or MS), Oil

Safety:-

- Take care of your hand while striking tail of riveting and riveting the head.
- Take care while you bushing out the sheet metal.
- The length of the rivet should be carefully calculated.
- Avoid mushroom head rivet head set.

Duty: DEVELOP PATTERN

Task: 16 Develop Pattern of rectangular box.

Time:-6 hrs
Theory:-1 hr
Practical:-5 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain an instruction drawing 2. Obtain an instruction. 3. Select the stock sheet metal as specified 4. Cut the sheet metal according to the drawing 5. Straighten and de-burr the sheet metal 6. Mark from outside for margin or if any 7. Mark for height/depth of object 8. Mark for length and width of the object 9. Notch the corner of material or if any where metal may overlap to each other. 10. Check dimensions of the completed job. 11. Punch the roll no on work piece. 12. Oil the surface of the work piece. 13. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Develop pattern of rectangular box. **Standard (How well):** • Pattern should be match with given drawing. • Tolerances of dimensions are within the ±0.5 mm	• Introduction development/pattern • Type development

Tools and Equipments:- Rivet head set, Ball pin hammer**,** Steel rule, marking scriber, try square, snips, hardies, steel hammer, Mallet, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file

Materials: GI Sheet, Rivet (Aluminum or MS), Oil

Safety:-

- De-burr the metal sheet edges.
- Place snips and material on bench.
- Avoid carrying scriber in pockets.
- Open the blades as far as possible for your hand and using the throat of the snips.
- Start the cut at the edge of the material.
- Avoid sharp corners.
- Avoid leaving jagged edges; cut the material by closing the blades just short of their full length.

Duty: DEVELOP PATTERN

Task: 17 Develop Pattern of Cylindrical Container.

Time:-6 hrs
Theory:-1 hr
Practical:-5 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain an instruction drawing 2. Obtain an instruction. 3. Select the stock sheet metal as specified 4. Cut the sheet metal according to the drawing 5. Straighten and de-burr the sheet metal 6. Determine the diameter and height of the cylinder to be develop 4. Calculate the circumference of diameter 5. Draw a horizontal line as circumference and vertical as height of the cylinder 6. Make a square drawing parallel line 7. Determine the folding joint 8. Mark and draw the folding margin as per joint on both side 9. Notch the corner or if any 7. Check dimensions of the completed job. 8. Punch the roll no on work piece. 9. Oil the surface of the work piece. 10. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Develop pattern of cylindrical container. **Standard (How well):** • Pattern should be match with given drawing. • Tolerances of dimensions are within the ±0.5 mm	• Introduction development/pattern • Type development

Tools and Equipments:- Rivet head set, Ball pin hammer**,** Steel rule, marking scriber, try square, snips, hardies, steel hammer, Mallet, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file

Materials: GI Sheet, Rivet (Aluminum or MS), Oil

Safety:-

- De-burr the metal sheet edges.
- Place snips and material on bench.
- Avoid carrying scriber in pockets.
- Open the blades as far as possible for your hand and using the throat of the snips.
- Start the cut at the edge of the material.
- Avoid sharp corners.
- Avoid leaving jagged edges; cut the material by closing the blades just short of their full length.

Duty: DEVELOP PATTERN

Task: 18 Develop Pattern of Truncated Cylindrical Container.

Time:-6 hrs
Theory:-1 hr
Practical:5 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain an instruction drawing 2. Obtain an instruction. 3. Select the stock sheet metal as specified 4. Cut the sheet metal according to the drawing 5. Straighten and de-burr the sheet metal 6. Select dimension such as diameter, length, and cutting angle 7. Draw a top view & front view of cylinder 8. Divide the circle twelve parts by compass and divider 9. Project the projection line from each of the point towards on front view respectively or vertically down ward 10. Cut the front view axially at any desired or required angle on the any desired height from the base 11. Project the projection line horizontally from the top and base line front view 12. Draw a vertical line of reference out any point on horizontal projection line 13. Take one part of length from top view by divider or compass. 14. Mark twelve times from the initially draw reference line by taking length from compass 15. Draw vertical projection line from each point respectively upper projection line 16. Project the projection line from cutting plane's point horizontally 17. Joint each point by french curve. 18. Determine the folding joint 19. Mark and draw the folding margin as per joint on both side 20. Notch the corner or if any 21. Check dimensions of the completed job. 22. Punch the roll no on work piece. 23. Oil the surface of the work piece. 24. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Develop pattern of truncated cylindrical container. **Standard (How well):** • Pattern should be match with given drawing. • Tolerances of dimensions are within the ±0.5 mm	• Introduction development/pattern • Type development

Tools and Equipments:- Rivet head set, Ball pin hammer**,** Steel rule, marking scriber, try square, snips, hardies, steel hammer, Mallet, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file

Materials: GI Sheet, Rivet (Aluminum or MS), Oil

Safety:-

- De-burr the metal sheet edges.
- Place snips and material on bench.
- Avoid carrying scriber in pockets.
- Open the blades as far as possible for your hand and using the throat of the snips.
- Start the cut at the edge of the material.
- Avoid sharp corners.
- Avoid leaving jagged edges; cut the material by closing the blades just short of their full length.

Duty: DEVELOP PATTERN

Task: 19 Develop a pattern of funnel

Time:-6hrs
Theory:-1 hr
Practical:-5 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain workshop drawing. 2. Select the stock sheet metal as specified 3. Cut the sheet metal according to the drawing 4. Straighten and de-burr the sheet metal 5. Lay out the elevation view, a half plan view of Body (Hopper) of funnel. 6. Project the line of elevation up to apex. 7. Mark a large curve by taking longer slant radius. 8. Repeat the same process from same center point by taking smaller slant radius. 9. Mark for margin if any 10. Similarly, develop the pattern for tail (Nozzle) of funnel. 11. Cut and notch the metal as per development. 12. Straighten and De-burr the edges 13. Check dimensions of the completed job. 14. Punch letter as Pattern – Hopper/Funnel and Nozzle/Funnel.. 15. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Develop a pattern of funnel. **Standard (How well):** • Pattern should be match with given drawing. • Tolerances of dimensions are within the ±0.5 mm	• Introduction to funnel • Concept of pattern of conical object

Tools and Equipments:- Rivet head set, Ball pin hammer**,** Steel rule, marking scriber, try square, snips, hardies, steel hammer, Mallet, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file

Materials: GI Sheet, Rivet (Aluminum or MS), Oil

Safety:-

- De-burr the metal sheet edges.
- Place snips and material on bench.
- Avoid carrying scriber in pockets.
- Open the blades as far as possible for your hand and using the throat of the snips.
- Start the cut at the edge of the material.
- Avoid sharp corners.
- Avoid leaving jagged edges; cut the material by closing the blades just short of their full length.

Duty: PERFORM PROJECT WORK

Task: 20 Fabricate a Rectangular Box

Time:-6 hrs
Theory:-1 hr
Practical:-5 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain an instruction drawing 2. Obtain an instruction. 3. Obtain workshop drawing with development 4. Collect the required tools and materials. 5. Obtain pattern of rectangular box 6. Fold all the corners respectively on the seam in bar folder 7. Make sure that the folded corners are 90 8. Check dimensions of the completed job. 9. Punch the roll no on work piece. 10. Oil the surface of the work piece. 11. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Fabricate a rectangular box. **Standard (How well):** • Pattern should be match with given drawing. • Tolerances of dimensions are within the ±0.5 mm	• Introduction development/pattern • Type development

Tools and Equipments:- Rivet head set, Ball pin hammer**,** Steel rule, marking scriber, try square, snips, hardies, steel hammer, Mallet, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file

Materials: GI Sheet, Rivet (Aluminum or MS), Oil

Safety:-

- De-burr the metal sheet edges.
- Place snips and material on bench.
- Avoid carrying scriber in pockets.
- Open the blades as far as possible for your hand and using the throat of the snips.
- Start the cut at the edge of the material.
- Avoid sharp corners.
- Avoid leaving jagged edges; cut the material by closing the blades just short of their full length.

Duty: PERFORM PROJECT WORK

Task: 21 Fabricate a Cylindrical Container

Time:-6 hrs
Theory:-1 hr
Practical:-5 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain an instruction drawing 2. Obtain an instruction. 3. Obtain workshop drawing with development 4. Select the stock material as specified 5. Obtain workshop drawing with development 6. Select the stock material as specified 7. Lay out for the cylinder on the metal 8. Lay out the allowance for the grooved seam and soldered seam. 9. Check the pattern for accuracy 10. Cut out and notch the metal 11. Bend the folds for the grooved seam in bar folder 12. Roll the cylinder in the slip roll forming machine 13. Groove the seam with a hand groover 14. Make sure that the cylinder is completely round. 15. Check dimensions of the completed job. 16. Punch the roll no on work piece. 17. Oil the surface of the work piece. 18. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Fabricate a cylindrical container. **Standard (How well):** • Container should be match with given drawing. • Tolerances of dimensions are within the ±0.5 mm	• Concept of pattern of cylindrical object

Tools and Equipments:- Rivet head set, Ball pin hammer**,** Steel rule, marking scriber, try square, snips, hardies, steel hammer, Mallet, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file

Materials: GI Sheet, Rivet (Aluminum or MS), Oil

Safety:-

- De-burr the metal sheet edges.
- Place snips and material on bench.
- Avoid carrying scriber in pockets.
- Open the blades as far as possible for your hand and using the throat of the snips.
- Start the cut at the edge of the material.
- Avoid sharp corners.
- Avoid leaving jagged edges; cut the material by closing the blades just short of their full length.

Duty: PERFORM PROJECT WORK

Task: 22 Fabricate a Funnel.

Time:-18hrs
Theory:-2 hr
Practical:-16 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain an instruction drawing 2. Obtain an instruction. 3. Select the stock sheet metal as specified 4. Cut the sheet metal according to the drawing 5. Straighten and de-burr the sheet metal 6. Mark the layout as per development drawing or pattern made for both Hopper and Nozzle. 7. Cut / shear the metal as per development. 8. Straighten and de-burr the seam. 9. Fold seam margin of both sides in opposite direction. 10. Fold to cone shape to the development. and soldered seam. 11. Hook the seam folded margins. 12. Mallet the seam placing on a form anvil. 13. Solder the seams of both Hopper and Nozzle part following the steps of soldering joints. 14. Assemble both Hopper and Nozzle of the Funnel following the same steps of soldering joints. 15. Make sure the soldered assemble is straight in axis 16. Check dimensions of the completed job. 17. Punch the roll no on work piece. 18. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** Fabricate a Funnel. **Standard (How well):** • Funnel should be match with given drawing. • Tolerances of dimensions are within the ±0.5 mm	• Concept of pattern of funnel.

Tools and Equipments:- Rivet head set, Ball pin hammer**,** Steel rule, marking scriber, try square, snips, hardies, steel hammer, Mallet, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file

Materials: GI Sheet, Rivet (Aluminum or MS), Oil

Safety:-

- De-burr the metal sheet edges.
- Place snips and material on bench.
- Avoid carrying scriber in pockets.
- Open the blades as far as possible for your hand and using the throat of the snips.
- Start the cut at the edge of the material.
- Avoid sharp corners.
- Avoid leaving jagged edges; cut the material by closing the blades just short of their full length.

Duty: PERFORM PROJECT WORK

Task: 23 Fabricate a Bucket.

Time:-18 hrs
Theory:-2 hr
Practical:-16 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain an instruction drawing 2. Obtain an instruction. 3. Select the stock sheet metal as specified 4. Cut the sheet metal according to the drawing 5. Straighten and de-burr the sheet metal 6. Obtain development drawing. 7. Collect the required tools and materials. 8. Mark the layout as per development drawing or pattern made for both Hopper and base. 9. Cut / shear the metal as per development. 10. Straighten and deburr the seam. 11. Fold seam margin of both sides in opposite direction. 12. Fold to cone shape to the development. 13. Hook the seam folded margins. 14. Mallet the seam placing on a form anvil. 15. Apply bottom flashing at the end of the cone. 16. Perform beading on double beads as marking. 17. Assemble the Handle hooks at opposite sides of the bottom flashed side. 18. Assemble the base part with bucket cone seaming bottom flash. 19. Make sure all the seams of assemble is straight in axis. 20. Check dimensions of the completed job. 21. Punch the roll no on work piece. 22. Oil the surface of the work piece. 23. Store the work piece and tools.	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** • Fabricate a Bucket. **Standard (How well):** • Bucket should be match with given drawing. • Tolerances of dimensions are within the ±0.5 mm	• Concept of pattern of Bucket.

Tools and Equipments:- Rivet head set, Ball pin hammer**,** Steel rule, marking scriber, try square, snips, hardies, steel hammer, Mallet, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file

Materials: GI Sheet, Rivet (Aluminum or MS), Oil

Safety:-

- De-burr the metal sheet edges.
- Place snips and material on bench.
- Avoid carrying scriber in pockets.
- Open the blades as far as possible for your hand and using the throat of the snips.
- Start the cut at the edge of the material.
- Avoid sharp corners.
- Avoid leaving jagged edges; cut the material by closing the blades just short of their full length.

Duty: PERFORM PROJECT WORK

Task: 24 Fabricate a cylindrical 90° elbow.

Time:-12 hrs
Theory:-2 hr
Practical:-10 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Obtain workshop drawing. 2. Select the stock sheet metal as specified 3. Cut the sheet metal according to the drawing 4. Straighten and deburr the sheet metal 5. Lay out the elevation view, a half plan view and the pattern on drawing paper 6. Check the paper for accuracy 7. Cut out the paper pattern 8. Transfer the paper pattern into the sheet metal 9. Cut out the sheet metal 10. Folds for the grooved seam in bar folder 11. Roll both cylinder pieces in the slip roll forming machine 12. Groove the seam with the hand grover 13. Make sure that the both cylinder is completely round 14. Assemble the pieces and tack the seam by soldering 15. Check the angle of the elbow with a protractor 16. Solder the seams on the outside 17. Check dimensions of the completed jo	**Condition (Given):** • Well equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. **Tasks (What):** • Fabricate a Cylindrical 90° elbow. **Standard (How well):** • Elbow should be match with given check list. • Tolerances of dimensions are within the ±0.5 mm	• Concept of pattern of truncated cylinder.

Tools and Equipments:- Rivet head set, Ball pin hammer**,** Steel rule, marking scriber, try square, snips, hardies, steel hammer, Mallet, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file

Materials: GI Sheet, Rivet (Aluminum or MS), Oil

Safety:-

- De-burr the metal sheet edges.
- Place snips and material on bench.
- Avoid carrying scriber in pockets.
- Open the blades as far as possible for your hand and using the throat of the snips.
- Start the cut at the edge of the material.
- Avoid sharp corners.
- Avoid leaving jagged edges; cut the material by closing the blades just short of their full length.

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Welding Technology - I

Total: 234 hrs
Class/week: 6 hrs

Duty/Task	Duties and Tasks	Time (hrs.)	
	Shielded Metal Arc Welding (SMAW)	**Demo**	**Practical**
1	**Perform Flat Position Welding**		
1.1	Perform striking	1	6
1.2	Perform surface weld	1	6
1.3	Grind off welding surfaces	1	6
1.4	Perform multi run straight beads	1	6
1.5	Weld corner joint	1	6
1.6	Weld edge joint	1	6
1.7	Weld Lap joint	1	6
1.8	Weld square butt from both sides	1	8
1.9	Perform tack weld for V-butt joint	1	6
1.10	Weld V-butt joint with backing	1	16
2	**Perform Horizontal Position Welding.**		
2.1	Perform surface weld	1	12
2.2	Perform square butt joint	1	6
	Perform V-butt joint weld with backing	1	10
	Perform fillet joint weld	1	6
3	**Perform Vertical Position Welding**		
3.1	Perform surface weld	1	8
3.2	Perform square butt	1	8
	Perform V-butt joint weld with backing	1	6
4	**Perform over head position welding**		
4.1	perform surface weld	1	8
4.2	perform butt joint	1	13
5	**Perform Pipe welding in Flat Position**		
5.1	Weld pipe to pipe joint in rotated position	1	8
5.2	Weld pipe to flat metal joint	1	8
6	**Repair Welding Parts**		
6.1	Repair of casting and forgings	2	
6.2	Fill a large hole.	1	8
6.3	Assemble individual weld parts and prepare whole products (project work)		32
	Total	**24**	**210**

Task Analysis

Duty: PERFORM FLAT POSITION WELDING

1.1 Perform Striking.

Time: 7.0 hrs.
Exercise: 6.0 hrs
Demo: 1.0 hrs

Task and Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instruction. 2. Obtain workpiece/ material. 3. Obtain accessories and tools required. 4. Obtain electrode of required size. 5. Set the current. 6. Clamp the earth line to the workpiece /material table 7. Clamp the electrode on electrode holder. 8. Hold hand shield on one hand and the by on holder one. 9. Produce arc by striking on the rough piece of metal use tapping method. 10. Travel the electrode maintaining the arc right angle.	**Condition :** Fully equipped workshop with Arc welding transformer, welding accessories and different sizes of electrodes. **Task :** Perform Striking. **Standards:** - Develop non sticking Arc.	- Introduction to welding - Arc welding machines / transformers. - Use of welding tools. - Striking method.

Safety Precautions :

- Avoid using electrode holder with broken handle.
- Always use Chipping hammer and Wire brush to clean up the welding slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.

Duty: PERFORM FLAT POSITION WELDING

1.2. Perform surface weld.

Time: 7.0 hrs.
Exercise: 6.0 hrs
Demo: 1.0 hrs

Task and Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instruction. 2 Obtain work piece/ material. Clean the metal surface with a wire brush and wipe off the oil and grease. 3 Mark the job by chalk as per instruction. 4 Set the work-piece on the welding table in a flat position. 5 Set the arc welding machine and connect the welding cables. 6 Select and clam MS electrode in the holder. 7 Set a welding current on a machine (amp). 8 Wear the complete safety apparel and check the filter lens of the welding shield. 9 Strike the arc on a rough-piece for trial and observe the current setting. 10 Strike the arc on the work-piece at one edge. 11 Move the electrode in a straight line and complete the bead at the other edge of the plate. 12 Remove the slag from the weld bead. 13 Repeat the exercise till you achieve good result.	**Condition :** Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes. **Task :** Perform surface weld. **Standards:** - Maintain a correct: angle of the electrode. - Maintain arc length. - Maintain arc wave and travel speed.	

Safety Precautions :

- Avoid using electrode holder with broken handle.
- Always use Chipping hammer and Wire brush to clean up the welding slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.

Duty: PERFORM ELEMENTATY WELDING

1.3 Grind Off welds surface.

Time: 7.0 hrs.
Exercise: 6.0 hrs
Demo: 1.0 hrs

Task and Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instruction. 2. Obtain pre-welded workpiece/ material. 3. Obtain accessories and tools required. 4. Set the workpiece. 5. Wear safety equipments. 6. Connect electrical line to machine. 7. Hold workpiece/ material into vice. 8. Grind the surface of weld as per the drawing.	**Condition :** Fully equipped workshop with Arc welding transformer and Hand vice and Hand surface grinder. **Task :** Grind off surfaces welds. **Standards:** - Re uses the material. - Prepare the edges for groove weld. - Chamfer the burrs. - Grinds the welding beads to prepare re weld.	

Safety Precautions :

Duty: PERFORM FLAT POSITION WELDING

1.4. Perform multi run straight beads

Time: 7.0 hrs.
Exercise: 6.0 hrs
Demo: 1.0 hrs

Task and Steps	Terminal Performance Objective	Related Knowledge
1. Obtain workshop drawing. 2. Obtain instruction. 3. Collect work piece 4. Clean the metal surface with a wire brush and wipe off the oil and grease. 5. Set the arc welding machine. 6. Refer and follow the steps of surface weld from 3 to 12 7. Weld other beads as per the drawing. 8. Remove slags and spatters. 9. Start welding on bead corner to the end of the previous welded bead. 10. Repeat the same welding until the workpiece width permits. 11. Clean welding beads.	**Condition :** Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes. **Task :** Perform multi run straight beads. **Standards:** - Maintain a correct: angle of the electrode. - Maintain beads start and beads finish. - Maintain undercuts. - Maintain deposition of beads overlap.	Arc wave and Travel speed. Deposition of beads and overlaps.

Safety Precautions :

- Avoid using electrode holder with broken handle.
- Always use Chipping hammer and Wire brush to clean up the welding slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.

Duty: PERFORM FLAT POSITION WELDING

1.5 Weld corner joint.

Time: 5.5 hrs.
Exercise: 5.0 hrs
Demo: 0.5 hrs

Task and Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instructional drawing. 2. Collect work piece 3. Refer and follow the steps of surface weld from 3 to 9. 4. Perform tack weld on both ends. 5. Check and re-set the angle. 6. Strike the arc on a rough-piece for trail. 7. Strike the arc on the work-piece at one edge. 8. Move the electrode in a straight following the edges of both workpiece and complete the bead at the other edge of the plate. 9. Remove the slag from the weld bead. 10. Repeat the exercise till you achieve good result.	**Condition :** Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes. **Task :** Weld corner joint. **Standards:** - Maintain welding distortion. - Maintain joining of two metals. - Maintain uniform beads.	

Safety Precautions :

- Avoid using electrode holder with broken handle.
- Always use Chipping hammer and Wire brush to clean up the welding slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry

Duty: PERFORM FLAT POSITION WELDING

1.6 weld edge joints

Time: 7 hrs.
Exercise: 6.0 hrs
Demo: 1 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instructional drawing. 2. Collect work piece 3. Refer and follow the steps of surface weld from 3 to 9. 4. Place the work-piece on the welding table with supporting in a flat position. 5. Perform tack weld on both ends. 6. Check and re-set the position. 7. Strike the arc on a rough-piece for trail. 8. Strike the arc on the work-piece at one edge. 9. Move the electrode in a straight following the edges of both workpiece and complete the bead at the other edge of the plate. 10. Remove the slag and spatters from the weld bead. 11. Repeat the exercise till you achieve good result.	**Condition :** Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes. **Task :** Weld edge joint. **Standards:** - Maintain joining of two metals. - Maintain spatters. - Maintain porosity.	

Duty: PERFORM FLAT POSITION WELDING

1.7 Weld Lap joint.

Time: 7.0hrs.
Exercise: 6.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instructional drawing. 2. Collect work piece 3. Refer and follow the steps of surface weld from 3 to 9. 4. Place the work-piece on the welding table with supporting in a flat position. 5. Perform tack weld on both ends. 6. Check and re-set the position. 7. Strike the arc on a rough-piece for trail. 8. Strike the arc on the work-piece at one edge. 9. Move the electrode in a straight following the edges of both workpiece and complete the bead at the other edge of the plate. 10. Remove the slag and spatters from the weld bead. 11. Repeat the exercise till you achieve good result.	**Condition :** Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes. **Task :** Weld Lap joint. **Standards:** - Maintain joining of two metals. - Maintain spatters. - Maintain porosity.	

Safety Precautions :

- Avoid using electrode holder with broken handle.
- Always use Chipping hammer and Wire brush to clean up the welding slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.

Duty: PERFORM FLAT POSITION WELDING

1.8. Weld Square butt joint from both sides.

Time: 9.o hrs.
Exercise: 8.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instructional drawing. 2. Obtain workpiece\meterial 3. Refer and follow the steps of surface weld from 4 to 9. 4. Place the work-piece on the welding table with supporting in a flat position. 5. Perform tack weld on both ends. 6. Check and re-set the position. 7. Strike the arc on a rough-piece for trail. 8. Strike the arc on the work-piece at one edge. 9. Move the electrode developing welding arc following the edges of both w/piece and complete the bead at other end of the plate. 10. Remove the slag from the weld bead. 11. Weld other side by using same process. 12. Remove slag and spatters.	**Condition :** Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes. **Task :** Weld Square butt joint from both sides. **Standards:** - Maintain joining of two metals. - Maintain welding penetration. - Maintain incomplete fusion and joints. - Maintain seams and laps.	

Safety Precautions :

- Avoid using electrode holder with broken handle.
- Always use Chipping hammer and Wire brush to clean up the welding slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.

Duty: PERFORM ELEMENTATY WELDING

1.9. **Perform Tack Welding or v-butt joint**

Time: 7.0 hrs.
Exercise: 6.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instruction. 2. Obtain workpiece\ material. 3. Obtain accessories and tools required. 4. Obtain electrode of required size. 5. Set the current. 6. Clamp the earth line to the table \ material. 7. Clamp the electrode on holder. 8. Hold hand shield by one hand and the on holder by another one . 9. Set workpiece material together maintaining the gap as required. 10. Spot weld maintaining short arc. 11. Repeat same process in interval of 10 to 15mm down.	**Condition :** Fully equipped workshop with Arc welding transformer and different sizes of welding electrodes **Task :** Perform Tack Weld for v-butt joint **Standards:** - Perform momentary weld join.	- Welding accessories.

Safety Precautions :

- Avoid using electrode holder with broken handle.
- Always use Chipping hammer and Wire brush to clean up the welding slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.

Duty: PERFORM FLAT POSITION WELDING

1.10 Weld V- butt joint with backing.

Time: 17 hrs.
Exercise: 16 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Obtain instructional drawing. 2. Obtain work piece/Material 3. Refer and follow the steps of surface weld from 4 to 9. 4. Position the work-piece on the welding table with supporting in a flat position. 5. Perform tack weld on both ends. 6. Check and re-set the position. 7. Strike the arc on a rough-piece for trail. 8. Strike the arc on the work-piece at one edge. 9. Move the electrode developing welding arc following the edges of both w/piece and complete the bead at other end of the plate. 10. Remove the slag from the weld bead. 11. Repeat the exercise till you achieve good result.	**Condition :** Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes. **Task :** Weld V-butt joint with backing. **Standards:** - Maintain joining of two metals. - Maintain welding distortion. - Maintain welding penetration.	

Safety Precautions :

- Avoid using Electrode holder with broken handle.
- Always use Chipping hammer and Wire brush to clean up the welding slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.

Duty: PERFORM HORIZONTALPOSITION WELDING

2.1. Perform surface weld.

Time: 13.0 hrs.
Exercise: 12.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Obtain instructional drawing. 2. Obtain work piece/Material 3. Refer and follow the steps of surface weld from 3 to 9 except 4. 4. Set the work-piece on the welding stand with clamps and supports in a horizontal position parallel to nose. 5. Strike the arc on a rough-piece for trail. 6. Strike arc and weld from left to right maintaining short arc length. 7. Move the electrode developing welding arc following the edges of both w/piece and complete the bead at other end of the plate. 8. Remove the slag from the weld bead. 9. Repeat the exercise till you achieve good result.	**Condition :** Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes. **Task :** Perform surface weld. **Standards:** - Maintain joining of two metals. - Maintain welding distortion. - Maintain welding penetration. - Follow welding procedure of Horizontal position welding.	• Work piece clamping. • Wave of welding in Horizontal position. • Penetration of welding in Horizontal position. • Welding procedure.

Safety Precautions :

- Avoid using Electrode holder with broken handle.
- Always use Chipping hammer and Wire brush to clean up the welding slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.

Duty: PERFORM HORIZONTAL POSITION WELDING

2.2. Perform square butt joint weld.

Time: 7.0 hrs.
Exercise: 6.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Obtain instructional drawing. 2. Obtain work piece/Material 3. Refer and follow the steps of surface weld from 3 to 9 except 4. 4. Set the work-piece on the welding stand with clamps and supports in a horizontal position parallel to nose. 5. Refer and follow the steps of surface welding of horizontal position from 5 to 9. 6. Move the electrode developing welding arc following the edges of both w/piece and complete the bead at other end of the plate. 7. Remove the slag from the weld bead. 8. Repeat the exercise till you achieve good result.	**Condition :** Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes. **Task :** Perform square butt joint weld. **Standards:** - Maintain joining of two metals. - Maintain welding distortion. - Maintain welding penetration. - Follow welding procedure of Horizontal position welding.	• Workpiece clamping. • Wave of welding in Horizontal position. • Penetration of welding in Horizontal position. • Welding procedure.

Safety Precautions :

- Avoid using Electrode holder with broken handle.
- Always use Chipping hammer and Wire brush to clean up the welding slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.

Duty: PERFORM VERTICAL POSITION WELDING

3.1 Perform surface weld in Vertical position

Time: 9.0 hrs.
Exercise: 8.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Obtain instructional drawing. 2. Obtain work piece/Material 3. Refer and follow the steps of surface weld from 3 to 9 except 4. 4. Place the work-piece on the welding stand with clamps and supports in a Vertical position. 5. Check and re-set the position. 6. Strike arc on a rough-piece for trail. 7. Strike arc and weld from the bottom end to upwards maintaining short arc length. 8. Move the electrode developing welding arc following the edges of both w/piece and complete the bead at other end of the plate. 9. Remove the slag from the weld bead. 10. Repeat the exercise till you achieve good result.	**Condition :** Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes. **Task :** Perform surface weld in Vertical position. **Standards:** - Maintain joining of two metals. - Maintain welding distortion. - Maintain welding penetration. - Follow welding procedure of Vertical position welding.	• Workpiece clamping. • Wave of welding in Vertical position. • Penetration of welding in Vertical position. • Welding procedure.

Safety Precautions :

- Avoid using Electrode holder with broken handle.
- Always use Chipping hammer and Wire brush to clean up the welding slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.

Duty: PERFORM VERTICAL POSITION WELDING

3.2. Perform Square butt in Vertical position

Time: 9.0 hrs.
Exercise: 8.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Obtain instructional drawing. 2. Obtain work piece/Material 3. Refer and follow the steps of surface weld from 3 to 9 except 4. 4. Use back plate at first time welding vertical position. 5. Place the work-piece on the welding stand with clamps and supports in a Vertical position parallel to nose. 6. Refer and follow the steps of vertical welding from 6 to 11.	**Condition :** Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes. **Task :** Perform Square butt in Vertical position. **Standards:** - Maintain joining of two metals. - Maintain welding distortion. - Maintain welding penetration. - Follow welding procedure of Vertical position welding.	• Workpiece clamping. • Wave of welding in vertical position. • Penetration of welding in Vertical position. • Welding procedure.

Safety Precautions :

- Avoid using Electrode holder with broken handle.
- Always use Chipping hammer and Wire brush to clean up the welding slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.

Duty: PERFORM OVERHEAD POSITION WELDING

4.1. Perform surface weld.

Time: 9.0 hrs.
Exercise: 8.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Obtain instructional drawing. 2. Obtain work piece/Material 3. Refer and follow the steps of surface weld from 3 to 9 except 4. 4. Place the work-piece on the welding stand with clamps and supports in a overhead position. 5. Check and re-set the position. 6. Strike the arc on a rough-piece for trail. 7. Strike arc and start welding from left to right maintaining short arc length. 8. Remove the slag from the weld bead. 9. Repeat the exercise till you achieve good result.	**Condition :** Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes. **Task :** Perform surface weld. **Standards:** - Maintain welding distortion. - Maintain welding - Follow welding procedure of overhead position welding.	• Workpiece clamping. • Wave of welding in overhead position. • Welding in overhead position. • Welding procedure.

Safety Precautions :

- Avoid using Electrode holder with broken handle.
- Always use Chipping hammer and Wire brush to clean up the welding slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.

Duty: PERFORM OVERHEAD POSITION WELDING

4.2 Perform square butt joint.

Time: 14.0 hrs.
Exercise: 13.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Obtain instructional drawing. 2. Obtain work piece/Material 3. Refer and follow the steps of surface weld from 3 to 9 except 4. 4. Refer and follow the steps of surface weld of outer head position from 4 to 9.	**Condition :** Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes. **Task :** Weld square butt joint from both side **Standards:** - Maintain welding distortion. - Follow welding procedure of overhead position welding.	• Workpiece clamping. • Wave of welding in overhead position. • Welding in overhead position. • Welding procedure.

Safety Precautions :

- Avoid using electrode holder with broken handle.
- Always use chipping hammer and Wire brush to clean up the welding slags.
- Always check the connection of holder, shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.

Duty: PERFORM PIPE WELDING IN FLAT POSITION

5.1 Weld Pipe to pipe joint in Rotated position.

Time: 9.0 hrs.
Exercise: 8.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Obtain instructional drawing. 2. Obtain work piece/Material 3. Collect and set up welding accessories and tools. 4. Deburr and grind 45° groove edge on all welding sides of pipes. 5. Set the work-piece on the 'V' block on welding table with supports needed in a Flat position. 6. Perform tack weld 3 or 4 according to the diameter of pipe. 7. Check and re-set the position. 8. Strike the arc on a rough-piece for trail. 9. Strike the arc and start welding from tack weld. 10. Rotate the pipe continuously developing welding arc and wave of both pipe and complete the bead at other end. 11. Remove the slag from the weld bead. 12. Repeat the exercise till you achieve good result.	**Condition :** Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes. **Task :** Weld pipe to pipe joint in rotated position. **Standards:** - Maintain joining of two metals. - Maintain welding distortion. - Maintain welding penetration. - Follow welding pipe to pipe joint procedure Flat position.	• Workpiece clamping. • Wave of welding in Horizontal position. • Penetration of welding in pipes. • Welding procedure.

Safety Precautions :

- Avoid using Electrode holder with broken handle.
- Always use Chipping hammer and Wire brush to clean up the welding slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.

Duty: PERFORM PIPE WELDING IN FLAT POSITION

5.2 Weld Pipe and Flat metal joint.

Time: 9.0 hrs.
Exercise: 8.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Obtain instructional drawing. 2. Obtain work piece/Material 3. Collect and set up welding accessories and tools. 4. Deburr and grind off 45° groove edge on all welding sides of pipe. 5. Set the work-piece on the welding table with supports needed in a Flat position. 6. Perform tack welds 2 or more according the diameter of pipe. 7. Check and re-set the position. 8. Strike the arc on a rough-piece for trail. 9. Strike the arc and start welding from left rotating pipe. 10. Remove the slag from the weld bead. 11. Repeat the exercise till you achieve good result.	**Condition :** Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes. **Task :** Weld pipe and flat metal joint. **Standards:** - Maintain joining of two metals. - Maintain welding distortion. - Follow welding Flange joint procedure.	• Workpiece clamping. • Wave of welding in Flange joint. • Penetration of welding in pipes. • Welding procedure.

Safety Precautions :

- Avoid using Electrode holder with broken handle.
- Always use Chipping hammer and Wire brush to clean up the welding slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.

Duty: REPAIR WELDING PARTS

6.1. Repair of cast iron parts.

Time: 7.0 hrs.
Exercise: 6.0 hrs
Demo: 1.0 hrs

Task and Steps	Terminal Performance Objective	Related Technical Knowledge
1. Obtain workpiece of cast iron to be repaired. 2. Obtain an Instruction. 3. Collect the accessories & tools required. 4. Set up LPG/Oxy-acetylene with blow torch. 5. Clean the worn parts. 6. Ground the work piece. 7. Pre heat as necessary. 8. Weld on worn parts and other areas. 9. Cool weld bead slowly by covering dry sands immediately after welding. 10. Finish the weld at remaining welding mark smoothly referring steps above.	**Condition :** Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes. **Task :** Repair of cast iron parts. **Standards:** - Repair welding of cast iron and forging metal parts.	• Preheating cast iron parts for welding. • Wave of welding in cast iron joint. • Welding procedure.

Safety Precautions :

- Avoid using Electrode holder with broken handle.
- Always use Chipping hammer and Wire brush to clean up the welding slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.

Duty: REPAIR WELDING PARTS

6.2. Fill a Large hole.

Time: 9.0 hrs.
Exercise: 8.0 hrs
Demo: 1.0 hrs

Task and Steps	Terminal Performance Objective	Related Technical Knowledge
1. Collect repairable work piece with hole to be filled. 2. Obtain instructions. 3. Collect and set up welding accessories and tools. 4. Grind off and clean the slags if needed. 5. Grind off more groove much as possible. 6. Set the work-piece on the welding table with supports needed. 7. Fill up the welding beads surroundings of the hole. 8. Check and clean the slags. 9. Fill up the welding beads as multi run to the surroundings to make small hole area. 10. Repeat it until the hole covered. 11. Remove the slag from the weld bead. 12. Repeat the exercise till you achieve good result.	**Condition :** Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes. **Task :** Fill a Large hole. **Standards:** - Fill the holes and over fusion surfaces of the work pieces. - Follow filling the holes of w/p by welding procedure.	• Welding procedure.

Safety Precautions :

- Avoid using Electrode holder with broken handle.
- Always use Chipping hammer and Wire brush to clean up the welding slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.

BIBLIOGRAPHY

SN	Name	Author	Publication
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

Workshop Technology -I

Total: 117 hrs
Class/week: 3 hrs

Unit/sub unit	Areas and Topics	Time (hrs.)
1	**General Safety Theory**	**4**
1.1	Safety introduction	
1.3	General workshop safety	
1.4	Occupational health surveillance	
1.5	Electrical safety	
1.6	Identifying shop hazards	
1.7	Fire hazards and fighting safety	
2	**Bench work Theory**	**30**
2.1	***File***	
2.1.1	Filing safety	
2.1.2	Introduction of File and its elements	
2.1.3	Size of files	
2.1.4	Types of file, Cuts of files.	
2.1.4.1	Profiles	
2.1.4.2	Cut of teeth	
2.1.4.3	Grades of cut	
2.1.5	Methods of filling	
2.1.5.1	Transverse filing (cross filing)	
2.1.5.2	Diagonal filing	
2.1.5.3	Draw filing	
2.2	***Bench work hand tools***	
2.2.1	Introduction	
2.2.1.1	Hacksaws and sawing	
2.2.1.2	Safety precaution	
2.2.1.3	Types of Frame	
2.2.1.4	Hacksaw blades	
2.2.2	Hammers	
2.2.2.1	Introduction	
2.2.2.2	Safety precaution	
2.2.2.3	Types and use of Hammer	
2.2.3	Chisels and chippings	
2.2.3.1	Introduction	
2.2.3.2	Safety precaution	
2.2.3.3	Types and use of Chisels	
2.2.4	Punch and punches	
2.2.4.1	Introduction	
2.2.4.2	Safety precaution	
2.2.4.3	Types and use of Punches	
2.2.5	Pliers and Cutters	
2.2.5.1	Introduction	
2.2.5.2	Safety precaution	
2.2.5.3	Types and use of Pliers	
2.2.6	Taps and dies	
2.2.6.1	Introduction	

2.2.6.2	Safety precaution	
2.2.6.3	Types of Taps and Dies	
2.2.6.4	Tap handles and Die stocks	
2.2.6.5	Size of Tap drills (tapping drills)	
2.2.6.6	Screw extractor	
2.2.7	Wrench and spanners	
2.2.7.1	Introduction	
2.2.7.2	Safety precaution	
2.2.7.3	Types and use of Wrenches and Spanners	
2.3	***Work clamping devices***	
2.3.1	Vices	
2.3.1.1	Introduction	
2.3.1.2	Types of vices	
2.3.1.3	Main parts of the vices	
2.3.1.4	Uses of vices	
2.3.2	C-clamps	
2.3.2.1	Introduction	
2.3.2.2	Types and Use of C-clamps	
2.3.3	V- Block with bridges	
2.3.3.1	Introduction	
2.3.3.2	Types and use of V-Blocks and Clamping	
3	**Measuring Instruments and Gauges**	**12**
3.1	Scales and meters	
3.1.1	Introduction	
3.1.2	Types of Scale and rules	
3.2	Calipers	
3.2.1	Introduction	
3.2.2	Types of calipers (Odd leg, Inside & Outside)	
3.3	Vernier Calipers	
3.3.1	Introduction	
3.3.2	safety precautions	
3.3.3	Main parts	
3.3.4	Least Count	
3.4	gauges	
3.4.1	Introduction	
3.4.2	Types and Use of (feeler gauge, radius gauge, Pitch gauge and Wire gauge) limit and adjustable.	
3.5	Introduce angle measuring instruments	
3.5.1	Introduction	
3.5.2	Types and Use of (Drill grinding gauge, Back Square, Center back square and Protractor)	
4	**Drills and Drilling**	**15**
4.1	Safety precaution	
4.2	Drills and drilling	
4.3	Types of drills	
4.5	Elements of twisted drill	

4.6	Drill chucks, keys, and drift	
4.7	Drill sleeves and sockets	
4.8	Drilling machines	
4.8.1	Types of drilling machines	
4.8.2	Main Parts of drilling machine	
4.8.3	Cutting speed feed and RPM	
4.8.4	Drilling operations	
5	**Sheet Metal**	**22**
5.1	Safety precaution	
5.2	Sheet metal and its application	
5.3	Marking and laying out	
5.4	Development of pattern	
5.5	Hand tools used in sheet metal work	
5.6	Explain machines for sheet metal forming machine	
5.6.1	Shearing m/c, types and application	
5.6.2	Folding machine,	
5.6.3	Beading machine,	
5.7	Punches and punch tools	
5.8	Riveting	
5.9	Soldering	
5.10	Flanging and crimping	
5.10.1	Standard sizes and gauges of sheet metals	
6	**Arc Welding**	**19**
6.1	Introduce welding technology	
6.2	Safety precaution	
6.3	Welding and welding procedures	
6.3.1	Welding machines	
6.3.2	Definition of Current	
6.3.3	Types and use of Electrodes	
6.3.4	Welding tools	
6.4	Welding joints, Symbols and Positions	
6.4.1	Edge and corner, Square butt joint, V joint, Lap joint, T joint and Flange	
6.4.2	welding position (Flat, Horizontal, Vertical and Overhead)	
6.5	Welding defects and their remedies / prevention	
6.5.1	Producing electric arc	
6.5.2	Undercuts	
6.5.3	Fusion and joint	
6.5.4	Penetration	
6.5.5	Porosity	
6.5.6	Overlap	
6.5.7	Seams and laps	
6.6	Inspections and testing of the welding.	
6.6.1	Destructive test (Crack test, Impact test and Bending test	
6.6.2	Non destructive test (Magnetic particle, X-ray, Ultrasonic test, Radiographic test)	

7	**Lathe Machine**	**15**
7.1	Lathe machine (working principles and main parts)	
7.2	Safety precaution	
7.3	Work holding in 3 jaw chuck (self centering independent chuck)	
7.4	Work holding in collets	
7.5	Tool holding devices	
7.6	Elements of Tool posts	
7.7	Lathe operations	
7.7.1	Facing	
7.7.2	Plain turning, Stepped turning	
7.7.3	Center drilling	
7.7.4	Drilling	
7.7.5	Boring / counter boring	
7.7.6	Chamfering	
7.7.7	Deburring	
	Total	***117***

BOOK AND REFERENCES

- 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.

Second Year

Subjects

1. Applied Math - II
2. Computer Aided Drafting
3. Engineering Drawing - II
4. Entrepreneurship Development
5. Lathe Operation -II
6. Material Science - II
7. Milling & Shaping Operation
8. Repair & Maintenance
9. Structural Fabrication
10. Welding Technology – II (Gas/ TIG/MIG)
11. Workshop Technology - II

Applied Mathematics - II

Total: 78 hrs
Class/week: 2 hrs

Areas and Topics	Time (hrs.)
1. Calculate Effects of force	**4**
1.1. Representation	
1.2. Line of Application	
1.3. Equi-directional force	
1.4. Opposite forces	
1.5. Forces at an angle	
1.6. Resolution of forces	
1.7. Examples and Exercises	
2. Calculate pulleys without friction	**4**
2.1. Fixed pulley	
2.2. Loose pulley	
2.3. Block	
2.4. Differential pulley	
2.5. Examples and Exercises	
3. Calculate Lever Forces	**4**
3.1. Moment of force	
3.2. One side lever	
3.3. Two side lever	
3.4. Elbow lever	
3.5. Several forces	
3.6. Examples and Exercises	
4. Calculate Reaction of supports	**4**
4.1. Equilibrium	
4.2. Support reaction	
4.3. Check	
4.4. Examples and Exercises	
5. Calculate uniform speeds	**4**
5.1. Laws of motion	
5.2. V is in a straight line	
5.3. V is circular	
5.4. Acceleration	
5.5. Examples and Exercises	
6. Calculate average speed	**4**
6.1. Stroke speed	
6.2. Piston speed	
6.3. Summary	
6.4. Examples and Exercises	
7. Calculate pressure and force	**6**
7.1. Concept of pressure	
7.2. Contact pressure	
7.3. Projected area	
7.4. Force	
7.5. Examples and Exercises	
8. Calculate shearing and punching	**4**
8.1. Cutting off	
8.2. Cutting out and punching	
8.3. Shear strength	
8.4. Shear force	

8.5. Examples and Exercises

9.	**Calculate work, power and efficiency**	**4**
	9.1. Work	
	9.2. Power	
	9.3. Efficiency	
	9.4. Examples and Exercises	
10.	**Calculate Simple belt drive**	**4**
	10.1. Peripheral speed	
	10.2. Transmission ratio	
	10.3. Examples and Exercises	
11.	**Calculate Multiple belt drive**	**4**
	11.1. Components, transmissions	
	11.2. Total transmission	
	11.3. Examples and Exercises	
12.	**Calculate gear wheel dimensions**	**4**
	13.1. Pitch	
	13.2. Module	
	13.3. Examples and Exercises	
13.	**Calculate Simple gear drive**	**4**
	13.1. Dependency of pitch diameter and revolution	
	13.2. Dependency of number of teeth and revolution	
	13.3. Transmission ratio	
	13.4. Distance between axis	
	13.5. Examples and Exercises	
14.	**Calculate Multiple gear drive**	**4**
	14.1. Component transmission	
	14.2. Total transmission	
	14.3. Examples and Exercises	
15.	**Calculate processing time for drilling**	**4**
	15.1. Calculation of feed speed	
	15.2. Calculation of processing time in min.	
	15.3. Calculation of initial cut	
	15.4. Examples and Exercises	
16.	**Calculate processing time for turning**	**4**
	16.1. Calculation of feed speed	
	16.2. Calculation of processing time in min.	
	16.3. Examples and Exercises	
17.	**Calculate processing time for planning, slotting & shaping**	**4**
	17.1. Processing time for planning	
	17.2. Processing time for slotting (shaping)	
	17.3. Examples and Exercises	
18.	**Calculate processing time for milling**	**4**
	18.1. Calculation of run up	
	18.2. Calculation of feed speed	
	18.3. Calculation of processing time in min.	
	18.4. Examples and Exercises	
19.	**Calculate Indexing (indirect indexing)**	**4**
	19.1. By indexing numbers	
	19.2. By degrees of angles	
	19.3. Calculation of Hole circles	
	19.4. Examples and Exercises	
	Total	**78**

BIBLIOGRAPHY:

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

Computer Aided Drafting

Total: 78 hrs
Class/week: 2 hrs

Course Description:
This 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 *civil engineering drawings*. The course is designed to fulfill specific needs of student who wants the transition from a paper to electronic drawing world by means of using CAD as a drafting tool. Students develop competencies focusing mainly on different features such as Geometric shapes, Layers and Linetypes, Annotating a drawing with Text, Hatching and Dimensioning and creating output.

Prerequisite:
- Engineering Drawing
- Basic Computer Application

Module: 1 Computer Fundamentals (Review)

S.N.	Task Statements	Related Technical Knowledge	Time (hrs)	
			T	P
1.	Apply Basic Computer Skills	▪ Overview of a computer operating system and peripherals (printers and plotters, system settings and the windows environment) ▪ Application Packages (Microsoft (MS) Office package or equivalent) • Word Processing package (MS Word or equivalent) • Spreadsheet Package (MS Excel or equivalent) • Presentation Package (MS Power Point or equivalent) ▪ Basic concept of E-mail/ Internet ▪ Computer handling ▪ Open, save, save as, cut, copy, paste etc	2	1
	Sub total		**2.00**	**1.00**

Module: 2 Familiarize Computer Aided Drafting (CAD) Software

S.N.	Task Statements	Related Technical Knowledge	Time (hrs)	
			T	P
1.	Startup Computer Aided Drafting (CAD) software	▪ Introduction ▪ Enlist different types of CAD software. ▪ System requirement for CAD ▪ Startup CAD by start menu ▪ Interpret CAD graphics window including screen layout, pull-down menus, screen icons, command line and dialogue boxes. ▪ Modify display ▪ Introduce and arrange toolbar ▪ Managing unit/limit ▪ Start, organize and save file	1	1
2.	Setup a Drawing	▪ Explain how to start drawing from scratch, using wizard and, using and creating a template file. ▪ Describe setting preferences (units, angle, direction, area)	0.25	0.5
3	Manage toolbar	▪ Standard tool bar ▪ Draw tool bar ▪ Modify toolbar ▪ Dimensioning tool bar ▪ Other	0.25	0.5
	Sub total		**1.50**	**2.00**

Module: 3 Construct 2-D drawing using CAD Software

S.N.	Task Statements	Related Technical Knowledge	Time (hrs)	
			T	P
1.	Draw lines	▪ Different system Relative , Cartesian and absolute coordinate system. ▪ Start and end point of a line ▪ Different methods of drawing a line in CAD ▪ Options available in drawing line in CAD (Undo, Close)	1.50	1.00
2.	Draw rectangle	▪ Corner points (first and other) ▪ Options available in drawing rectangle (chamfer, fillet) ▪ Chamfer distance ▪ Fillet radius	0.25	0.50

S.N.	Task Statements	Related Technical Knowledge	Time (hrs)	
			T	P
3.	Draw arc	▪ Identify arc among various types of geometric shapes. ▪ Describe different options for drawing arc (3 points method, Start Center method, Start End method, Center Start method	0.25	0.75
4.	Draw circle	▪ Describe different options for drawing arc (Center Radius method, Center Diameter method, 2P method, 3P method, Tan, Tan Radius method, Tan, Tan, Tan method)	0.25	0.50
5.	Draw polygon	▪ Describe different options for drawing polygon (center, edge)	0.25	0.50
6.	Manage lines	▪ Line properties ▪ Line weight ▪ Line color ▪ Line loading	0.25	0.50
7.	Draw an isometric drawing	▪ Concept Isometric snap and rectangular snap ▪ Setting of isometric snap	0.50	1.00
8.	Draw ellipse	▪ Ellipse in rectangular snap • Center Radius method ▪ Center Diameter method ▪ Ellipse in isometric snap	0.50	0.75
	Sub total		**2.00**	**4.00**

Module: 4 Edit drawing using CAD Software

S.N.	Task Statements	Related Technical Knowledge	Time (hrs)	
			T	P
1.	Relocate object using Move command	▪ Different methods of selecting objects for editing such as window, crossing, fence, all … • Base point ▪ Second point of displacement	0.25	0.50
2.	Relocate object using rotate command	▪ Define rotation angle ▪ Explain Reference Point.	0.25	0.50

S.N.	Task Statements	Related Technical Knowledge	Time (hrs)	
			T	P
3.	Duplicate object using Copy command	▪ Differentiate Multiple copy and Single copy. ▪ Explain the procedure for duplicating object using copy command.	0.25	0.50
4.	Duplicate object using Mirror command	▪ State the purpose of Mirror. ▪ Explain First point and Second point of mirror line ▪ Second point of mirror line ▪ Describe options available in mirror command	0.25	1.00
5.	Duplicate object using Offset command	▪ Describe options available for ▪ Offset distance ▪ Through	0.25	1.00
6.	Duplicate object using Array command	▪ Differentiate Rectangular Array and Polar Array ▪ Explain Rows, Columns ad Distance, Center point, number, angle and rotation	0.25	1.00
7.	Modify object using trim command	▪ Define Cutting edge ▪ Explain the options available for trimming object (project, edge, undo)	0.25	0.50
8.	Modify object using extend command	▪ Define Boundary edge ▪ State the procedure for modifying object using Extend command.	0.25	1.00
9.	Modify object using fillet command	▪ Differentiate Chamfer and Fillet. ▪ Explain the options available for filleting object i.e. fillet radius	0.25	0.50
10.	Modify object using chamfer command	Explain the options available for chamfering object i.e. Distance, angle	0.25	0.50
	Sub total		**2.50**	**7.00**

Module: 5 Annotate a drawing with Text, layer, lock, Hatching and Dimensioning

S.N.	Task Statements	Related Technical Knowledge	Time (hrs)	
			T	P
1.	Create a Layer	▪ Define Layer. ▪ 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) ▪ Explain the procedure for creating a layer.	0.75	2.00
2.	Create text styles.	▪ Differentiate Single line text [TEXT] and Multiline Text [MTEXT] ▪ Explain Style name, Font Name, Style and Height ▪ Describe Font effect, Width factor and Oblique angle ▪ Explain the procedure for creating text styles.	0.50	1.00
3.	Add Single/Multiple line text to a drawing		0.25	1.00
4.	Edit text using these commands and methods.	▪ Multiline Text Editor • Character • Properties • Line spacing • Find/replace, import text Layer and symbol	0.25	1.00
5.	Hatch the sectional area	▪ Define hatching. ▪ Differentiate ISO Hatch Pattern, User Defined Hatch Pattern, Pre-Defined Hatch and Associative Hatch ▪ Explain Boundary set, copying of hatch properties, pick point, hatch angle, scale, pattern, and object selection. ▪ modify the hatched pattern	0.50	2.00
6.	Create Block	▪ Definition ▪ Name ▪ Pick point ▪ selection	0.25	1.00

S.N.	Task Statements	Related Technical Knowledge	Time (hrs)	
			T	P

7.	Add dimensions to a drawing	▪ Interpret dimension elements (dimension text, lines and arrowheads, leader, extension lines, units, tolerance and center marks)
		▪ Describe dimension types (linear, aligned, ordinate, radius, diameter, angular, baseline and continue)
		▪ Dimension dialog box
		  ▪ Lines and arrow
		  ▪ Dimension and text
		  ▪ Fit
		  ▪ Unit
		  ▪ Tolerances
		▪ Modify Dimension style
		▪ Dimension in isometric drawing
			0.50	2.00

	Sub total		**3.00**	**10.00**

Module: 6 Create output

S.N.	Task Statements	Related Technical Knowledge	Time (hrs)	
			T	P
1.	Configure Plotters/Printers	▪ Define Plotter Manager ▪ Explain Plot Style Manager ▪ State the Printer/Plotter Installation process	0.5	1.0
2.	Plot drawing	▪ Explain paper size and paper units, drawing orientation, plot area and plot scale, plot offset. ▪ Describe the procedure for printing a drawing.	0.5	1.0
	Sub total		**1.00**	**2.00**

Project works

1.	Following drawings are to be prepared and submitted (e-copy and hard copy both) using CAD software. • Draw an Isometric drawing • Draw an Oblique drawing • Draw Orthographic drawing	0	42.0

	• Draw Workshop drawing • Give dimension(Orthographic, Isometric)		
	Sub total	**0**	**42.0**
	Total	**12**	**68**
	Grand total	**78**	

Suggested texts and references:

- Kognet learning solution, *Simple steps in AutoCAD*, Dream tech press, India
- George Omura, *Mastering AutoCAD 2013 and AutoCAD LT 2013*,India

Engineering Drawing – II

Total: 78 hrs
Class/week: 2 hrs

Duties and Tasks	Time (hrs.)	
	Demo	**Practical**
1. Development of Sheet Metal		
1.1.Draw square box development	2	2
1.2.Draw truncated cylindrical development	-	2
1.3.Draw truncated cone development	-	2
1.4.Draw truncated square prism development	-	2
1.5.Draw Pyramid Development	-	2
1.6.Draw cylindrical T-joint development	-	2
2. Draw the Machine Elements		
2.1.Draw hexagon nuts	2	2
2.2.Draw hexagon bolts	2	2
2.3. Draw gear drawings	3	
3. Draw Assembly Views		
3.1.Copy simple assembly views	2	10
3.2.Draw detail from assembly view		10
3.3.Draw assembly view from detail drawings	-	8
4. Draw Steel Fabrication		
4.1.Draw Steel windows	1	4
4.2.Draw Steel Stairs	1	4
4.3.Draw Roof Truss	1	6
5. Sketch Freehand Drawings		
5.1.Sketch workshop drawing from sample / real object.	-	6
Sub Total	***14***	***64***
Total	***78***	

DUTY: 1: DEVELOPMENT OF SHEET METAL

1.1 Draw Square Box Development

Time: 4.0 hrs.
Exercise: 2.0 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Set paper in drawing board 2. Prepare a drawing sheet 3. Determine the length breadth and height of the box to be develop 4. Draw a reference vertical line leaving the left border margin and horizontal line on bottom information column 5. Calculate the total area of the box including edge folding margin 6. Draw the area 7. Divide the area from center for length breadth and height 8. Mark and draw the line in based folding line for excess folding margin outside the box area on all 4 side 9. Mark and draw the line for edge folding margin on 4 edges 10. Mark and draw all corners to notch in 45 at all excess folding margin 11. Erase projection lines if draw it 12. Represent the dimensions with symbol require 13. Give darkness for necessary lines 14. Clean up the drawing sheet.	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task :** Draw square box development. **Standards:** • Calculation of drawing area. • Design the view with margin, edge folding, and notching. • Draw the views. • Maintain the uniformity of line thickness. • Maintain the line joints. • Maintain the neatness and cleanliness	- Types of sheet metal development (Parallel line and Radial line) - Sheet metal development - Sheet metal pattern development - Area calculation - Importance of notching - Importance of edge folding - Sheet metal folding

Safety Precautions :

DUTY: 1: DEVELOPMENT OF SHEET METAL

1.2 Draw Truncated Cylindrical Development

Time: 2.0 hrs.
Exercise: 2.0 hrs
Demo: 0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Set paper in drawing board 2. Prepare a drawing sheet 3. Select dimension such as diameter, length, and cutting angle 4. Draw a top view & front view of cylinder 5. Divide the circle twelve parts by compass and divider 6. Project the projection line from each of the point towards on front view respectively or vertically down ward 7. Give the name where the projection line cuts the upper and lower parts of front view line 8. Cut the front view axially at any desired or required angle on the any desired height from the base 9. Give same name where the projection line cut the cutting plane 10. Project the projection line horizontally from the top and base line front view 11. Draw a vertical line of reference out any point on horizontal projection line 12. Take one part of length from top view by divider or compass. 13. Mark twelve times from the initially draw reference line by taking length from compass 14. Draw vertical projection line from each point respectively upper projection line 15. Give name at each point according to initially given name 16. Project the projection line from cutting plane's point horizontally 17. Give name at same point of projection line intersect to each other respectively 18. Joint each point by French curve 19. Erase projection lines if draw it 20. Represent the dimensions with symbol require 21. Give darkness for necessary lines 22. Clean up the drawing sheet.	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument and French curve **Task :** Draw truncated cylindrical development. **Standards:** • Calculation of drawing area. • Projected representative lines • Design the view with axially at required angle. • Draw the views. • Maintain the uniformity of line thickness. • Maintain the line joints. • Maintain the neatness and cleanliness	

Safety Precautions :

DUTY: 1: DEVELOPMENT OF SHEET METAL

1.3 Draw Truncated Cone Development

Time: 2.0 hrs.
Exercise: 2.0 hrs
Demo: 0.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Set paper in drawing board 2. Prepare a drawing sheet 3. Select the diameter for truncated cone 4. Draw a top view and front view of cone 5. Divide the top view circle into 12 equal parts 6. Name on each point of the divided circle 7. Project the projection line from each point of parting circle vertically down wards which intersect the base line of front view 8. Give same name whether the projection line intersect 9. Project the line from the each point. 10. Draw a cutting plane line in desired angle and height from the base line of front view 11. Give name when cutting plane cut each projecting line by its same name 12. Draw horizontal projection line from each point of cutting plane at 0-1 projection line 13. Give same name as dash at 0-1 line by respecting point of projection line 14. Take radius 0-1 by compass 15. Draw an arc by taking radius 0-1 at any where place as far as possible 16. Join the arc for reference from approx. 0 17. Take 1 part of distance by compass from top view 18. Mark at initially drawn arc 12 line by distance taking compass 19. Give name respectively 20. Draw projection from each point. 21. Take radius 0-1 22. Set one tip of compass on apex 0 and draw an arc by taking radius 0-1 23. Give name where drawing arc cut respective projection line such as 0-1 24. Take radius 0-2' 12' and set at apex 0 & draw an arc 25. Give same name whether 0-2', 12' arc cut to its respective projection line. 26. Draw a line by French curve 27. Erase projection lines if draw it 28. Represent the dimensions with symbol. 29. Give darkness for necessary lines 30. Clean up the drawing sheet.	**Condition :** Fully equipped Classroom with Drawing board, T-set, French curve and drawing instrument. **Task :** Draw truncated cone development. **Standards:** • Calculation of drawing area. • Projected representative lines • Design the view with axially at required angle. • Draw the views. • Maintain the uniformity of line thickness. • Maintain the line joints. • Maintain the neatness and cleanliness	

DUTY: 1: DEVELOPMENT OF SHEET METAL

1.4 Draw a Truncated Square Prism Development

Time: 2.0 hrs.
Exercise: 2.0 hrs
Demo: 0.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Set paper in drawing board 2. Prepare a drawing sheet 3. Select the dimensions of object or drawing to be drawn 4. Draw top and front view of right square prism 5. Draw a cutting plane at desired length and angle 6. Give name where the cutting plane cut the front view by same name 7. Project the projection line horizontally from top and base line of front view 8. Draw a vertical projection line for reference at any point on horizontal line which cuts upper horizontal projection line 9. Take one side length of prism from top view by setting compass 10. Mark four times from reference point at lower horizontal line by initially setting compass. 11. Give name on each point according to top view basis in to twelve horizontal point 12. Project the projection line horizontally front cutting plane point 13. Give same name when same projection line intersect the each of view 14. Joint the drawn points 15. Erase projection lines if draw it 16. Represent the dimensions with symbol require 17. Give darkness for necessary lines 18. Clean up the drawing sheet.	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task :** Draw right square prism development. **Standards:** • Calculation of drawing area. • Projected representative lines • Design the view with axially at required angle. • Draw the views. • Maintain the uniformity of line thickness. • Maintain the line joints. • Maintain the neatness and cleanliness	

Safety Precautions :

DUTY: 1: DEVELOPMENT OF SHEET METAL

1.5 Draw Pyramid Development

Time: 2.0 hrs.
Exercise: 2.0 hrs
Demo: 0.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Set paper in drawing board 2. Prepare a drawing sheet 3. Determine the length breadth and height of the box to be develop 4. Draw a reference vertical line leaving the left border margin and horizontal line on bottom information column 5. Calculate the total area of the box including edge folding margin 6. Draw the area 7. Divide the area from center for length breadth and height 8. Mark and draw the line in based folding line for excess folding margin outside the box area on all 4 side 9. Mark and draw the line for edge folding margin on 4 edges 10. Mark and draw all corners to notch in 45 at all excess folding margin 11. Erase projection lines if draw it 12. Represent the dimensions with symbol require 13. Give darkness for necessary lines 14. Clean up the drawing sheet.	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task :** Draw pyramid development. **Standards:** • Calculation of drawing area. • Projected representative lines • Design the view with axially at required angle. • Draw the views. • Maintain the uniformity of line thickness. • Maintain the line joints. • Maintain the neatness and cleanliness	

Safety Precautions :

DUTY: 1: DEVELOPMENT OF SHEET METAL

1.6 Draw Cylindrical T-Joint Development

Time: 2.0 hrs.
Exercise: 2.0 hrs
Demo: 0.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Set paper in drawing board 2. Prepare a drawing sheet 3. Determine the length breadth and height of the box to be develop 4. Draw a reference vertical line leaving the left border margin and horizontal line on bottom information column 5. Calculate the total area of the box including edge folding margin 6. Draw the area 7. Divide the area from center for length breadth and height 8. Mark and draw the line in based folding line for excess folding margin outside the box area on all 4 side 9. Mark and draw the line for edge folding margin on 4 edges 10. Mark and draw all corners to notch in 45 at all excess folding margin 11. Erase projection lines if draw it 12. Represent the dimensions with symbol require 13. Give darkness for necessary lines 14. Clean up the drawing sheet.	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task :** Draw cylinder T-joint development. **Standards:** • Calculation of drawing area. • Projected representative lines • Design the development. • Draw the views. • Maintain the uniformity of line thickness. • Maintain the line joints. • Maintain the neatness and cleanliness	

Safety Precautions :

DUTY: 2: DRAW MACHINE ELEMENT

2.1 Draw Hexagon Nut

Time: 4.0 hrs.
Exercise: 2.0 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Set paper in drawing board 2. Prepare a drawing sheet 3. Determine the size of nut in mm 4. Identify the standards of nut 5. Draw the center line crossing X and Y axis 6. Draw the circle of 2xd (dithered size in mm) of the center 7. Draw a hexagon in the circle using compass 8. Draw ¾ th circle major diameter of thread size (d) on the center 9. Draw small circle of minor diameter on same circle 10. Draw circle width size of hexagon 11. Draw a rectangle, height of nut in above the hexagon at same vertical center line 12. Divide the rectangle corresponding the line from hexagon corner 13. Mark a point on vertical center line down from rectangle height 1.5xd 14. Adjust the compass with marked point to rectangle height 15. Draw an arc upto full length of the nut 16. Draw horizontal line on arc ending point 17. Divide the center point vertically on both small rectangles 18. Draw the arcs from center point to small rectangle size 19. Make the 30 corner at both ends of the nut on arc drawn side 20. Draw the same arcs at the bottom of the nuts if necessary 21. Erase the projection lines drawn 22. Give darkness for necessary lines 23. Clean up the drawing sheet	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task :** Draw hexagon nut. **Standards:** • Draw the supporting lines. • Projected representative lines. • Design the view. • Draw the views. • Maintain the uniformity of line thickness. • Maintain the line joints. • Maintain the neatness and cleanliness	- Standards of threads. - Nomenclature of threads. - Types of nuts. - How to construct hexagon.

Safety Precautions :

- Refer; the safety precautions of draw three view drawing.

DUTY: 2: DRAW MACHINE ELEMENT

2.2 Draw Hexagon Bolts

Time: 4.0 hrs.
Exercise: 2.0 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Set paper in drawing board 2. Prepare a drawing sheet 3. Determine the size of bolt in mm 4. Identify the standards of bolt 5. Scaled and mark on the drawing sheet 6. Draw a center line 7. Mark horizontally on center line for thread length, shank, head and chamfers 8. Draw a vertical lines on every marked dots 9. Mark from center line with dividend for height and width on all vertical line 10. Draw horizontally to join the lines 11 Draw thin line onto thread length as a pitch of the thread size 12. Draw the chamfer size at the thread end 13. Represent hexagon at head referring the steps no.12 to 20 of draw hexagon nut 14 Give dimensions 15. Erase the projection lines if drawn 16. Ensure the rectangle or square drawn is dark enough 17. Clean up the drawing sheet.	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task :** Draw hexagon bolts. **Standards:** • Draw the supporting lines. • Projected representative lines. • Design the view. • Draw the views. • Maintain the uniformity of line thickness. • Maintain the line joints. • Maintain the neatness and cleanliness and lines	- Screws, - Bolts, - Studs, - Square & trapezoid.

Safety Precautions :

- Avoid using damaged drawing board.
- Avoid using damaged T-set.

DUTY: 2: DRAW MACHINE ELEMENT

2.3 Draw Gear Drawings

Time: 3.0 hrs.
Exercise: 0.0 hrs
Demo: 3.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Set paper in drawing board 2. Prepare a drawing sheet 3. Determine the size of drawing 4. Scaled and mark on the drawing sheet 5. Draw a center line 6. Mark horizontally on center line for drawing. 7. Draw a vertical lines on every marked dots 8. Mark from center line with dividend for height and width on all vertical line 9. Draw horizontally to join the lines 10. Follow the sinstruction 11. Clean up the drawing sheet.	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task :** Draw gear drawings. **Standards:** • score min 40 percent marks out of 100 in every internal assessment	- Introduction, - Types of gear - Representation of different types of gear - Application of different gear

Safety Precautions :

DUTY: 3: DRAW ASSEMBLY VIEWS

3.1 Copy Simple Assembly Views

Time: 12.0 hrs.
Exercise: 10.0 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Set paper in drawing board 2. Prepare a drawing sheet 3. Obtain the drawing sheet of assembly view to be draw 4. Identify nos. of part 5. Determine the part 6. Measure and scale the dimension of individual part on drawing sheet 7. Scaled and mark on the drawing sheet 8. Construct the view as the object nature (if it have cylindrical part start from center line) 9. Hatch the lines if it have 10. Erase the projection lines drawn 11. Give darkness for necessary lines 12. Clean up the drawing sheet	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task :** Copy simple assembly view. **Standards:** • Draw the supporting lines. • Projected representative lines. • Draw the views. • Maintain the uniformity of line thickness. • Maintain the line joints. • Maintain the neatness and cleanliness and lines	- Method of drawing assembly views

Safety Precautions :

- Refer; the safety precautions of draw three view drawing.

DUTY: 3: DRAW ASSEMBLY VIEWS

3.2 Draw Detail from Assembly View

Time: 10.0 hrs.
Exercise: 10.0 hrs
Demo: 0.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Set paper in drawing board 2. Prepare a drawing sheet 3. Obtain the drawing sheet of assembly view 4. Identify nos. of part 5. Determine the part 6. Measure and scale the dimension of individual part on drawing sheet 7. Give the numbers in individual part 8. Draw free hand sketch in necessary views on rough paper & dimensioned it 7. Scaled and mark on the drawing sheet 8. Construct the view as drawn in rough paper 9. Section the views if require 10.Hatch the lines if sectioned 11.Draw projection lines and represent the dimensions 12.Give tolerances as required 10.Erase the projection lines drawn 11.Give darkness for necessary lines 12.Clean up the drawing sheet	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task :** Draw detail from assembly view. **Standards:** • Draw the supporting lines. • Projected representative lines. • Draw the views. • Maintain the uniformity of line thickness. • Maintain the line joints. • Maintain the neatness and cleanliness and lines	

Safety Precautions :

- Refer; the safety precautions of draw three view drawing.

DUTY: 3: DRAW ASSEMBLY VIEWS

3.3 Draw Assembly View from Detail Drawing

Time: 8.0 hrs.
Exercise: 8 hrs
Demo: 0.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Set paper in drawing board 2. Prepare a drawing sheet 3. Obtain the drawing sheet of detail drawing that has to be assembly 4. Identify the assembly 5. Determine the functions of the part (which part goes in which part) 6. Draw free hand sketch in rough paper 7. Ensure the view with instructor 8. Scaled and mark on the drawing sheet 9. Construct the view as the object nature (if it have cylindrical part start from center line) 10. Section the view if it necessary 9. Hatch the lines if it sectioned 10. Erase the projection lines drawn 11. Give darkness for necessary lines 12. Clean up the drawing sheet	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task :** Draw assembly view from detail drawing. **Standards:** • Draw the supporting lines. • Projected representative lines. • Draw the views. • Maintain the uniformity of line thickness. • Maintain the line joints. • Maintain the neatness and cleanliness and lines.	

Safety Precautions :

- Refer; the safety precautions of draw three view drawing.

DUTY: 4: DRAW STEEL FABRICATION

4.1 Draw Steel Windows

Time: 5.0 hrs.
Exercise: 4.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Set paper in drawing board 2. Prepare a drawing sheet 3. Determine the length breadth and height of the box to be develop 4. Draw a reference vertical line leaving the left border margin and horizontal line on bottom information column 5. Sketch out the rough design of steel windows with dimensions in extra sheet. 6. Calculate the Scale of drawing to be drawn. 7. Draw the supporting lines. 8. Erase all projection lines. 9. Darken all objective lines. 12. Represent the dimensions with symbol require 13. Give darkness for necessary lines 14. Clean up the drawing sheet.	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task :** Draw steel windows. **Standards:** • Draw the supporting lines. • Projected representative lines. • Design the view. • Draw the views. • Maintain the uniformity of line thickness. • Maintain the line joints. • Maintain the neatness and cleanliness and lines	- Measurement obtain - Drawing scale. - Basic configuration of Steel windows.

Safety Precautions :

DUTY: 4: DRAW STEEL FABRICATION

4.2 Draw Steel Stairs.

Time: 5.0 hrs.
Exercise: 4.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Set paper in drawing board 2. Prepare a drawing sheet 3. Determine the length breadth and height of the box to be develop 4. Draw a reference vertical line leaving the left border margin and horizontal line on bottom information column 5. Sketch out the rough design of steel Stairs with dimensions in extra sheet. 6. Calculate the Scale of drawing to be drawn. 7. Draw the supporting lines. 8. Erase all projection lines. 9. Darken all objective lines. 12. Represent the dimensions with symbol require 13. Give darkness for necessary lines 14. Clean up the drawing sheet.	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task :** Draw Steel Stairs. **Standards:** • Draw the supporting lines. • Projected representative lines. • Design the view. • Draw the views. • Maintain the uniformity of line thickness. • Maintain the line joints. • Maintain the neatness and cleanliness and lines	- Measurement obtain - Basic configuration of Steel Stairs.

Safety Precautions :

DUTY: 4: DRAW STEEL FABRICATION

4.3 Draw Steel Roof Truss.

Time: 7.0 hrs.
Exercise: 6.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1 Set paper in drawing board 2. Prepare a drawing sheet 3. Determine the length breadth and height of the box to be develop 4. Draw a reference vertical line leaving the left border margin and horizontal line on bottom information column 5. Sketch out the rough design of steel Truss with dimensions in extra sheet. 6. Calculate the Scale of drawing to be drawn. 7. Draw the supporting lines. 8. Erase all projection lines. 9. Darken all objective lines. 12.Represent the dimensions with symbol require 13.Give darkness for necessary lines 14.Clean up the drawing sheet.	**Condition :** Fully equipped Classroom with Drawing board, T-set and drawing instrument. **Task :** Draw Steel Truss. **Standards:** • Draw the supporting lines. • Projected representative lines. • Design the view. • Draw the views. • Maintain the uniformity of line thickness. • Maintain the line joints. • Maintain the neatness and cleanliness and lines	- Measurement obtain - Basic configuration of Steel Stairs/Truss

Safety Precautions :

DUTY: 5: SKETCH FREE HAND DRAWING

5.1 Construct Workshop Drawing from Sample / Real Object.

Time: 6.0 hrs.
Exercise: 6.0 hrs
Demo: 0.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Set paper in drawing board 2. Prepare a drawing sheet 3. Obtain the sample or real object 4. Determine the view in which all dimensions can be represent 5. Construct necessary views 6. Section the view if it necessary 7. Hatch the lines on sectional area 8. Erase the projection lines drawn 9. Represent the dimensions with symbol require 10. Give darkness for necessary lines 11. Clean up the drawing sheet	**Condition :** Fully equipped Classroom with Drawing board, and drawing instrument. **Task :** Construct workshop drawing from sample / real object. **Standards:** • Projected representative lines. • Design the view. • Draw the views. • Maintain the uniformity of line thickness. • Maintain the line joints. • Maintain the neatness and cleanliness and lines.	

Safety Precautions :

- Refer; the safety precautions of draw three view drawing.

BIBLIOGRAPHY

SN	Name	Author	Publication
1.	Engineering Drawing	P S Gill,	S K Kataria & Sons
2.	Engineering Drawing for Mechanical Trade		Instructional Material for Vocational Training, India
3.	Elements of Mechanical Drafting	Samual Yaslov	Delmar Publishers
4.	Engineering Drawing	N.D. BHATT	Charotar Publishing House Pvt. Ltd.
5.	Machine Drawing (1st Angle Projection)	Er.R.K.DHAWAN	S.CHAND

Entrepreneurship Development

Total: 78 hrs
Class/week: 2

Course 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. Understand the concept of business and entrepreneurship
2. Explore entrepreneurial competencies
3. Analyze business ideas and viability
4. Formulate business plan
5. Learn to manage small business

S.No.	Task statements	Related technical knowledge	Time (hrs)		
			T	P	Tot
Unit 1: Introduction to Entrepreneurship			5.75	4.08	9.83
1	Introduce business	Introduction of business: • Definition of business/enterprise • Types of business • Classification of business • Overview of MSMEs(Micro, Small and Medium Enterprises) in Nepal	1.5		1.5
2	***Define entrepreneur/entrepreneurship***	*Definition of entrepreneur:* • ***Definition of entrepreneur*** • ***Definition of entrepreneurship*** • ***Entrepreneurship development process***	0.5	0.5	1.0
3	***Describe entrepreneur's characteristics***	*Entrepreneur's characteristics:* • ***Characteristics of entrepreneurs*** • Nature of entrepreneurs	0.67	0.83	1.5
4	***Assess entrepreneur's characteristics***	*Assessment of entrepreneur's characteristics:* • ***List of human characteristics*** • ***Assessment of entrepreneurial characteristics***	0.5	1.0	1.5
5	Compare entrepreneur with other occupations	**Entrepreneur and other occupations:** • Comparison of entrepreneur with other occupations • Types and styles of entrepreneurs	1.0		1.0
6	Differentiate between entrepreneur and employee	**Entrepreneur and employee:** • Difference between entrepreneur and employee • Benefit of doing own business	0.5	0.5	1.0
7	Assess "Self"	**"Self" assessment:** • Understanding "self" • Self disclosure and feedback taking	0.6	0.4	1.0
8	**Entrepreneurial personality test:** • Assess "Self" inclination to business	**Entrepreneurial personality test:** • Concept of entrepreneurial personality test • Assessing self entrepreneurial inclination	0.67	0.83	1.5
Unit 2: Creativity and Assessment			**6.5**	**4.0**	**10.5**
9	Create viable business idea	**Creativity:** • Concept of creativity • Barriers to creative thinking	1.67	0.33	2.0

10	Innovate business idea	**Innovation:** • Concept of innovation • SCAMPER Method of innovation	0.83	0.67	1.5
11	Transfer ideas into action	**Transformation of idea into action:** • Concept of transferring idea into action • Self assessment of creative style	1.0	0.5	1.5
12	Assess personal entrepreneurial competencies	**Personal entrepreneurial competencies:** • Concept of entrepreneurial competencies • Assessing personal entrepreneurial competencies	0.5	1.0	1.5
13	Assess personal risk taking attitude	**Risk taking attitude:** • Concept of risk • Personal risk taking attitude • Do and don't do while taking risk	1.5	1.0	2.5
14	Make decision	**Decision making:** • Concept of decision making • Personal decision making attitude • Do and don't do while making decision	1.0	0.5	1.5
Unit 3:Identification and Selection of Viable Business Ideas			**0.83**	**3.42**	**4.25**
15	Identify/ select potential business idea • Analyze strength, Weakness, Opportunity and Threat (SWOT) of business idea	**Identification and selection of potential business:** • Sources of business ideas • Points to be considered while selecting business idea • Business selection process • Potential business selection among different businesses • Strength, Weakness, Opportunity and Threats (SWOT) analysis of business idea • Selection of viable business idea matching to "self"	0.83	3.42	4.25
Unit 4: Business Plan			**16.67**	**36.58**	**53.25**
16	Assess market and marketing	**Market and marketing:** • Concept of market and marketing • Marketing and selling • Market forces • 4 Ps of marketing	1.33	0.75	2.08

		• Marketing strategies			
17	**Business exercise:** Explore small business management concept	**<u>Business exercise:</u>** • Business exercise rules • Concept of small business management • Elements of business management · Planning · Organizing · Executing · Controlling	1.58	1.67	3.25
18	Prepare market plan	**<u>Business plan/Market plan</u>** • Concept of business plan • Concept of market plan • Steps of market plan	2.0	2.0	4.0
19	Prepare production plan	**<u>Business plan/Production plan:</u>** • Concept of production plan • Steps of production plan	1.25	1.5	2.75
20	Prepare business operation plan	**<u>Business plan/Business operation plan:</u>** • Concept of business operation plan • Steps of business operation plan • Cost price determination	2.5	2.67	5.17
21	Prepare financial plan	**<u>Business plan/Financial plan:</u>** • Concept of financial plan • Steps of financial plan • Working capital estimation • Pricing strategy • Profit/loss calculation • BEP and ROI analysis • Cash flow calculation	4.5	7.5	12.0
22	Collect market information /prepare business plan	**<u>Information collection and preparing business plan:</u>** • Introduction • Market survey · Precaution to be taken while collecting information · Sample questions for market survey · Questions to be asked to the customers · Questions to be asked to the retailer · Questions to be asked to	2.0	13.0	15.0

		the stockiest/suppliers • Preparing business plan			
23	Appraise business plan	**Business plan appraisal:** • Return on investment • Breakeven analysis • Cash flow • Risk factors	0.5	5.5	6.0
24	Maintain basic book keeping	**Basic book keeping:** • Concept and need of book keeping • Methods and types of book keeping • Keeping and maintaining of day book and sales records	1.0	2.0	3.0
	Total:		**30**	**48**	**78**

Text book:

क) प्रशिक्षकहरुका लागि निर्मित निर्देशिका तथा प्रशिक्षण सामग्री, प्राविधिक शिक्षा तथा व्यावसायिक तालीम परिषद्, २०६९

ख) प्रशिक्षार्थीहरुका लागि निर्मित पाठ्यसामग्री तथा कार्यपुस्तिका, प्राविधिक शिक्षा तथा व्यावसायिक तालीम परिषद् (अप्रकाशित), २०६९

Reference book:

Entrepreneur's Handbook, Technonet Asia, 1981.

Lathe Operation - II

Total: 234 hrs
Class/week: 6 hrs

Duties and Tasks		Time (hrs.)	
1	**Set Up Machine**	**Demo**	**Practical**
	1.1.Set up irregular work piece on face plate	4	-
	1.2.Set up work piece center to center with	3	-
	1.3.Set up work piece with steady rest	3	-
	1.4.Set up work piece with follower rest.	3	-
2	**Perform Machining Operation**		0
	2.1.Perform knurling on machined surface	1	7
	2.2.Perform parting off machined part	1	8
	2.3.Perform internal grooves	2	16
	2.4.Perform internal tapers	4	22
	2.5.Perform eccentric shaft	4	20
3	**Perform Thread Cutting**		0
	3.1.Cut threads on machine using taps and die	4	18
	3.2.Cut external ‘V’ m/c thread	4	32
	3.3.Cut internal ‘V’ m/c thread	4	32
4	**Perform Off Hand Grinding**		0
	4.1.Re-sharpen twist drill	1	7
	4.2.Grind facing or corner tool in HSS bit	1	6
	4.3.Grind roughing tool in HSS bit	1	5
	4.4.Grind grooving tool	1	5
	4.5.Grind thread cutting tool	1	5
	4.6.Prepare boring tool	1	8
5	**Perform Project Work**		0
	5.1.Manufacture lathe center	-	24
	5.2.Manufacture taper fitting component	-	16
	5.3.Manufacture knurled head screw 55°	-	12
	5.4.Manufacture knurled head screw 60°	-	10
	5.5.Manufacture multiple thread shaft	-	12
	Sub Total	***43***	***191***
	Total	***234***	

Duty: 1: SET UP MACHINE

1.1 Set up Irregular Work piece on Face Plate

Time: 4.0 hrs.
Exercise: 0.0 hrs
Demo: 4.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain a work piece 2. Obtain Face plate 3. Obtain clamps, T bolts and nuts with washer 4. Identify the position to clamp the work piece 5. Place the work piece as position and clamp with the T bolts and nuts 6. Clamp the counter piece if necessary 7. Set the speed change gear lever for low speed 8. Remove the chuck if necessary 7. Clean up threads on the spindle nose 8. Mount the face plate along with the work piece 9. Reset the rpm lever in neutral position 10. Check trueness of work piece clamping 11. Realign if necessary 14. Tighten all the nuts bolts equally.	**Condition :** Fully equipped workshop with Center lathe machine, Face plate and clamping set. **Task :** Set up irregular work piece on face plate. **Standards:** • Process of clamping regular / irregular workpiece. • Use of counter weight or supports. • Machining parts should be in center.	- Introduction of Face plate and its application. - Importance of using counter weight on face plate. - Process of clamping irregular different shaped work piece on Face plate.

Safety Precautions:

- Always keep the counter piece of same weight.
- Always use same size of spanners.
- Keep the carriers away from the Head stock.
- Switch off the main electrical line while setting up the workpiece.
- Pre-set enough lighting in machine area.
- Always keep the machine and its surroundings neat and clean.
- Use a wooden block on lathe bed when installing / removing the chuck.
- Setting or removing of a chuck or faceplate shall be made with due care not to drop them down.

Duty: 1: SET UP MACHINE

1.2 Set up Workpiece Center to Center with Lathe Dog and Dog Clamp

Time: 3.0 hrs.
Exercise: 0.0 hrs
Demo: 3.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain .workpiece 2. Obtain facing tool, centre drill and drill chuck with key 3. Clamp the workpiece on three jaw chuck 4. Set up the cutting tool on tool post 5. Perform facing operation 6. Perform center drilling operation 7. Perform step no. 5 & 6 for other side of the workpiece. 8. Remove three jaw chuck 9. Set up face dog plate with dog stopper 10. Hold the lathe dog on a side of work piece 11. Set up live center on spindle nose. 12. Set the tail stock, leaving center distance close to the workpiece 13. Fix the work center of both side on live and dead or revolving center 14. Tighten the work from tail stock 15. Turn the workpiece by hand until it stops on stopper in anticlock wise direction.	**Condition :** Fully equipped workshop with Center lathe machine, Live and Revolving center, Faceplate, Lathe dog and clamps. **Task :** Set up workpiece center to center with lathe dog and dog clamp **Standards:** • Process of clamping workpiece with a lathe dog. • Supports a workpiece with a Tailstock. • Lathe dog is tightened.	- Introduction of Lathe dog and Dog clamp. - Center drilling for Dog clamp. - Process of clamping work pieces on center to center. - Importance of center to center works

Safety Precautions:

- Use small piece of Vee block when tightening the dog on machined surface.
- Clean the spindle noses of Head and Tail-stock before setting the center.
- Keep the carriers away from the Head stock.
- Switch off the main electrical line while setting up the workpiece.
- Follow the same safety precautions of center drilling and facing operation.
- Always keep the machine and its surroundings neat and clean.

Duty:1: SET UP MACHINE

1.3 Set up Workpiece Along a Steady Rest

Time: 3.0 hrs.
Exercise: 0.0 hrs
Demo: 3.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain workpiece 2. Obtain steady rest 3. Set up wokpiece on the chuck to turn at the rest surface 4. Mount the Steady rest on lathe bed in the position according to the length of the workpiece 5. Set up the turning tool on the tool post 6. Open the rest from its clamp 7. Set up workpiece on positioning the rest surface exactly on the rest 8. Close the rest and tighten the nuts 9. Align concentricity with the help of height gauge 10. Tighten fully chuck and nuts of Steady rest 11. Start the operation as needed.	**Condition :** Fully equipped workshop with Center lathe machine and Steady rest. **Task :** Set up workpiece along a steady rest. **Standards:** • Process of clamping workpiece. • Take care of safety precaution.	- Introduction of Steady rest. - Importance of using rests. - Process of using Steady rests.

Safety Precautions:

- Use sufficient oil on the rest surface while rotating the work.
- Keep the carriers away from the Headstock while setting the Steady rest.
- Switch off the main electrical line while setting up the workpiece.
- Pre-set enough lighting in machine area.
- Always keep the machine and its surroundings neat and clean.

Duty:4: SET UP MACHINE

1.4 Set up Work piece Along a Follower Rest

Time: 3.0 hrs.
Exercise: 0.0 hrs
Demo: 3.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Refer the step no. 1 to 6 of set up workpiece center to center with lathe dog and dog clamp. 2. Set up the Follower rest on the carrier 3. Reclamp workpiece projecting all machine length 4. Support at the end from tail stock with revolving center 5. Adjust the jaws of rest along with workpiece diameter 6. Set the tool according to the rest adjusted 7. Tighten all the jaws equally. 8. Try a cut to ensure the jaws of the rest follows to the cutting tool & its surface	**Condition :** Fully equipped workshop with Center lathe machine and Follower rest. **Task :** Set up workpiece along with follower rest. **Standards:** • Process of clamping workpiece. • Take care of safety precaution. • Distance of rest is set as per the length of workpiece.	- Introduction of follower rest. - Importance of using rests. - Process of using Follower rests

Safety Precautions:

- Refer all the safety precautions of set up workpiece with steady rest.
- The spindle of tailstock shall not project out for. Whenever the tailstock is not in use it is safer to apply a stopper at the end of the bed or to completely removed it.

Duty:2: PERFORM MACHINING OPERATION

2.1. Perform Knurling on Machined Surface

Time: 7.0 hrs.
Exercise: 6.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Refer and follow all the steps of task perform Plain turning 2. Perform further operations if necessary 3. Identify the distance and length to be knurled 4. Obtain knurling tool (machine knurling) 5. Calculate the feed and set on the m/c 6. Calculate the RPM and set on the m/c 7. Set the tool on tool post 8. Bring and touch gently the tool roller on the workpiece 9. Run the machine 10. Give depth of cut 11. Set the auto lever and start feeding 12. Check the mark on the surface 13. Stop auto feeding and return to starting position 14. Clean with the brush 15. Repeat the process from step no 10 until fine knurling surface obtain.	**Condition :** Fully equipped workshop with Center lathe machine and Knurling tools. **Task :** Perform knurling on machined surface. **Standards:** • Knurling length and depth should be as per drawing. • Knurling should not be overlapped.	- Introduction of Knurling and its type. - Types of knurling tools. - Process of knurling operation. - Use of knurling parts.

Safety Precautions:

- Avoid giving more depth as required.
- Avoid knurling overlapped.
- Apply light oil with brush when knurling, and take care that the brush can rolled.
- Take care the knurl could be overlapped.

Duty:2: PERFORM MACHINING OPERATION

2.2. Perform Parting Off Machined Part

Time: 6.0 hrs.
Exercise: 5.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Finished all the operations that has to be perform as directed 2. Obtain parting off tool 3. Set up tool on tool post perpendicular to the machine center 4. Identify the length to be part off 5. Bring the tool and touch gently the cutting tip on w/p that has to be part off 6. Set half a RPM than normal range 7. Start the machine 8. Give feed from cross slide handle till min. two circle 9. Turn back, move top slide left/right half of the tool width 10. Give feed as step no. 8 double the depth than previous cut 11. Turn back move the tool at first cut place 12. Give feed as step no. 8 double the depth than step no. 10 13. Turn back move the tool at second cut place 14. Give feed till the finished workpiece cut and fell	**Condition :** Fully equipped workshop with Center lathe machine and Parting off tool. **Task :** Perform parting off machined part. **Standards:** • Dimension should be as per drawing.	- Process of parting off the machined part. - Importance of parting off.

Safety Precautions:

- Refer to the task Perform grooves
- Set up low RPM to avoid chattering.

Duty:2: PERFORM MACHINING OPERATION

2.3. Perform Internal Grooves

Time: 14 hrs.
Exercise: 12 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain workshop drawing 2. Obtain workpiece material 3. Obtain required tools and equipment 4. Set up workpiece on three jaw chuck 5. Perform facing following the same steps 6. Perform center drilling following the same steps 7. Perform plain boring following the same steps of previous tasks 8. Reset the internal grooving tool 9. Bring and touch the side of tool tip gently on the facing surface 10. Set the dial scale '0' on top slide 11 Insert the tool as mentioned on drawing for internal groove distance reading dial scale 12. Touch the tool tip gently on the bore surface 13. Set the dial scale '0' on cross slide 14. Calculate and set the levers of RPM 15. Disclose the tool and run the machine 16. Turn the cross slide anticlockwise reading dial scale so that the tool cuts toward operator 17. Stop the machine, bring back the tool, give side from top slide if necessary 18. Repeat step no 11 to make a complete groove 19. Stop the machine, bring back the tool, measure all the dimension, open the workpiece and tool. 20 Collect all tools and store in its place.	**Condition :** Fully equipped workshop with Center lathe machine and Facing tool, turning tool, Center drill, Drill bits for guide hole plain boring tool internal grooving tool. **Task :** Perform internal grooves. **Standards:** • Dimension should be as per drawing. • Grooved surface should be as per drawing.	- Process of turning internal grooves. - Uses of internal grooves.

Safety Precautions:

Refer to the task Perform Boring and grooving external surface.

Duty:2: PERFORM MACHINING OPERATION

2.4. Perform Internal Tapers

Time: 22 hrs.
Exercise: 18 hrs
Demo: 4.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain workshop drawing 2. Obtain workpiece material 3. Obtain required tools and equipment 4. Set up workpiece on three jaw chuck 5. Perform facing 6. Perform center drilling 7. Perform plain boring 8. Identify the angle to be cut and set 9. Loosen the nuts of the swivel device on the cross slide 10. Set the required angle reading swivel scale and tighten the nuts 11. Reset the sliding length of top slide as per taper length 12. Bring and touch gently the cutting tip on the bore edge of the workpiece 13. Set the dial scale '0' on cross slide 14. Run the machine and give depth of cut from cross slide 15. Give feed manually from top slide slowly 16. Repeat turning taper until the required dimension obtain giving depth of cut from cross slide respectively 17. Make sure the dimensions is as given in workshop drawing 18. Stop the machine, bring back the tool, measure the entire dimension, open the workpiece and tool. 19. Collect all tools and store in its place.	**Condition :** Fully equipped workshop with Center lathe machine and Facing tool, turning tool, Center drill, Drill bits for guide hole plain boring tool. **Task :** Perform internal tapers. **Standards:** • Maintained surface quality. • Measurement of taper angle made should be as per drawing.	- Setting angle for internal taper operation. - Process of turning internal taper operation. - Applications of internal tappers.

Safety Precautions:

- Refer to the task Perform boring and Taper turning.

Duty:2: PERFORM MACHINING OPERATION

2.5. Manufacture Eccentric Shaft

Time: 20hrs.
Exercise: 16 hrs
Demo: 4.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain workshop drawing 2. Obtain workpiece material 3. Obtain required tools and equipment 4. Set up workpiece on three jaw chuck 5. Perform facing 6. Perform center drilling 7. Reset the workpiece in side out on the three jaw chuck 8. Perform facing and then center drilling 9. Remove the workpiece 10. Mark eccentric center on both surface with Vernier height gauge and punch it 11. Make center drilling on both marked center with drilling machine 12. Set up worpiece center to center with lathe dog and dog clamp 13. Obtain grooving tool according to the size of the groove 14. Reset the grooving tool on tool post so that the cutting blade is parallel to the work length 15. Identify and mark for groove to be cut 16. Set low RPM than turning same diameter 17. Run the machine 18. Perform grooving. 19. Reset the workpiece for another eccentric center 20. Repeat step no 15 and 18 for next eccentric groove 21. Make sure the dimensions are as given in workshop drawing 22. Stop the machine, bring back the tool, measure all dimensions, open the workpiece and tool. 23. Collect all tools and store in its place	**Condition :** Fully equipped workshop with Center lathe machine and turning tool, Center punch, Hammer, Vernier height gauge, Center drill & Grooving tool. **Task :** Manufacture eccentric shaft. **Standards:** • Eccentric dimensions should be as per given drawing.	- Importance and use of eccentric operation. - Regrinding tool bits. - Process of holding workpiece for turning eccentric operation. - Process of turning eccentric operation.

Safety Precautions:

- Take care when center drilling in drilling machine.
- Refer to the task Set up turning tool, Plain turning and Center drilling.

Duty:3: PERFORM THREAD CUTTING

3.1 Cut Threads on Machine Using Threading Die/Taps

Time: 16 hrs.
Exercise: 12 hrs
Demo: 4.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain workshop drawing 2. Obtain workpiece material 3. Obtain required tools and equipment 4. Set up workpiece on three jaw chuck 5. Perform facing 6. Perform center drilling if necessary 7. Reset the workpiece elongating enough length to machine 8. Perform plain turning 9. Perform step turning into thread diameter if necessary 10. Perform grooving at the shoulder end 11. Perform chamfering at the end for thread cutting 45 x 2 mm 12. Set the threading die on its holder 13. Hold the die on threading start supporting with tailstock spindle 14. Set the RPM lever in neutral position 15. Insert the chuck key on key point 16. Turn Chuck anti-clockwise by hand pressing continuos support from tailstock 17. Turn ¼ backward to break the chips at every ½ round cutting thread 18. Stop at the end, Turn back the die, Remove from the workpiece 19. Check the thread with Check nut. 20. Make sure the dimensions are as given in workshop drawing	**Condition :** Fully equipped workshop with Center lathe machine, Turning tool, Center drill, Grooving tool and threading die/taps and handles. **Task :** Cut threads on machine using threading die/taps. **Standards:** • Thread size and shape should be as per drawing. • Length and surface is as per drawing.	- Process cutting threads on lathe machine.

Safety Precautions:

- Support should be applied continuously from tails tock spindle.
- Never tries to run machine for cutting thread.
- Avoid falling the taps and dies on the floors.
- Apply oil fluently when cutting thread manually.

Duty: 3: PERFORM THREAD CUTTING

3.2 Cut External Vee Thread on Lathe Machine

Time: 30 hrs.
Exercise: 26 hrs
Demo: 4 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain workshop drawing 2. Obtain workpiece material 3. Obtain required tools and equipment 4. Set up workpiece on three jaw chuck 5. Refer and follow the step no. 5 to 11 of task "Cut threads on machine using threading die/taps" 6. Reset the "V" shaped threading tool on tool post 7. Calculate the pitch and gear to be set 8. Set the gear lever (refer chart on the machine) 9. Calculate and set the RPM for thread cutting 10. Bring and touch gently the cutting tip on edge of the work piece 11. Run the machine, engage the half nut lever on carriage 12. Give light depth of cut and observe the helical mark on periphery of work piece 13. Return the tool back, disengaging the half nut lever then, stop the machine 14. Check the helical mark with pitch gauge 15. Set the dial scale '0' on both top and cross slide 16. Calculate the depth of cut 17. Give depth of cut for rough cut 18. Align the coolant pipe 19. Run the machine and start cutting helical groove (thread) 20. Turn back the tool in front position, give depth of cut and cut ahead 21. Cut the thread until obtain required depth of cut 22. Check the thread with pitch gauge / thread gauge 23. Make sure the dimensions are as given in workshop drawing.	**Condition :** Fully equipped workshop with Center lathe machine, turning tool, Center drill, Grooving tool, Thread cutting tool, Pitch gauge and Check nut. **Task :** Cut external vee thread on lathe machine. **Standards:** • Thread dimension should be as per drawing. • Thread surface should be N6 or as specified.	- Manufacture a thread on lathe machine. - Taking a measuring of thread element.

Safety Precautions:

- Pay full concentration when cutting the thread engaging the auto lever of half nut.
- Refer to the task Set up turning tool, Plain turning and Center drilling.

Duty:3: PERFORM THREAD CUTTING

3.3 Cut Internal Vee Thread on Lathe Machine

Time: 30 hrs.
Exercise: 26 hrs
Demo: 4.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain workshop drawing 2. Obtain workpiece material 3. Obtain required tools and equipment 4. Set up workpiece on three jaw chuck 5. Perform facing 6. Perform center drilling 7. Refer and follow the step no. 8 to 20 of the task perform Plain boring 12. Reset the "V" shaped internal thread cutting tool on tool post 7. Calculate the pitch and gear to be set 8. Set the gear lever (refer chart on the m/c) 9. Calculate & set RPM for thread cutting 10. Bring and touch gently the cutting tip on bore edge of the work piece 11. Run the machine, engage the half nut lever on carriage 12. Give light depth of cut and observe the helical mark on periphery of work piece 13. Return the tool back, disengaging the half nut lever then, stop the machine 14. Check the helical mark with pitch gauge 15. Set the dial scale '0' on both top and cross slide 16. Calculate the depth of cut 17. Give depth of cut for rough cut 18. Align the coolant pipe 19. Run the machine and start cutting helical groove (thread) 20. Turn back the tool in front position, give depth of cut and cut ahead 21. Cut the thread until required depth 22. Check the thread with pitch gauge / thread gauge 23. Make sure the dimensions are as given in workshop drawing.	**Condition :** Fully equipped workshop with Center lathe machine, turning tool, Center drill, Drill bits for guide hole, Boring tool, Internal thread cutting tool, Thread plug gauge and Pitch gauge. **Task :** Cut Vee Internal thread on lathe machine. **Standards:** • Thread size and shape should be as per drawing. • Thread surface should be N6 or as specified.	- Setting of internal thread cutting tool on tool post. - Process of cutting internal threads operation..

Safety Precautions:

- Refer to the task Cut Vee External thread on lathe machine, Perform boring and internal grooving.

Duty:4: PERFORM OFF HAND GRINDING

Time: 4.0 hrs.
Exercise: 3.0 hrs
Demo: 1.0 hrs

4.1. Re-sharpen Twist Drills

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain Bench or Pedestrian grinding machine. 2. Obtain blunt drill bits. 3. Obtain Safety goggles, Bevel protractor or grinding gauge. 4. Check the grinding wheel abrasive type, trueness of wheel and cracks. 5. Dress the wheel, if necessary. 6. Set up tool-rest if necessary. 7. Hold twist drills lightly between the thumb and the first finger, pointing the tip towards wheel. 8. Wear safety goggles 9. Run the machine. 10. Hold the drill level and turn it to 59° to the face of the wheel so that the cutting edge is horizontal and parallel to the grinding wheel - face. 11. Swing the shank of the drill slightly downward and towards the left. 12. Rotate the drill to the right by turning it between the thumb and the finger. 13. Apply slight forward motions while swinging down, this will help to form the clearance angle. 14. Repeat the process from step no. 10 to 13 to re-sharpen the second cutting edge. 12. Check both the cutting edges with a drill angle gauge or Bevel protractor, for correctness of the lip angle and equality of the lip length. 13. Repeat the grinding until desired angle and sharpened tip obtained.	**Condition :** Fully equipped workshop with Bench or Pedestrian grinding machines, Safety goggles, Blunt drills bits Bevel protractor or Angle gauge. **Tasks :** Re-sharpen twist drills **Standards:** - Cutting angles and drill angle should be match with drill angle gauge. - Lip angle should be equal.	- Nomenclature of Drills elements - Re-sharpening process of drill bit. - Angle of ddrill bit tip.

Safety Precautions:

- All movement made to the drill i.e. angular turning swinging and forward movements, should be well coordinated.
- Too much depth may colour the tip and may cause short hardness.
- Any damage to the grinding wheel, if noticed, should be reported to the instructor.
- When switching on the grinding machine, stand aside until the wheel reaches full speed.

Duty:4: PERFORM OFF HAND GRINDING

4.2. Grind Facing/Corner Tool in HSS Bit

Time: 5.0 hrs.
Exercise 4.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain Bench or Pedestrian grinding machine. 2. Obtain HSS tool bits. 3. Obtain Safety goggles, Bevel protractor or grinding gauge. 4. Dress the wheel, if necessary. 5. Set up tool-rest if necessary. 6. Identify the shape of tool to be grind. 7. Identify the angles of tool to be grind. 8. Wear safety goggles 9. Run the machine. 10. Hold HSS tool left hand in between the thumb, fore and the middle finger, so that front clearance and first cut shape of the tool to be produce. 11. Rest the left finger & tool on the tool rest. 12. Apply a slight forward motion. 13. Move the tool across full face of the wheel with the help of right hand. 14. Dip frequently on the coolant to cool the tool.after every second interval. 15. Repeat the processes until the required depth obtain. 16. Change holding position for side clearance angle. 17. Repeat the same step no 12 to 16 for side clearance. 18. Change holding rest only the left arm on the tool rest. 19. Reposition for the top rake angle. 20. Repeat the same step as for the clearance angle. 21. Check the angles with the gauge or bevel protractor. 22. Deburr the edges using oilstone.	**Condition :** Fully equipped workshop with Bench or Pedestrian grinding machine, Safety goggles, HSS Tool bits Bevel protractor or Angle gauge. **Tasks :** Grind facing/corner tool in HSS bit. **Standards:** - All the angel should be as per drawing. - Cutting tip should be sharp. -	- Importance of cutting geometry of lathe tools. - Too angle of facing and corner tool. - Process of re-sharpening the facing and corner tool. - Wheel dressing process.

Safety Precautions:

- Too much depth may coloured the tip and may cause short hardness.
- Any damage to the grinding wheel, if noticed, should be reported to the instructor.
- When switching on the grinding machine, stand aside until the wheel reaches full speed.
- Refer the same safety precautions of the task grind twist drill.

Duty:4: PERFORM OFF HAND GRINDING

Time: 4.0 hrs.
Exercise: 3.0 hrs
Demo: 1.0 hrs

4.3. Grind Roughing Tool in HSS Bit

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain Bench or Pedestrian grinding machine. 2. Obtain HSS tool bits. 3. Obtain Safety goggles, Bevel protractor or grinding gauge. 4. Dress the wheel, if necessary. 5. Set up tool-rest if necessary. 6. Identify the shape of tool to be grind. 7. Identify the angles of tool to be grind. 8. Wear safety goggles 9. Refer and follow the steps of the task grind Facing/corner tool in HSS bit 10. Check the angles with the gauge or bevel protractor. 11. Deburr the edges using oilstone.	**Condition :** Fully equipped workshop with Bench or Pedestrian grinding machine, Safety goggles, HSS Tool bits Bevel protractor or Angle gauge. **Tasks :** Grind roughing tool in HSS bit. **Standards:** - All the angle should be as per drawing. - Cutting tip should be sharp.	- Angle of roughing tool. - Process of re-sharpening the roughing tool.

Safety Precautions:

- Too much depth may coloured the tip and may cause short hardness.
- Any damage to the grinding wheel, if noticed, should be reported to the instructor.
- When switching on the grinding machine, stand aside until the wheel reaches full speed.
- Refer the same safety precautions of the task grind twist drill.

Duty:4: PERFORM OFF HAND GRINDING

4.4. Grind Grooving Tool

Time: 4.0hrs.
Exercise: 3.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain Bench or Pedestrian grinding machine. 2. Obtain HSS tool bits. 3. Obtain Safety goggles, Bevel protractor or grinding gauge. 4. Dress the wheel, if necessary. 5. Set up tool-rest if necessary. 6. Identify the shape of tool to be grind. 7. Identify the angles of tool to be grind. 8. Wear safety goggles 9. Run the machine. 10. Refer and follow the steps of the task grind Facing/corner tool in HSS bit 10. Check the angles with the gauge or bevel protractor. 11. Deburr the edges using oilstone.	**Condition :** Fully equipped workshop with Bench or Pedestrian grinding machine, Safety goggles, HSS Tool bits Bevel protractor or Angle gauge. **Tasks :** Grind grooving tool. **Standards:** - Angle of grooving tool should be match with given drawing. - Cutting tip should be match with given drawing.	- Angle of grooving tool. - Process of re-sharpening the grooving tool

Safety Precautions:

- Too much depth may coloured the tip and may cause short hardness.
- Any damage to the grinding wheel, if noticed, should be reported to the instructor.
- When switching on the grinding machine, stand aside until the wheel reaches full speed.
- Refer the same safety precautions of the task grind twist drill.

Duty:4: PERFORM OFF HAND GRINDING

4.5. Grind Thread Cutting Tool

Time: 5.0 hrs.
Exercise: 4.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain Bench or Pedestrian grinding machine. 2. Obtain HSS tool bits. 3. Obtain Safety goggles, Bevel protractor or grinding gauge. 4. Dress the wheel, if necessary. 5. Set up tool-rest if necessary. 6. Identify the shape of tool to be grind. 7. Identify the angles of tool to be grind. 8. Wear safety goggles 9. Refer and follow the steps of the task grind Facing/corner tool in HSS bit 10. Check the angles with the gauge or bevel protractor. 11. Deburr the edges using oilstone.	**Condition :** Fully equipped workshop with Bench or Pedestrian grinding machine, Safety goggles, HSS Tool bits Bevel protractor or Angle gauge. **Tasks :** Grind thread cutting tool. **Standards:** - Thread cutting tool should be match with given drawing.	- Introduction - Type of thread cutting tool. - Process of re-sharpening the thread cutting tool.

Safety Precautions:

- Too much depth may coloured the tip and may cause short hardness.
- Any damage to the grinding wheel, if noticed, should be reported to the instructor.
- When switching on the grinding machine, stand aside until the wheel reaches full speed.
- Refer the same safety precautions of the task grind Twist drill.

Duty:4: PERFORM OFF HAND GRINDING

Time: 6.0 hrs.
Exercise: 5.0 hrs
Demo: 1.0 hrs

4.6. Prepare Boring Tool

Steps	Terminal Performance Objective	Related Knowledge
1. Prepare a cylindrical rod as per required length. 2. Drill a hole at the end of the rod from side according to HSS bit to be insert 3. File a hole into square hole 4. Check the hole inserting the HSS bit 5. Drill a through hole at the face toward square hole as per thread to be tap 6. Tap the hole clamping the rod on the Bench vice 7. Obtain a headless screw as per thread. 8. Insert the bit and tighten the screw 9. Dress the wheel, if necessary. 10. Set up tool-rest if necessary. 11. Identify the shape of tool to be grind. 12. Identify the angles of tool to be grind. 13. Wear safety goggles 14. Run the machine. 15. Amend the tip height 16. Grind out the cutting edge length. 17. Grind out the side cutting edge and the side relief angle 18. Grind the top rake angle 19. Relieve the end clearance angle 20. Round off the nose if necessary 21. Deburr the edges using oilstone.	**Condition :** Fully equipped workshop with Bench or Pedestrian grinding machines, Safety goggles, and HSS Tool bits Bevel protractor or Angle gauge. **Tasks :** Prepare boring tool. **Standards:** - Dress wheel performed. - Checked cutting edges and angles ground. - Angle should be match as per drawing.	- Types of boring tool. - Process of preparing boring tool of HSS bit.

Safety Precautions:

- Make the wall distance of square sufficient to hold the tool when clamping.
- Use headless screw as far as possible and have less projection.
- Be careful when drilling a hole on periphery of the cylindrical rod.
- Refer the same safety precautions of the task grind-grooving tool.

Duty:5: PERFORM PROJECT WORK

5.1. Manufacture a Lathe Center

Time: 16.0 hrs.
Exercise: 16.0 hrs
Demo: 0.0 hrs

Steps	Terminal Performance Objective	Related Technical Knowledge
1. Clamp a morse taper gauge in center to center clamping 2. Set the dial gauge in tool post 3. Loosen the top slide swiveling nut 4. Bring and touch the dial gauge lever to the smallest diameter of a sleeve 5. Move ahead top slide manually setting the angle so that the indicator shows in entire length of the morse taper 6. Tighten the nuts carefully 7. Check once again the angle 8. Exchange the dial gauge into turning tool 9. Remove all setting and follow the steps 1 to 4 of manufacturing stepped shaft 10. Take rough cut through top slide according to angle set 11. Check the dimensions and angles turned is correct 12. Re-sharpened the tool if necessary 13. Take finishing cut with fire surface 14. Check the angles with a gauge of available same size of sleeve 15. Remove workpiece from the chuck 16. Remove chuck from the spindle 17. Clean up thoroughly the taper nose of the spindle 18. Insert the manufactured morse taper side of the workpiece in spindle nose 19. Calculate the taper angle 20. Reset the angle 21. Repeat the steps 10 to 13 22. Check the angles with gauge or bevel protactor	**Condition :** Fully equipped workshop with Center lathe machine Facing tool, turning tool, Center drill, Drill bits for guide hole plain boring tool. **Task :** Manufacture a lathe center **Standards:** • Exercise of combine skills. • Perform process of manufacturing a Lathe center. • Check Dimensions of the product.	

Safety Precautions :

- Refer the task Perform taper turning

Duty:5: PERFORM PROJECT WORK

5.2 Manufacture a Taper fitting Component.

Time: 12 hrs.
Exercise: 12 hrs
Demo: 0.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Refer and follow the complete steps of External taper turning for pos 1 and machine other dimensions as required 2. Refer and follow the complete steps of manufacture bush for pos 2 and machine other dimensions as required. 3. Calculate the angle to be set 4. Reset the angle in top slide swiveling 5. Change the boring tool in tool post 6. Take rough cut leaving 0.5mm manually by cross slide. 7. Take final cut in fine surface 8. Check the measurements of all dimensions 9. Remove and punch the numbers	**Condition :** Fully equipped workshop with Center lathe machine Facing tool, turning tool, Center drill, Drill bits for guide hole plain boring tool. **Task :** Manufacture a Taper fitting component. **Standards:** • According to provided drawing.	

Safety Precautions :

- Refer the task Perform taper turning

Duty:5: PERFORM PROJECT WORK

5.3 Manufacture a Knurled head screw 55°

Time: 8 hrs.
Exercise: 8 hrs
Demo: 0.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Refer and follow the same steps of perform knurling on machined surface. 2. Re-clamp the workpiece 3. Face out and maintain the require length 4. Turn rough diameter according to thread size 5. Turn groove on end of the shoulder. 6. Change threading tool of 55 7. Reset the lead screw according to lead. 8. Take rough cut leaving 0.5mm 9. Change the r.p.m if necessary 10. Take final cut in fine surface 11. Check the measurements of all dimensions 12. Remove and punch the numbers	**Condition :** Fully equipped workshop with Center lathe machine Facing tool, turning tool, Center drill. **Task :** Manufacture a Knurled head screw 55° **Standards:** • According to provided drawing. •	

Safety Precautions :

- Refer the task Perform knurling on machined surface and cut external ‘V’ machine thread.

Duty:5: PERFORM PROJECT WORK

5.4 Manufacture a Multiple Thread Shaft

Time: 12 hrs.
Exercise: 12 hrs
Demo: 0.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain workshop drawing 2. Obtain workshop material 3. Obtain required tools and equipment 4. Perform facing 5. Perform center drilling 6. Reclamp the workpiece and drill center drilling 7. Set up workpiece center to center with lathe dog and dog clamp 8. Perform plain turning 9. Perform step turning 10. Perform grooves 11. Perform chamfers 12. Perform external vee thread 13. Check the thread with thread gauge 14. Reset the workpiece for further machining in off side 15. Make sure the dimension	**Condition :** Fully equipped workshop with Center lathe machine Facing tool, turning tool, Center drill, Drill bits for guide hole plain boring tool. **Task :** Manufacture a Multiple thread shaft **Standards:** • Thread should be match According to provided drawing. • Thread should be match with given pitch gauge.	

Safety Precautions:

- Refer the task Perform step turning and cut external vee thread on lathe machine

BIBLIOGRAPHY

SN	Name	Author	Publication
1.	Technology of the Metal Trade		– GTZ, Deutsche Gesellschaft fur Technische Zusammenarbeit
2.	Mechanical engineering.	ILO learning element	
3.	All about MACHINE TOOLS	- Heinrich Gerling	
4.	Elementary Metal Course Training Section I	- BBF.	
5	Instructional manual Lathe Machine Techniques		The institute of vocational training, The ministry of Labour, Japan.
6	Machining Operations (II) Turning manual		O V T Association
7.	Sharpening of cutting tools -		MIR Publishers, MOSCOW

Material Science - II

Total: 39 hrs
Class/week: 1 hr

Areas and Topics	Time (hrs.)
1. Mechanical Tests	**7**
1.1. Definition and types	
1.2. Destructive tests	
1.3. Tensile Test	
1.4. Bend Test	
1.5. Hardness testing	
1.6. Impact test	
1.7. Non destructive tests	
1.8. Visual examination	
1.9. Magnetic particle test	
1.10. X-ray test	
1.11. Radiographic test	
1.12. Ultra sonic test	
1.13. Dye penetrate test	
2. Corrosion	**8**
2.1. Introduction	
2.2. Specific types of corrosion	
2.3. Atmospheric corrosion	
2.4. Underground corrosion	
2.5. Microbiological corrosion	
2.6. Uniform corrosion	
2.7. Crevice corrosion	
2.8. Stress corrosion	
2.9. Control and prevention of corrosion	
2.10. Metal and alloys	
2.11. Catholic precaution	
3. Non Ferrous Metals	**8**
3.1. Aluminium and its alloys	
3.2. Introduction and its properties	
3.3. Aluminium alloys	
3.4. Applications	
3.5. Copper and its alloys	
3.6. Introduction and its properties	
3.7. Copper alloys	
3.8. Applications	
3.9. Lead and its alloys	
3.10. Introduction and its properties	
3.11. Lead alloys	
3.12. Applications	
3.13. Zinc and its alloys	
3.14. Introduction and its properties	
3.15. Zinc alloys	
3.16. Applications	
3.17. Tungsten and powder metallurgy	
3.18. Introduction	
3.19. Manufacturing process	

3.20. Application

4. Non Metals **8**

4.1. Introduction to non metals
4.2. Polymers: properties, classification and uses
4.3. Plastics: properties, classification and uses
4.4. Rubber: properties, classification and uses
4.5. Ceramics: properties, classification and uses
4.6. Composite materials: properties, classification and uses
4.7. Glass: properties, classification and uses

5. Abrasives & Bonds **8**

5.1. Define & application of abrasive
5.2. Types of abrasive (Natural & artificial abrasive)
5.3. Aluminium oxide
5.4. Silicon carbide
5.5. Diamond
5.6. Define bonds
5.7. Rubber and Shellac bond
5.8. Vitrified and silicate bond
5.9. Resionoid bond
5.10. Mounting, Loading & Glazing of grinding wheels
5.11. Trueing and Dressing of Grinding wheel
5.12. Hard stock material removing
5.13. Finishing
5.14. Total ***39***

BIBLIOGRAPHY:

SN	Name	Author	Publication
1.	Technology of the metal trade,	Appold,Feiler, Reinhard, Schmidt,	Deutsche Gesellschaft fur Technische Zusammenenarbeit (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
4.			
5.			

Milling & Shaping Operation

Total: 312 hrs
Class/week: 8 hrs

S. No.	Duties and Tasks	Time (hrs.)	
A.	**Milling Machine Operation**	**Demo**	**Practical**
1	**Set Up Machine**		
1.1	Set up machine controls	1	2
1.2	Set up milling vice on machine table	2	2
1.3	Set up workpiece on machine table	2	2
1.4	Mount milling cutter on long arbor and in horizontal spindle	1	2
1.5	Mount milling cutter on short arbor in vertical spindle	1	1
1.6	Set up milling cutter in collets chuck.	1	1
1.7	Grind single tip tool for fly cutter	2	4
2	**Mill Plain Surface**		
2.1	Mill plain surface on horizontal milling.	3	12
2.2	Mill plain surface on vertical milling.	3	12
3	**Mill Shoulders**		
3.1	Mill step surface in vertical milling with shell end mill cutter.	2	12
4	**Mill Angular Surface**		
4.1	Produce angular surface tilting vertical head	3	12
4.2	Perform angular surface with angular cutter	1	7
4.3	Perform angular surface setting the workpiece on machine table or vice.	2	8
5	**Drill and Bore**		
5.1	Perform drilling & boring in milling machine	2	16
6	**Mill Grooves**		
6.1	End Milling a slot	2	8
6.2	Mill ‘V’ groove	2	8
6.3	Mill blind groove, through groove	3	12
7	**Mill Key Ways**		
7.1	Mill key-way through the length in a round workpiece	1	5
7.2	Mill blind key-way in a round workpiece	1	5
8	**Index Milling**		
8.1	Mill hexagonal shape around the periphery of round workpiece	2	8
9	**Perform Project**		
9.1	Manufacture a Clamp	-	18
9.2	Manufacture Slide Rule	-	24
9.3	Manufacture a spur gear	-	16
	Sub Total	***24***	***210***
	Total	***234***	
B.	**Shaper Machine Operation**		
1	**Set up Machine & Holding Devices**		
1.1	Set up shaper vice on machine table	1	2
1.2	Hold HSS cutting tool bit	0.5	1
1.3	Adjust stroke length	0.5	1
1.4	Position the Ram in center of the work-piece	1	2
2	**Perform Plain Surface Shaping**		

2.1	Produce flat even surface	3	27
3	**Perform 90 Step Surface**		
3.1	Produce 90 right angle corner step surface	3	21
4	**Perform Project Work**		
4.1	Manufacture step block	-	15
	Sub Total	***9***	***69***
	Total	***78***	
	Total (A + B)	**234 + 78 = 312**	

Milling Machine Operation

Duty 1: SET UP MACHINE

1.1**. Set up machine control.**

Time: 3.0hrs.
Exercise: 2.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Identify the switches for main spindle, coolant pump and Auto feed. 2. Determine the levers for selecting speeds and feeds. 3. Determine the controls for reverse, forward and emergency stops of spindle and feeds. 4. Identify the levers or nuts for adjusting slides and over arm 5. Read and set up the graduated scale drum for setting depth of cut and specific dimensions. 6. Identify the levers or stoppers for table lock of vertical; longitudinal and cross movement.	**Condition :** Fully equipped workshop with Vertical, Horizontal and Universal Milling machine. **Task :** Set up machine control. **Standards:** - Cutting speed according to tool diameter. - Height should be maintained.	- Introductions of milling machine - Main parts and their functions - Advantages of scale graduation

Safety Precautions :

- Do not operate any machines without knowing thoroughly.
- Check all guards are in positions.
- Wear personal safety apparels
- Keep the machine and surroundings clean.
- Avoid leaving the machine, when it is in operation.
- Check oil levels before start the machine.

Duty 1: SET UP MACHINE

1.2. Set up milling vice on machine table

Time: 4.0 hrs.
Exercise: 2.0 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Place milling vice 2. Place tee bolts and nuts. 3. Obtain lever type Dial test indicator with magnetic stand. 4. Clean the machine vice & m/c table. 5. Apply thin film of oil at the bottom of machine vice. 6. Clamp the vice on machine table with tee bolt and nuts. 7. Tighten slightly both the nuts 8. Hold dial test indicator on magnetic stand and then magnetized on machine column. 9. Bring fixed jaw of the vice to contact with dial test lever. 10. Move the table along longitudinal axis to other end. 11 Observer the indicator. 12 Set the indicator lever zero. 13 Move the table longitudinal axis to other end of the vice. 14 Align the vice hammering opposite to the indicating line. 15 Repeat steps no. 13 & 14 until the indicating lever does not show zero at both ends of the vice. 16. Tighten fully both the nuts.	**Condition :** Fully equipped workshop with milling vice and T-bolts, amidst Vertical, Horizontal or Universal Milling machine. **Tasks :** Set up milling vice on machine table. **Standards:** - Machine vice is aligned parallel to longitudinal movement to the m/c table. - Tighten milling vice very securely.	- Use and care of Dial test indicator. - Procedure of setting milling vice with dial indicator.. - Process of holding works on milling vices

Safety Precautions :

- Avoid clamping the nut without washer.
- Always use correct size of spanner.
- Always disconnect the dial test lever before hammering in the vice.
- Avoid using slide wrenches
- Always clean the surfaces where magnetic stand is to be located.
- Switch off the main switch before setting the vice.
- Dial test indicator must not be dropped and should not be exposed to severe shocks.

Duty 1: SET UP MACHINE

1.3. Set up workpiece on machine table.

Time: 4 hrs.
Exercise: 2 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain sets of Parallel blocks as required size 2. Obtain sets of tee bolts and nuts 3. Obtain sets of parallel clamps with step blocks as required no. 4. Clean all parallel blocks. 5. Clean machine table. 6. Place the workpiece on machine table 7. Set the tee bolts as near to the machine surface. 8. Put the parallel blocks under the workpiece close to the tee bolts.. 9. Set the parallel clamps and step block on the tee bolts 10 Tighten slightly the nuts. 11 Make alignments if necessary. 12 Tighten all nuts gradually. 13. Ensure the parallel blocks are fixed.	**Condition :** Fully equipped workshop with set of T-bolts and clamps, amidst Vertical, Horizontal or Universal Milling machine. **Tasks :** Set up milling workpiece on machine table. **Standards:** - Positioned the clamps and parallels to edge machining. - Work piece should be tighten.	- Introduction of 'T' Bolts and clamps. - Process of holding work on clamps, T-bolts, Stepped blocks, and parallel blocks.

Safety Precautions :

- Tee bolts must always be close to the workpiece.
- Parallel blocks should place right under the clamping position.
- Avoid using extra lever to tighten the nuts
- Refer safety for vice setting.

Duty 1: SET UP MACHINE

1.4. Mount milling cutter on long arbor and in Horizontal spindle

Time: 3 hrs.
Exercise: 2 hrs
Demo: 1 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Set rpm lever for lowest spindle speed. 2. Clean up taper shank of long arbor and the spindle nose. 3. Insert the taper shank into the spindle nose positioning arbor notches fits onto the spindle key. 4. Screw the arbor by draw in bar from the rear of the spindle. 5. Tighten draw in bar lock nut. 6. Unscrew and remove the arbor nut. 7. Pull out the Over arm to accommodate the arbor support 8. Decide the position of the cutter to be fitted on the long arbor. 9. Remove the unnecessary collars. 10. Clean the hole of the cutter and slide away onto the long arbor so that the arbor key fits into the keyways. 11. Slide enough collars on the arbor to extend the edge of the workpiece. 12 Slide - on the bush bearing. 13 Slide on more collars until they just cover the one or two threads of the arbor screw. 14. Screw the arbor nut, hand tight only. 15. Fix the long arbor support onto the Over arm and to be fitted on the bush bearing. 16. Tighten the arbor support nut. 17. Tighten the long arbor nut. 18 Set r.p.m.	**Condition :** Fully equipped workshop with plain milling cutter, long arbor amidst Horizontal and Universal Milling machine. **Tasks :** Set up milling cutter on long arbor and in Horizontal milling **Standards:** - Cutter Tool should be fitted within bed area. - Arbor should be tighten. - Cutter Tool should be locked by key.	- Cotter holding devices - Long arbor and their uses. - Different cutter used in horizontal milling machines.

Safety Precautions :

- Be ensuring the thread of arbor screw is left hand.
- Cutter should be as close as possible to the spindle nose.
- Make sure that the cutter is facing in the direction of rotation of the cutter spindle.
- The bush bearing should extend equally each side of the arbor support.
- Use correct size of spanner to tighten or loosen the nuts.
- Hold the arbor support firmly to avoid dropping it on the work table or floor.

Duty 1: SET UP MACHINE

1.5. Mount milling cutter on Short arbor and in Vertical spindle

Time: 2 hrs.
Exercise: 1 hrs
Demo: 1 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Set rpm lever for lowest speed. 2. Clean the taper shank of short arbor and the spindle nose. 3. Insert taper shank into the Vertical head spindle nose. 4. Hold short arbor in position and screw in draw in bar 5. Tighten draw in bar lock nut. 6. Unscrew the cutter holding screw on the arbor. 7. Insert the cutter on short arbor aligning the key way and hold until screwed 8. Tighten the cutter holding screw with special wrench provided. 9. Set r.p.m. lever according to cutter diameter and material of workpiece.	**Condition :** Fully equipped workshop with shell end mill cutter, stub arbor amidst Vertical, Horizontal and Universal Milling machine. **Tasks :** Set up milling cutter on short arbor in vertical milling **Standards:** - RPM should be set according to cutter tool diameter. - Arbor is tightened securely on draw in bar.	- Types of cutter holding devices. Short arbors - Different types of milling cutters that can be fitted on the short arbors.

Safety Precautions :

- Follow the similar safety precautions of task set up milling cutter on long arbor in Horizontal milling.
- Use Fly cutter in order to avoid breaking of the multi toothed cutter.

Duty 1: SET UP MACHINE

1.6. Set up milling cutter in collect chuck.

Time: 2 hrs.
Exercise: 1 hrs
Demo: 1 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain required size of End mill cutter of parallel shank. 2. Select collect according to diameter of cutter shank. 3. Obtain collect chuck arbor 4. Repeat the steps 1 to 5 of short arbor setting on vertical milling. 5. Unscrew the ring nut of a chuck arbor. 6. Insert the collect chuck in and screw the nut till just grips the collect 7. Insert the cutter shank into the collect chuck. 8. Tighten the nut as tightly as possible using special wrench provided.	**Condition :** Fully equipped workshop with End mill cutter, Collect chucks and arbor amidst Vertical, Horizontal and Universal Milling machine. **Tasks :** Set up milling cutter in collect chuck. **Standards:** - End mill cutter is identically tightened in collect chuck and arbor. - Arbor is Tightened securely on draw in bar. .	- Different shank type cutters fitted on the collect chuck and adaptors.

Safety Precautions :

- Ensure the taper size of arbor and spindle nose is same.
- Cutter shank should be inserted as much as possible.
- Use cotton / rags when holding the cutter.
- Always keeps the collets in order when storing.
- Use same size of spanners to tighten or loosen the nuts
- Avoid clamping the taper shank of cutter in the collects.

Duty 1: SET UP MACHINE

1.7. Grind Single Tip tool for Fly cutter

Time: 6 hrs.
Exercise: 4 hrs
Demo: 2 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain HSS tool bits. 2. Wear Safety goggles, Bevel protractor or grinding gauge. 3. Dress the wheel, if necessary. 4. Set up tool-rest if necessary. 5. Identify the shape of tool to be grind. 6. Identify the angles of tool to be grind. 7. Wear safety goggles 8. Refer and follow the steps of the task grind Facing/corner tool in HSS bit 9. Check the angles with the gauge or bevel protractor. 10. Deburr the edges using oilstone.	**Condition :** Fully equipped workshop with Bench or Pedestal grinding machine, Safety goggles, HSS Tool bits Bevel protractor or Angle gauge. **Tasks :** Grind Single Tip tool for Fly cutter. **Standards:** - Ground shape and angle is according to Fly cutter tool bit.	- Cutting angles of different tools used in Fly cutter - Method of grinding a single tip tool for Fly cutter.

Safety Precautions:

- Too much depth may overheat the tip and may cause short hardness.
- Any damage to the grinding wheel, if noticed, should be reported to the instructor.
- When switching on the grinding machine, stand aside until the wheel reaches full speed.

Duty 2: MILL PLAIN SURFACE

2.1. Mill Plain Surface on Horizontal Milling

Time: 15 hrs.
Exercise: 12 hrs
Demo: 3 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain workpiece material. 2. Obtain set of parallel blocks as per working dimensions. 3. Set up workpiece as per the size. 4. Set up plain milling cutter on long arbor in Horizontal spindle 5. Set up machine controls 6. Bring the table so that the cutter is close to top of the workpiece. 8. Place a thin piece of paper over the surface of workpiece. 9. Start the machine. 10 Raise the table using vertical hand feed, move the table slowly until the cutter just remove the paper. 11. Move along the cutter from longitudinal feed. 12. Make sure that the cut must be conventional. 13. Give depth of cut as required. 14. Give feed till finishing at the end. 15. Take further machining until complete surface machined 16. File out the burrs on all corners of the surface.	**Condition :** Fully equipped workshop with Horizontal and Universal Milling machine. **Tasks :** Mill Plain Surface on Horizontal Milling **Standards:** - Identified the cutter and set on horizontal milling. - Milling surface is plain and even.	- Fundamental of milling. - Process of milling a Plain surface.

Safety Precautions :

- Always place the matching size of keys on arbor.
- Apply sufficient coolant.
- Distance between workpiece and arbor support must be clear.
- Parallel blocks should not be use while clamping rough workpiece.
- Ensure the parallel blocks are tighten sufficiently when use.
- Avoid sharp edges when handling workpiece.
- Clean and store all used accessories in proper place after completing the tasks.
- Check that the main switch is put off and clean off before leave the machine.

Duty 2: MILL PLAIN SURFACE

2.2. Mill Plain Surface on Vertical Milling

Time: 15 hrs.
Exercise: 12 hrs
Demo: 3 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain workpiece material 2. Obtain sets of parallel blocks 3. Set up workpiece as per the obtained size. 4. Set up shell end mill cutter on Vertical milling Stub arbor. 5. Set up machine controls 6. Bring the cutter just above the workpiece. 7. Wet the piece of paper and stick on the surface. 8. Start the machine. 9. Touch the cutter gradually on work surface, so that the paper moves slidely. 10. Take off the cutter moving table longitudinally. 11. Give depth of cut as required. 12. Give feed till finishing at the end. 13. Repeat until the required surface obtained 14. File out the burrs at all corners of the surface.	**Condition :** Fully equipped workshop with Universal and Vertical Milling machine. **Tasks :** Mill Plain Surface on Vertical Milling. **Standards:** - Identified the cutter and set on universal / vertical milling. - Milling surface is plain and even.	- Process of milling a plain surface on Vertical milling.

Safety Precautions :

- Follow the same Safety precaution of task milling Plain surface on Vertical milling

Duty 3: MILL SHOULDER

3.1. Mill Stepped Surface in Vertical milling with Shell end mill cutter

Time: 14 hrs.
Exercise: 12 hrs
Demo: 2 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain workpiece material 2. Obtain sets of parallel blocks 3. Obtain Shell end mill cutter as per required size. 4. Set up workpiece material as per the size. 5. Set up milling cutter on short arbor in vertical spindle 6. Set the machine controls 7. Prepare a square block following the steps of previous task. 8. Raise the table so that the face of the cutter is top of the workpiece using vertical hand feed. 9. Place a thin piece of paper over the surface. 10. 10.Start the spindle, using vertical hand feed move up the table very slowly until the cutter just remove the paper 11. Set vertical hand feed scale to zero. 12. Move along the table. 13. Give depth of cut as per required dimension 14. Bring the periphery of cutter on the side of the workpiece. 15. Place a thin piece of paper at the side 16. Start spindle, using the cross hand feed, move the table very slowly until the cutter just remove the paper. 17. Set the cross feed scale to zero. 18. Move along the table. 19. Give width of cut. 20. Start the machine and feed the work. 21. Repeat machining till the dimension obtained. 22. De burrs the edges. 23. Remove the workpiece and check for the final measurement	**Condition :** Fully equipped workshop with Universal and Vertical Milling machine. **Tasks :** Mill Step Surface in Vertical Milling with Shell end mill cutter. **Standards:** - Milling surface is step and right angled. - Step height should be match as per given drawing.	- Machining rules in milling. - Width of cut - Use of depth caliper - Process of step surface milling

Safety Precautions :

- Follow the same safety precautions for task preparing a square block milling.

Duty 4: MILL ANGULAR SURFACE

Time: 15 hrs.
Exercise: 12 hrs
Demo: 3 hrs

4.1. Produce angular Surface tilting Vertical head

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain workshop drawing 2. Obtain workpiece material 3. Obtain sets of parallel blocks 4. Obtain Shell end mill cutter as per required size. 5. Mount shell end mill cutter on short arbor in Vertical milling 6. Set the machine controls. 7. Set up workpiece material as per the size. 8. Prepare a square block. 9. Loosen the nuts of vertical head 10. Tilt the head as per given angle. 11. Tighten the nuts gradually. 12. Bring the face of cutter over the corner where an angle to be machine. 13. Set the longitudinal hand feed scale to zero 14. Move along the cutter from work piece moving cross movement of table. 15. Give depth of cut by longitudinal hand feed. 16. Position the coolant pipe 17. Start the machine and give feeding. 18. Repeat machining till the dimension obtained.	**Condition :** Fully equipped workshop with Universal and Vertical Milling machine. **Tasks :** Produce angular surface tilting Vertical head. **Standards:** - Angle should be accordinng to drawing. - Surface should be plane and even.	- Setting a vertical head at angle to be cut. - Process of feeding and depth of cut. - Process of milling angular surface. - Use of Vernier Bevel Protractor -

Safety Precautions :

- Be ensure the graduation mark on the vertical head has been corrected
- Follow other safety precautions of task preparing a square block milling

Duty 4: MILL ANGULAR SURFACE

Time: 8 hrs.
Exercise: 7 hrs
Demo: 1 hrs

4.2. Produce angular cutting with angular cutter

Steps	Terminal Performance Objective	Related Knowledge
1. Refer the steps no.1.2.3.from task produce angular surface tilting vertical head. 2. Obtain Angular milling cutter as per required size (45°/60°) 3. Set up workpiece material. 4. Mount the cutter according to cutter type 5. Set the machine controls 6. Bring the edge of cutter over the corner. 7. Set the longitudinal / cross hand feed scale to zero 8. Position the cutting edge where an angle is to be machined. 9. Give depth of cut as per machine rule by longitudinal hand feed. 10. Position the coolant pipe 11. Start the machine and give feeding. 12. Repeat machining till the dimension obtained. 13. Clean and stored all used accessories in proper place. 14. Check that the main switch is put off and clean off.	**Condition :** Fully equipped workshop with Universal and Vertical Milling machine. **Tasks :** Produce angular surface with Angular cutter. **Standards:** - Angle should be according to drawing. - Surface should be plain and even.	- Process of feeding and depth of cut. - Process of milling angular surface. - Process of measuring Bevelled surface.

Safety Precautions :

- Follow the same safet precaution of task preparing a Square block

Duty 4: MILL ANGULAR SURFACE

4.3. Perform angular surface setting the workpiece on machine table or vice

Time: 10 hrs.
Exercise: 8 hrs
Demo: 2 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Refer steps 1 to 6 from task Produce angular surface tilting Vertical head. 2. Mark the symmetrical line on w/p with the help of Bevel protector 3. Hold the workpiece on machine vice with the help of Bevel protector or by swiveling the vice. 4. Mount the milling cutter. 5. Set the machine controls 6. Refer the steps from no.9 to 17 of producing angular surface tilting vertical head	**Condition :** Fully equipped workshop with Universal and Vertical Milling machine. **Tasks :** Perform angular surface setting the workpiece on machine table or vice. **Standards:** - Machine table or vice angle should be accurate and tightened.	- Setting a machine table or machine vice in angle to be cut. - Process of feeding and depth of cut. - Process of milling angular surface. - Use of Vernier Bevel Protractor

Safety Precautions :

- Follow the same safety precautions of task preparing a Square block milling

Duty 5: DRILL AND BORE

5.1. Perform drilling and boring in milling machine

Time: 18 hrs.
Exercise: 16 hrs
Demo: 2 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain workshop drawing. 2. Obtain workshop material 3. Obtain sets of parallel blocks 4. Obtain required tools equipments. 5. Prepare a rectangular block referring the steps of Prepare a square block 6. Reclamp the workpiece protruding more than 15mm from the vice jaw. 7. Hold Centro fix on collect chuck. 8. Reset machine control 9. Choose datum point as per drawing 10. Raise the table towards the datum point so that half of the anvil part of Centro fixes touches the workpiece side. 11.Start the m/c, using the hand cross feed, move the table very slowly until the Centro fix just touches to shows the center 12. Stop and set the cross feed scale to zero. 13. Lower the table until the Centro fix clears. 14. Move table, using hand cross feed at the center axis for drilling a hole. 15.Lock the table as far as possible 16. Move the table longitudinally. 17.Repeat the steps from 15 to 21 18. Change center drill, reset r.p.m. 19. Start spindle, raise the table, very slowly until the depth of center drill is sufficient. 20. Change guide drills and perform holes from small to large. 21. Change boring head with tool. 22. Raise the table, set the boring diameter. 23.Give depth of cut 24.Give feed by raising the table 25.Go further machining until required bore is finished 27. Remove the workpiece and check the final measurement.	**Condition :** Fully equipped workshop with Universal and Vertical milling machine. **Tasks:** Perform Drilling and Boring in milling machine **Standards** : - Dimension should be according ro drawing. - Drilled and bored surface should be smooth and even.	- Setting up shank cutter in collect chuck. - Eliminate backlashes of work table - Uses of Centro fix - Drilling and boring in milling machine. - Types of boring tool used in boring head

Safety Precautions :

- Be careful when setting the boring tool on boring head
- Be ensuring the cutting edge of boring tool is not blunt.
- Set in average of 500 to 600 r.p.m. for Centro fix
- Be careful when mounting the Centro fix.
- Follow the other safety precautions of previous task.

Duty 6: MILL GROOVES

6.1. End milling a Slot

Time: 10 hrs.
Exercise: 8 hrs
Demo: 2 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Prepare a Square block referring the previous tasks. 2. Obtain Key way cutter that is smaller than width of slot to be cut 3. Set up the collect chuck in the machine spindle 4. Mount the cutter in the collect chuck. 5. Re-clamp the workpiece material as per the size. 6. Set the machine controls. 7. Bring the face of the cutter over the machined surface 8. Set the vertical hand feed scale to zero 9. Move along the cutter from cross feed 10.Set depth of cut 11.Bring the periphery of cutter on the side of the workpiece 12.Set the cross feed scale to zero 13. Clear out the cutter from work piece moving longitudinal movement of table. 14. Position the cutter at the slot to be mill. 15.Position the coolant pipe 16. Start the machine and mill one side of the slot. 17. Check dimension of side machined and further cuts until depth dimension is reached. 18.Reset the worktable to machine other side of slot 19. Mill other side of slot as for the first side. 20.File out burrs from edges of slot 21. Remove the workpiece and check the final measurement.	**Condition :** Fully equipped workshop with Universal and Vertical Milling machine. **Tasks :** End Milling a Slot **Standards:** - Dimension should be as per drawing. - Surface should be plain and smooth.	- Set up End mill cutter in collect chuck - Set up work table eliminating backlashes - Process of end milling a slot.

Safety Precautions :

- Follow the same safety precautions of the task prepare a Square block milling.

Duty 6: MILL GROOVES

Time: 10 hrs.
Exercise: 8 hrs
Demo: 2 hrs

6.2. Mill 'V' Groove

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain workshop drawing. 2. Obtain pre-machined workpiece 3. Obtain sets of parallel blocks 4. Obtain hole type angular milling cutter as per vee to be cut 5. Set up horizontal arbor in the m/c spindle 6. Mount the cutter on the arbor 7. Set up workpiece material 8. Set the machine controls. 9. Bring the table so that the cutter is close to the top of the workpiece 10. Bring the cutter from the edge of the workpiece to the side of the slot. 11. Use depth caliper to set the distance 12. Start the spindle and check the direction of the rotation of the cutter 13. Raise the table until the cutter just touches the workpiece 14. Set the vertical hand feed scale zero 15. Move along the cutter by longitudinal feed 16. Set depth of cut for trail cut 17. Position the coolant pipe 18. Start the machine and take a trail cut 19. Check position of vee on central of the slot 20. Set the worktable if necessary 21. Take further machining until depth dimension is reached 22. File out burrs from edges of slot 23. Remove the workpiece and check the final measurement.	**Condition :** Fully equipped workshop with Universal and Vertical Milling machine. **Tasks :** Mill 'V' Groove **Standards:** - Size and shape should be match as per drawing.	- Set hole type double side milling cutter in long arbor. - Work table backlashes - Process of milling a 'V' Groove.

Safety Precautions :

- Check that the cutter is sharp and undamaged.
- Make sure that the contact faces, keys and slots are clean and free from burrs
- Be ensure the cut should always be up milling.
- Always deburr the corners of machined surface before taking measurement.
- Set slightly lower speed and feed, if the machine does not have exact values.
- Lock the table after setting as far possible before taking the cut.
- Always stop machine and clear away chips before taking measurement

Duty 6: MILL GROOVES

Time: 15 hrs.
Exercise: 12 hrs
Demo: 3 hrs

6.3. Mill Blind Groove and Through Grooves

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain workshop drawing. 2. Obtain pre-machined workpiece 3. Obtain sets of parallel blocks 4. Obtain two lips Key way cutter as per width of groove to be cut, Centro fix, Centre drill & drill bit as per groove 5. Refer the steps no.9 to 22 of performs drilling and boring in milling. 6. Change drill bits along with collect chuck. 7. Position the coolant pipe 8. Start spindle, raise the table, very slowly until the hole is drilled 9. Change Key way cutter 10. Reset r.p.m. 11. Start the spindle; raise the table inserting the cutter through a hole. 12. Move the table longitudinally very slowly until the cutter diameter reaches the length of the groove. 13.File out burrs from edges of slot 14. Remove the workpiece and check the final measurement.	**Condition :** Fully equipped workshop with Universal and Vertical Milling machine. **Tasks :** Mill Blind Groove **Standards:** - Produced blind groove is checked as given measurement of groove.	- Set up Key way cutter in collect chuck - Set up work table eliminating backlashes - Process of milling a Key ways.

Safety Precautions :

- Follow the safety precautions of task Perform drilling and boring in milling machine and task end milling a slot.

Duty 7: MILL KEY WAYS

7.1. Mill Key Way through the length in a Round Workpiece

Time: 6 hrs.
Exercise: 5 hrs
Demo: 1 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain pre-machined round w/p. 2. Obtain a pair of vee blocks of suitable size for mounting the workpiece 3. Obtain parallel clamps with T-Bolts and nuts 4. Obtain parallel block as per the slot of m/c table, Key way cutter. 5. Mount the vee blocks keeping the parallel block in using as a stopper 6. Set the workpiece in the vee blocks 7. Set up Key way cutter in collect chuck 8. Set the machine controls. 9. Stick a piece of thin wet paper on the periphery of the workpiece 10. Start the spindle, move the table very slowly until the cutter just removes the paper. 11. Set the cross feed scale to zero 12. Lower the table until the cutter clears w/p. 13. Move the table to bring the cutter clear of the end of the workpiece 14. Raise the table so that the cutter is above the level of the top of the workpiece. 15. Move the table so that the center of the cutter is in line with the center of the workpiece. 16. Place a piece of paper at the end of the w/p. 17. Repeat step no 11 using longitudinal feed. 18. Set the scale to zero. 19. Lower the table so that cutter is above the starting position for the key way 20. Raise table until the cutter just touches w/p. 21. Set the vertical scale to zero (0) 22. Move along and set the depth of cut using vertical hand feed 23. Mill away to the required length 24. Stop the spindle and lower the table until the cutter clear from the work. 25. Deburr the edges & check the keyways	**Condition :** Fully equipped workshop with Universal and Vertical Milling machine. **Tasks :** Mill Key Way through the length in a Round Workpiece **Standards:** - Produced Key ways is checked as given measurement of groove.	- Vee Block setting on work table - Position to bring the cutter at the center of round work piece. - Measurement of key ways - Process of milling a key ways in a round workpiece.

Safety Precautions :

- Vee blocks should be such that the sides of workpiece contacts the vee at about the center
- Make sure that the clamps clear the area where the key way is to be machined.
- Always debur the corners of machined surface before taking measurement.
- Make sure that the contact faces, keys and slots are clean and free form burrs
- It is safe to drill slot size at the starting point before milling keyways.
- Always check the rotating direction before taking cut.
- Add the radius of the cutter diameter when setting the position and milling longitudinal.
- Lock the table as far as possible before taking cut

Duty 7: MILL KEY WAYS

7.2. Mill blind Key way in a Round W/p.

Time: 6 hrs.
Exercise: 5 hrs
Demo: 1 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Refer and follow the steps of Mill end Key way up to step 17. 2. Lower the table. 3. Move table distance for starting of Key way. 4. Change the Centro fix to Center drill. 5. Make a center drill on starting spot. 6. Check the distance. 7. Change drill bit of key width size. 8. Drill a blank hole as key depth. 9. Change Key way cutter. 10. Start machine applying depth maintain. 11. Feed the table as it clamped on table. 12. Stope and measure the manufactured key way. 13.Deburr the edges of the keyways 14.Check the depth and length of the keyways	**Condition :** Fully equipped workshop with Universal and Vertical Milling machine. **Tasks :** Mill Blind Key ways in a Round workpiece. **Standards:** - Produced key way is checked as given measurement of groove.	- Vee Block setting on work table - Position to bring the cutter at the center of round work piece. - Measurement of key ways - Process of milling a key ways in a round workpiece.

Safety Precautions :

- Refer and follow the safety of Mill end Key way.

Duty 8: INDEX MILLING

8.1. Mill Hexagonal Shape Around the Periphery of Round Workpiece

Time: 10 hrs.
Exercise: 8 hrs
Demo: 2 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain pre-machined round w/p. 2. Obtain Direct indexing head & tail stock 3. Obtain end mill cutter as per width to be cut. 4. Mount the cutter in collect chuck. 5. Set up Indexing head and tail stock so that the length of work piece will come at the middle of the table as well as in between. 6. Set up workpiece in 3 jaw chuck of the indexing head checking concentricity. 7. Set the machine controls. 8. Set the worktable to position the table so that the cutter is close to the top of the workpiece. 9. Place a piece of thin wet paper on the workpiece. 10. Start the spindle, using the hand vertical feed; raise the table until the cutter just remove the piece of paper. 11.Set the vertical scale to zero 12.Move along cutter from cross feed 13.Set up the crank lever 14.Set the depth of cut 15.Position the coolant pipe 16. Start the machine and take cut. 17. Check the depth. 18. Take further cut as per depth require. 19. Index the workpiece by moving the crank. 20. Reset the indexing lever. 21. Repeat machining and indexing until the hexagonal shape obtained. 22.Remove burrs from edges	**Condition :** Fully equipped workshop with Universal Milling machine. **Tasks :** Mill Hexagonal shape around the periphery of round workpiece. **Standards:** - Produced hexagon is checked as given measurement (head length, width, chamfer).	- Introduction of indexing. - Direct indexing method. - Indexing calculation. - Process of index milling.

Safety Precautions :

- Be ensuring the cut should always be up milling.
- Lock the table after each and every setting.
- Be ensuring the cutter should not touch the Indexing head and Tail stock.

Duty 9: PERFORM PROJECT WORK

9.1. Manufacture a Clamp.

Time: 18 hrs.
Exercise: 18 hrs
Demo: hrs

Steps	Terminal Performance Objective	Related Knowledge
Position 1 (Ruler); 1. Obtain workshop drawing 2. Obtain workpiece material 3. Refer and Follow the steps of Mill Square block in vertical milling. 4. Reclamp the workpiece. 5. Refer and follow the steps of Mill groove in a workpiece 6. Remove the workpiece and check the two adjacent surfaces are right angle. 7. Reclamp the workpiece. 8. Refer and follow the steps of Produce angular surface tilting vertical head on both sides. 9. Measure the dimension and take further cuts as required 10. Remove the workpiece, Deburr the edges and chucks the final measurement.	**Condition :** Fully equipped workshop with Universal and Vertical Milling machine. **Tasks :** Manufacture a Clamp. **Standards:** - Produced rectangular is checked as given dimension in workshop drawing. - Produced groove is checked as given dimension in workshop drawing. - Produced angular surface is checked as given dimension in workshop drawing.	• Specific tolerance of machine parts

Safety Precautions :

- Deburr sharp edges when handling workpiece.
- Clean up the vice jaws and parallel blocks every time when resetting the workpiece.
- Check that the cutter is sharp edge and undamaged before setting.
- Select the RPM slightly lower than the higher.
- Be ensure the parallel blocks are tighten sufficiently when use.
- Check that the main switch is put off and clean off whenever you leave the machine.

Duty 9: PERFORM PROJECT WORK

9.2. Manufacture Slide Rule in Vertical milling.

Time: 24 hrs.
Exercise: 24 hrs
Demo: hrs

Steps	Terminal Performance Objective	Related Knowledge
Position 1 (Ruler); 1. Obtain workshop drawing 2. Obtain workpiece material 3. Refer and Follow the steps of Mill Square block in vertical milling. 4. Reclamp the workpiece. 5. Refer and follow the steps of Mill Blank Key way in a round workpiece 6. Remove the workpiece and check the two adjacent surfaces are right angle. 7. Reclamp the workpiece. 8. Refer and follow the steps of Produce angular surface tilting vertical head on both sides. 9. Measure the dimension and take further cuts as required 10. Remove the workpiece, Deburr the edges and chucks the final measurement. **Position 2 (Slide Bar);** 12. Refer and follow the steps of prepare Square block in Vertical milling. 13. Reclamp the workpiece. 14. Refer and follow the steps of Mill end slot. 15. Reclamp the workpiece. 16. Change dovetail cutter of required size. 17. Bring cutter middle of the slot. 18. Touch one side running the spindle maintaining up milling. 19. Clear off the workpiece. 20. Give depth as required. 21. Machine the dovetail slot. 22. Check the measurement using standard cylindrical pin. 23. Mill opposite side following the steps no. 7 to 9. 24. Remove the workpiece and check the final measurement.	**Condition :** Fully equipped workshop with Universal and Vertical Milling machine. **Tasks :** Manufacture Slide Rule in Vertical milling. **Standards:** - Produced ruler is checked as given dimension in workshop drawing. - Produced slide bar is checked as given dimension in workshop drawing.	• Application of slide rule

Safety Precautions :

- Deburr sharp edges when handling workpiece.
- Clean up the vice jaws and parallel blocks every time when resetting the workpiece.
- Check that the cutter is sharp edge and undamaged before setting.
- Select the RPM slightly lower than the higher.
- Be ensure the parallel blocks are tighten sufficiently when use.
- Check that the main switch is put off and clean off whenever you leave the machine.

Duty 9: PERFORM PROJECT WORK

9.3. Manufacture a Spur Gear

Time: 16 hrs.
Exercise: 16 hrs
Demo: 0.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain workshop drawing 2. Obtain gear blank with corresponding mandrel pre – machined workpiece material 3. Obtain pre – machined / ready made mandrel 4. Calculate the module, depth of cut and indexing moments 5. Set up indexing head and tailstock on the machine table the length of workpiece will come at the middle of the table as well as in between indexing head and tailstock 6. Mount the cutter horizontally on long arbor 7. Set up workpiece in indexing head checking concentricity supporting with tailstock 8. Set the center axis of cutter and gear blank in cross axis 9. Set the machine control 10. Place a piece of thin wet paper over the gear blank 11. Run the machine raise the table using vertical hand feed until the cutter just remove the paper 12. Set the vertical scale to zero 13. Move along the cutter from cross feed 14. Set up the indexing crank lever 15. Set the depth of cut 16. Start the machine and face cut 17. Check the depth 18. Index the workpiece by moving the crank 19. Repeat taking cut indexing the workpiece for every groove by moving the crank until the periphery of gear blank complete 20. Give further depth of cut 21. Repeat taking cut same as step 19 22. Stop the machine, remove workpiece 23. Check the final measurement	**Condition :** Fully equipped workshop with Universal Milling machine, Indexing head and supporting plates. **Tasks :** Manufacture a spur gear **Standards:** - Produced spur gear is checked as given dimension in workshop drawing.	• Introduction to gear • Gear terminology • Types of geas

Safety Precautions :

- Refer and follow the task Mill Hexagonal shape in round workpiece.

B. Shaper Machine Operation

Duty 1: SET UP MACHINE & HOLDING DEVICES

1.1 Set up Shaper Vice on Machine Table:

Time: 3.0 hrs.
Exercise: 2.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain shaper vice. 2. Obtain T- bolts, nuts and washer. 3. Obtain large size parallel block. 4. Obtain dial test indicator with magnetic stand. 5. Clean machine vice and machine table along tee slot thoroughly. 6. Apply thin film of oil at the bottom of machine vice. 7. Set the vice on machine table with tee bolt and nuts positioning the jaw in lengthwise parallel to the ram movement. 8. Tighten lightly all nuts. 9. Hold dial test indicator on magnetic stand then magnetized on tool head. 10. Clamp the parallel block between the vice projecting more than ½ of the width. 11. Bring the table in contact with dial test lever on parallel block. 12. Move ram slowly by hand wheel at the starting end for dial test lever. 13. Observe the indicator. 14. Set the indicator lever into zero. 15. Move the ram to other end of the parallel block. 16. Align the vice hammering opposite to the indicating line. 17. Repeat steps no. 12 & 16 until the indicating lever does not show zero at both ends of the parallel block. 18. Tighten fully all the nuts.	**Condition:** Fully equipped workshop with Shaper vice, T-bolts, Nuts and Washer & Shaping machine. **Tasks:** Set up shaper vice on machine table **Standards:** - Vice jaw is parallel to ram movement. - Tighten the Shaper vice with all nuts and bolts.	• Introduction of shaper machine • Introduction of dial test indicator • Use and care of dial test indicator • Procedure of setting a Shaper vice on machine table.

Safety Precaution:

- Always clamps the nut with washer.
- Always use same size of spanner.
- Always disconnect the dial test lever before hammering in the vice.
- Always clean the surfaces where magnetic stand will magnetize.
- Dial test indicator must not be dropped and should not be exposed to severe shocks.

Duty 1: SET UP MACHINE& HOLDING DEVICES

1.2 Hold HSS Cutting Tool bit on Tool Post:

Time: 1.5 hrs.
Exercise: 1 hrs
Demo: 0.5 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain ground HSS cutting tool bit. 2. Obtain 2 nos. of MS T-shape packing. 3. Insert both the packing in tool post. 4. Insert HSS cutting tool bit between packing facing the cutting edge towards the vice. 5. Tighten the tool tightening screw-protruding tool enough to cut. 6. Set the clapper box at angle if needed.	**Condition:** Fully equipped workshop with Ground HSS shaping tool with Shaping machine. **Tasks:** Hold HSS cutting tool bit on tool post **Standards:** • Clamped cutting edge facing towards the vice hanging the tool bit. • Placed both side packing's on clamping screw.	• Introduction of tool post • Use of clapper box • Process of Holding HSS cutting tool bit on tool post.

Safety Precaution:

- Avoid holding the tool over hanging.
- Make sure that the cutting edge of the tool is facing towards the vice.
- Avoid tightening the tool without T-shaped MS packages.
- Avoid using over sizes Spanner or Slide wrenches.

Duty 1: SET UP MACHINE & HOLDING DEVICES

1.3 Adjust Stroke Length:

Time: 1.5 hrs.
Exercise: 1 hrs
Demo: 0,5 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Clamp the work-piece material. 2. Hold shaper cutting tool on tool post. 3. Move ram extreme behind by hand. 4. Insert a handle in stroke adjusting spindle. 5. Loosen the spindle turning clockwise direction. 6. Turn half of the round nut-covering spindle by hand. 7. Turn spindle anti clock-wise to move the tool near to the work-piece. 8. Turn hand wheel if possible to check the stroke length. 9. Repeat turning spindle until the stroke length is adequate. 10. Tighten the round nut-covering spindle by hand. 11. Tighten the spindle turning anti clockwise spindle by hand.	**Condition:** Fully equipped workshop with Shaping machine and stroke adjusting handle. **Tasks:** Adjust stroke length **Standards:** • Stroke length is according to the length of work piece.	• Process of adjusting stroke length.

Safety Precaution:

- While adjusting the stroke length keep the tool just above from the work-piece.
- Avoid hammering on the handle.
- The length of the stroke should be about 2cm more than the length of the job.
- Not confusing to turn the spindle clockwise and anti clockwise direction.

Duty 1: SET UP MACHINE& HOLDING DEVICES

1.4 Position The Ram in Center as per Work-piece Length:

Time: 3 hrs.
Exercise: 2 hrs
Demo: 1 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Clamp the work-piece material. 2. Hold shaper cutting tool in tool post. 3. Check the position of stroke length by moving tool head manually. 4. Move ram extreme behind by hand. 5. Insert the handle in handling position toward or forward of ram. 6. Loosen the ram lock. 7. Adjust the position of tool by moving the handle 8. Repeat moving the handle if necessary until the tool is in position. 9. Recheck the position of stroke length. 10. Repeat moving the handling until the position is correct.	**Condition:** Fully equipped workshop with Shaping machine and shaper handle. **Tasks:** Position stroke length in center as per work-piece length. **Standards:** • Stroke length is centered to length of work piece.	- Process of positioning stroke length in center as per workpiece size.

Safety Precaution:

- Refer the same safety precautions of task Adjust stroke length.

Duty 2: PERFORM PLAIN SURFACE SHAPING

2.1 Produce Flat Even Surface:

Time: 30 hrs.
Exercise: 27 hrs
Demo: 3 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain work-piece material. 2. Obtain set of parallel blocks as per working dimensions. 3. Set up work-piece as per the shape and size. 4. Hold the HSS shaping rough tool bit. 5. Adjust stroke length. 6. Position stroke length in the center. 7. Bring the table so that the tool touches the top surface of the work-piece. 8. Move table by hand out of the work-piece longitudinally. 9. Loosen the nut of tool post slide. 10. Give depth of cut as for rough-cut. 11. Tighten the nut of tool post slide. 12. Start the machine. 13. Give feeding by hand observing surface made until complete the total surface. 14. Stop the machine. 15. Return the tool at the same starting point. 16. Give further depth of cut referring the steps no. 10, 11 and 12. 17. Take further machining until complete surface machined. 18. File out the burrs on all corners of the surface.	**Condition:** Fully equipped workshop with work-piece material, shaping tool and Shaping machine. **Tasks:** Produce flat even surface **Standards:** - Machined surface is Flat and even.	• Process of shaping a flat even surface • Auto feed mechanism of shaper machine.

Safety Precaution:

- Always deburr the work-piece before clamping.
- Always wear safety goggles when machining.
- Parallel blocks should not be use while clamping rough work-pieces.
- Be ensure the parallel blocks are tighten sufficiently when use.
- Avoid sharp edges when handling work-piece.
- Clean and store all used accessories in proper place after completing the tasks.
- Check that the main switch is put off and clean off before leave the machine.
- Refer the same safety precautions of task adjust stroke length.

Duty 3: PERFORM 90º STEP SURFACE

3.1 Produce 90º Right angle corner step surface:

Time: 24 hrs.
Exercise: 21 hrs
Demo: 3 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain workshop drawing 2. Obtain work-piece material. 3. Obtain sets of parallel blocks. 4. Obtain shaping tool rough and corner. 5. Set up work-piece material. 6. Clamp the rough tool on tool head. 7. Prepare a square block following the same steps of previous task. 8. Mark symmetrical line using height gauge. 9. Reclamp the work-piece. 10. Refer the steps no. 8 to 13 to produce flat even surface. 11. Give feeding observing surface made until the few mm remain to touches the marked line. 12. Stop the machine. 13. Return tool at same starting place. 14. Give further depth of cut as per required dimension. 15. Take machining to remove maximum rough material. 16. Change corner tool for shoulder. 17. Repeat same as for the step no. 10. 18. Repeat machining till total depth of the dimension obtained. 19. Stop machine. 20. Raise the tool from sliding tool head slide. 21. Set the clapper box opposite to the shoulder side. 22. Give depth of cut as remain to reach total width by longitudinal movement. 23. Start machine & give feeding from tool head slide 24. Repeat machining until the dimension obtained. 25. File out the burrs at the edges. 26. Remove the work-piece and check the final measurement.	**Condition:** Fully equipped workshop with work-piece material and Shaping machine. **Tasks:** Produce 90º Right angle corner step surface **Standards:** - Machined step surface is 90 º right angle corners.	• Types of shoulder. • Shaper tool for shaping a shoulder. • Process of producing a shoulder.

Safety Precaution:

- Follow the same safety precautions of task Produce a plain surface.

Duty 4: PERFORM PROJECT WORK

4.1 Manufacture a Step Block:

Time: 15 hrs.
Exercise: 15 hrs
Demo: 0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain workshop drawing 2. Obtain workpiece material 3. Prepare a rectangular block referring to prepare square block 4. Mark the layout on vernier height gauge 5. Punch dots on layout mark 6. Reclamp the workpiece 7. Produce step surface referring / following to produce 90 right angle corner step surface. 8. Remove workpiece 9. File out burrs from edges. 10. Check the final measurement	**Condition:** Fully equipped workshop with workshop drawing of step block, HSS tool, parallel blocks and Shaping machine. **Tasks:** Manufacture a step block **Standards:** • Produced step block is as per given dimension and within tolerance in workshop drawing.	•

Safety Precaution:

- Follow the same safety precaution of task produce 90º Right angle corner step surface.

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Repair & Maintenance

Total: 156 hrs
Class/week: 4 hrs

Course Stage	Duties and Tasks	Time	
A.	**Mechanical Maintenance**	**Demo**	**Practical**
1.	**Preventive Maintenance**	**5**	**8**
1.1	Schedule maintenance plan	1	2
1.2	Manage stock spare components	1	2
1.3	Apply lubricants and lubrication	1	2
1.4	Maintain history card and machine records	2	2
2.	**Breakdown Maintenance**	**8**	**20**
2.1	Diagnose / find faults	1	2
2.2	Replace / change gear	1	2
2.3	Adjust / replace 'V' and 'Flat' belts	1	2
2.4	Overhaul gear box	2	10
2.5	Align Lathe tailstock offset	1	2
2.6	Repair coolant pipe lines	2	2
3	**Project work of Machines repair**		**37**
	Total	***13***	***65***
	Total	**78**	
B.	**Electrical Maintenance**	**Demo**	**Practical**
1.	**Interpret Electrical Symbol & Drawing**	**5**	**8**
1.1	Schematic Diagram	1	2
1.2	Layout Diagram	1	2
1.3	Wiring Diagram	1	2
1.4	Power and Control Diagram	2	2
2.	**Read & Handle Multi meter**		
2.1	Multi meter	**1**	**2**
3.	**Repair Electrical Wiring**	**2**	**10**
3.1	One bulb control by one way switch	1	5
3.2	One bulb control by two way switch	1	5
4.	**Replace common electrical Accessories & materials**	**1**	**5**
5	**Repair motor control and installation system.**	**4**	**8**
5.1	Connect direct on line starter (DOL)	2	4
5.2	Connect forward / reverse motor starter	2	4
6.	**Project work of Electrical repair**		**32**
	Total	***13***	***65***
	Total	**78**	
	Total (A + B)	**78 + 78 = 156**	

TASK ANALYSIS

Duty:1: PREVENTIVE MAINTENANCE

1.1. Schedule Maintenance Plan.

Time: 3.0 hrs
Exercise: 2.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instructional manual. 2. Read the pages of maintenance instructions. 3. List down with maintenance intervals. 4. Draw a wall chart. 5. Collect all material as required. 6. Follow the instruction at very first time. 7. Clean the working surroundings. 8. Restore all remaining materials	**Condition :** Fully equipped Machining shop with maintenance tools and materials. **Task :** Schedule Maintenance Plan. **Standards:** - Maintenance plan should be labeled as per provided plan.	- Introduction of preventive maintenance. - Prepare recycle maintenance chart. - Read instructional manual.

Safety Precautions:

- Follow the safety of Occupational Safety and Health Administration (OSHA).

Duty:1: PREVENTIVE MAINTENANCE

1.2. Manage Stock Spare Components.

Time: 3.0 hrs
Exercise: 2.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instructional manual. 2. Read the pages of maintenance instructions. 3. List down the machine components to spare. 4. Purchase the components as its frequency of replace. 5. Make a separate store with different racks. 6. Control the store environment from being ageing. 7. Prepare a record book to maintain the stock balance.	**Condition :** Fully equipped Machining shop with maintenance tools and materials. **Task :** Manage Stock Spare Components. **Standards:** - Record book should be match with provided original book.	- Introduction of Stock materials. - Plan standard spares and materials for stocks.

Safety Precautions:

- Follow the safety of Occupational Safety and Health Administration (OSHA).

Duty:1: PREVENTIVE MAINTENANCE

1.3. Apply Lubricants and lubrication.

Time: 3.0 hrs
Exercise: 2.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain user's manual. 2. Read the pages and charts of lubrication point. 3. List down with lubrication intervals. 4. Draw a wall chart. 5. Collect all material as required. 6. Follow the instruction at very first time. 7. Clean the working surroundings. 8. Restore all remaining materials	**Condition :** Fully equipped Machining shop with maintenance tools and materials. **Task :** Apply lubricants and lubrication. **Standards:** - Lubricants should be applied as per lubrication point. - Lubrication chart of machine should be followed. - User's manual should be referred.	- Introduction of lubricants and lubrication. - Properties and application of lubricants. - Read user's manual. - Sample lubrication chart of a machine.

Safety Precautions:

- Follow the safety of Occupational Safety and Health Administration (OSHA).

Duty:1: PREVENTIVE MAINTENANCE

1.4. Maintain History card and Machine record.

Time: 4.0 hrs
Exercise: 2.0 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instructional manual. 2. Read the pages of maintenance instructions. 3. List down with maintenance intervals. 4. Prepare a A4 size History card / Log sheet. 5. Collect all material as required. 6. Follow the instruction at very first time. 7. Clean the working surroundings. 8. Restore all remaining materials	**Condition :** Fully equipped Machining shop with maintenance tools and materials. **Task :** Maintain History card and machine record. **Standards:** - History card should be prepared. - Machine record should be maintained.	- Introduction of history card. - Prepare history card. - Important of keeping records of machines.

Safety Precautions:

- Follow the safety of Occupational Safety and Health Administration (OSHA).

Duty:2: BREAKDOWN MAINTENANCE

2.1. Diagnose / Finds Faults.

Time: 3.0 hrs
Exercise: 2.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instructional manual. 2. Read the pages of machine errors and remedies instructions. 3. Check the electrical power supply 4. Noted all remarks seen and observed. 5. Check the power transmissions 6. Noted all the remarks and observed. 7. Check all the machine faults 8. Noted all the remarks and observed	**Condition :** Fully equipped Machining shop with maintenance tools and materials. **Task :** Diagnose / Find Faults. **Standards:** - Diagnosed and prepared report on faults power supply. - Diagnosed and prepared report on power transmission faults. - Fault machine is diagnosed and prepared.	- Introduction of bad power supply. - Introduction and characteristics of bad power transmission - Introduction and characteristic of bad machine components.

Safety Precautions:

- Follow the safety of Occupational Safety and Health Administration (OSHA).

Duty:2: BREAKDOWN MAINTENANCE

2.2. Replace / Change Gear.

Time: 3.0 hrs
Exercise: 2.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instructional manual. 2. Read the pages of gear train transmissions. 3. Prepare a gear to be replace / change 4. Collect the set of repair tools. 5. Dismantle the gear to be replace 6. Clean the parts by kerosene bath. 7. Greased the parts to be assembly. 8. Assemble the parts 9. Align the gear mesh 10. Check the gear mesh 11. Cover up the safety cover or housing 12.Restore all remaining materials	**Condition :** Fully equipped Machining shop with maintenance tools and materials. **Task :** Replace / Change Gear. **Standards:** - Gear is fixed and true aligned. - Re-lubricated on gear and housing.	- Introduction, types and application of gear. - Gear transmission calculation. - Gear alignment process.

Safety Precautions:

- Follow the safety of Occupational Safety and Health Administration (OSHA).

Duty:2: PREVENTIVE MAINTENANCE

2.3. Adjust / replace 'V' and "Flat" belts.

Time: 3.0 hrs
Exercise: 2.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instructional manual. 2. Read the pages of Belt transmission. 3. Prepare the belt to be replaced. 4. Collect the repair tools. 5. Check and note the specification of the belt 6. Switch off the machine and de-fuse if possible 7. Loosen enough the belt adjustment knob, nut or bolt 8. Remove the belt from pulley 9. Change the belt in pulley 10. Tighten enough the belt adjustment knob, nut or bolt 11. Turn on switch the machine 12. Keep all tools and equipment on their specified place.	**Condition :** Fully equipped Machining shop with maintenance tools and materials. **Task :** Adjust / replace 'V' and 'Flat' belts.. **Standards:** - Belt is replaced and re-adjusted. - Belt transmission ratio is true.	- Introduction, types and application of 'V' belts, Flat belts and pulleys. - Chart of belts specification. - Calculation of belt transmission ratio.

Safety Precautions:

- Follow the safety of Occupational Safety and Health Administration (OSHA).

Duty:2: BREAKDOWN MAINTENANCE

2.4. Overhaul Gear box.

Time: 12 hrs
Exercise: 10 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instructional manual. 2. Read the pages of Gear box. 3. Confirm the gear box of a machine. 4. Collect the required repair tools 5. Switch off the machine and de-fuse if possible 6. Drain out the gear oil. 7. Disconnect gear connecting shaft. 8. Remove plug screw to drain out all gear out. 9. Check the lever connection for reconfirming the gear positioning 10. Sketch a drawing of a gear and shaft position 11. Remove bearings, seals, circlip, and pin from the shaft connection. 12. Remove all gears and bathed on kerosene oil. 13. Clean up all gears, shaft and machine components in kerosene oil and make dry. 14. Checks the condition of all dismantled components. 15. Distinguish the excellent one and parts needs to be replaced. 16. Assemble the parts as its original position. 17. Fill up new gear oil as required quantity. 18. Cover up the gear box cover. 19. Re-connect the gear and shaft connection. 20. Turn on the machine. 21. Confirm oil leakage, levers position and variable speed. 22. Keep all tools and equipments on their specified place.	**Condition :** Fully equipped Machining shop with maintenance tools and materials. **Task :** Overhaul Gear box. **Standards:** - Gear oil is not leaking. - Gear lever turned smoothly. - Variable speed is same as before.	- Introduction, types and application of gear transmission. - Chart of different model of gear box as manual. - Safety knowledge of machine components used in gear boxes.

Safety Precautions:

- Follow the safety of Occupational Safety and Health Administration (OSHA).

Duty:2: BREAKDOWN MAINTENANCE

2.5. Align Lathe Tailstock Offset.

Time: 3.0 hrs
Exercise: 2.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Perform plain turning on a shaft as long as possible supporting tailstock. 2. Check the diameter of both end and calculate the taper ratio. 3. Calculate the offset distance of tailstock. 4. Loosen the screw of tailstock 5. Hold the dial gauge on tool post. 6. Touch the lever on spindle of tailstock and set zero. 7. Tighten other screw and align the dial gauge half distance that of calculation. 8. Check the taper ratio once again. 9. Reset the tailstock and confirm the alignment. 10. Tighten all screws. 11. Clean and replace all tools in their respective place.	**Condition :** Fully equipped Machining shop with maintenance tools and materials. **Task :** Align lathe tailstock offset. **Standards:** - Aligned tailstock should be parrallel with bed.	- Principal part of lathe – Function of Tailstock. - Taper turning offsetting tailstock - Method of re-alignment offset tailstock.

Safety Precautions:

- Follow the safety of Occupational Safety and Health Administration (OSHA).

Duty:2: BREAKDOWN MAINTENANCE

2.6. Repair Coolant pipe lines.

Time: 4.0 hrs
Exercise: 2.0 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instructions. 2. Check the coolant flow system. 3. Note the required size and length of pipe. 4. Note the required size of connectors. 5. Collect all the tools as required. 6. Collect all the pipes and connectors. 7. Install the pipes. 8. Turn on the pump. 9. Check the leaks and mend if needed 8. Restore all remaining materials	**Condition :** Fully equipped Machining shop with maintenance tools and materials. **Task :** Repair coolant pipe line. **Standards:** - Coolant is taped from pipe. - Pipe should be leaked proof.	- Introduction of pipes and their connectors and fixers. - Methods of fixing the pipe connection. - Introduction of sealing and their methods.

Safety Precautions:

- Follow the safety of Occupational Safety and Health Administration (OSHA).

Duty:3: PROJECT WORK ON MACHINE REPAIR

3.1. Repair machine.

Time: 37 hrs
Exercise: 37 hrs
Demo: 0.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instructions. 2. Obtain manual of the machine. 3. Diagnose / Find the faults 4. Overhaul or replace the components as required. 5. Re check the errors 6. Run the machine. 7. Restore all remaining materials	**Condition :** Fully equipped Machining shop with maintenance tools and materials. **Task :** Repair machine. **Standards:** - Machine is repaired.	

Safety Precautions:

- Follow the safety of Occupational Safety and Health Administration (OSHA).

Electrical Repair and Maintenance

Duty:1: INTERPRET ELECTRICAL SYMBOLS AND DRAWINGS

1.1. Interpret Schematic Diagram.

Time: 3.0 hrs
Exercise: 2.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain the instruction. 2. Prepare the drawing instruments. 3. Prepare the drawing sheet. 4. Draw a schematic diagram of one bulb control by one way switch. 5. Wipe off unnecessary drawing lines. 6. Submit the drawing to instructor for evaluation.	**Condition :** Fully equipped Drawing classroom with drawing instrument. **Task :** Interpret Schematic Diagram. **Standards:** - Schematic drawings should be followed. - Simple diagram of one bulb control by one way switch should be drawn as per given drawing.	- Introductions of electrical symbols. - Electrical schematic wiring and layout. -

Safety Precautions:

- Follow the safety precautions of Technical drawing subject.

Duty:1: INTERPRET ELECTRICAL SYMBOLS AND DRAWINGS

1.2. Interpret Layout Diagram.

Time: 3.0 hrs.
Exercise: 2.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain the instruction. 2. Obtain the layout diagram. 3. Prepare electrical accessories as per layout diagram.	**Condition :** Fully equipped Electrical workshop with different electrical accessories. **Task :** Interpret Layout Diagram. **Standards:** - Layout diagram should be interpreted. - Different electrical accessories should be identified.	- Introductions of Layout diagram. - Introduction of electrical accessories.

Safety Precautions :

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Duty:1: INTERPRET ELECTRICAL SYMBOLS AND DRAWINGS

1.3. Interpret Wiring Diagram.

Time: 3.0 hrs.
Exercise: 2.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain the instruction. 2. Obtain the Wiring diagram. 3. Prepare electrical accessories as per wiring diagram.	**Condition :** Fully equipped Electrical workshop with different electrical accessories **Task :** Interpret Wiring Diagram. **Standards:** - Wiring diagram should be interpreted. - Different electrical accessories should be used.	- Introductions of wiring diagram. - Use of electrical accessories.

Safety Precautions :

- Carefully handle electrical accessories.

Duty:1: INTERPRET ELECTRICAL SYMBOLS AND DRAWINGS

1.4. Interpret Power & Control Diagram.

Time: 4.0 hrs.
Exercise: 2.0 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain the instruction. 2. Obtain the Plan diagram. 3. Prepare motor control electrical accessories as per plan diagram.	**Condition :** Fully equipped workshop with Vertical, Horizontal and Universal Milling machine. **Task :** Interpret Power & Control diagram. **Standards:** - Introduce plan diagram - Prepared power and control diagram according to the plan diagram - Prepared motor control electrical accessories as per plan diagram.	- Introductions plan diagram - Prepare power and control diagram according to the plan diagram - Prepare motor control electrical accessories as per plan diagram.

Safety Precautions :

- Handle all electrical apparatus and equipment carefully.
- Replace broken switches and plugs immediately as and when seen.
- Never pulls the flexible cable or wire to disconnect the plug.
- Never place bare wire seen on plugs and sockets.
-

Duty:2: READ & HANDLE ELECTRICAL INSTRUMENTS

2.1 Read & Handle Multi meter

Time: 3.0 hrs.
Exercise: 2.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain Multi meter. 2. Insert probe (jack) into positive terminal and negative terminal. 3. Connect multi meter probe in respective supply. 4. Read measured Volt. 5. Note down the measurement. 6. Follow the steps from 3 to 6 for adjusting selector switch to Ampere. 7. Follow the steps from 3 to 6 for adjusting selector switch to Resistance. 8. Clean and store the meter in safe and sound place.	**Condition :** Fully equipped Electrical workshop with Multi meter. **Task :** Read & Handle Multi meter. **Standards:** • Multi meter reading should be between ±1.	- Introduction and types of Multi meter. - Advantage of using Multi meter. - Process of reading and handling Multi meter. - Handle and care of Multi meter.

Safety Precautions:

- Handle all electrical apparatus and equipment carefully.
- Replace broken switches and plugs immediately as and when seen.
- Never pulls the flexible cable or wire to disconnect the plug.
- Never place bare wire seen on plugs and sockets.

Duty:3: REPAIR ELECTRICAL WIRING

3.1 Repair one bulb control by one way switch.

Time: 6.0 hrs.
Exercise: 5.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instruction layout diagram. 2. Prepare wiring diagram. 3. Obtain electrical accessories as per diagram. 4. Mark the layout on the board as per diagram. 5. Prepare the auxiliary accessories as per diagram measurement. 6. Install the auxiliary accessories on the board. 7. Lay wire according to the wiring diagram. 8. Connect all electrical accessories according to the wiring diagram. 9. Clean and store the electrical instrument used in safe and sound place.	**Condition :** Fully equipped Electrical workshop with Multi meter. **Task :** • Repair one bulb control by one way switch. **Standards:** • Bulb should be glow. • Connection should be tight and no bared wire seen.	- Introduction of one bulb control by one way switch.

Safety Precautions:

- Handle all electrical apparatus and equipment carefully.
- Replace broken switches and plugs immediately as and when seen.
- Never pulls the flexible cable or wire to disconnect the plug.
- Never place bare wire seen on plugs and sockets.

Duty:3: REPAIR ELECTRICAL WIRING

3.2 Repair one bulb control by two way switch.

Time: 6.0 hrs.
Exercise: 5.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instruction layout diagram. 2. Prepare wiring diagram. 3. Obtain electrical accessories as per diagram. 4. Mark the layout on the board as per diagram. 5. Prepare the auxiliary accessories as per diagram measurement. 6. Install the auxiliary accessories on the board. 7. Lay wire according to the wiring diagram. 8. Connect all electrical accessories according to the wiring diagram. 9. Clean and store the electrical instrument used in safe and sound place.	**Condition :** Fully equipped Electrical workshop with Multi meter. **Task :** • Repair one bulb control by two way switch. **Standards:** • Bulb should be glow. • Connection should be tight and no beared wire seen.	- Introduction of one bulb control by two way switch.

Safety Precautions:

- Handle all electrical apparatus and equipment carefully.
- Replace broken switches and plugs immediately as and when seen.
- Never pulls the flexible cable or wire to disconnect the plug.
- Never place bare wire seen on plugs and sockets.

Duty:4: REPLACE COMMON ELECTRICAL ACCESSORIES AND MATERIALS

4.1 Replace Electrical Accessories

Time: 6.0 hrs.
Exercise: 5.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instruction layout diagram. 2. Prepare wiring diagram. 3. Obtain electrical accessories as per diagram. 4. Mark the layout on the board as per diagram. 5. Prepare the auxiliary accessories as per diagram measurement. 6. Install the auxiliary accessories on the board. 7. Lay wire according to the wiring diagram. 8. Connect all electrical accessories according to the wiring diagram. 9. Clean and store the electrical instrument used in safe and sound place.	**Condition :** Fully equipped Electrical workshop with hand tools. **Task :** • Replace electrical accessories. **Standards:** • Bulb, sockets, fuses, plugs, holders, switch with push button switch, buzzer should be replaced.	- Introduction of one bulb control by one way switch with push button switch control by buzzer.

Safety Precautions:

- Handle all electrical apparatus and equipment carefully.
- Replace broken switches and plugs immediately as and when seen.
- Never pulls the flexible cable or wire to disconnect the plug.
- Never place bare wire seen on plugs and sockets.

Duty:5: REPAIR MOTOR CONTROL AND INSTALLATION SYSTEM

5.1 Connect direct on line starter (DOL).

Time: 6.0 hrs.
Exercise: 4.0 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instruction plan, control and power diagram. 2. Obtain electrical accessories as per diagram. 3. Mark on the board as per plan diagram. 4. Prepare the auxiliary accessories as per diagram measurement. 5. Install the auxiliary accessories on the board. 6. Lay wire according to the control and power diagram. 7. Connect all electrical accessories according to the control and power diagram. 8. Re-check all control and power circuit. 9. Clean and store the electrical instrument used in safe and sound place.	**Condition :** Fully equipped Electrical workshop with line starter (DOL) and Multi meter. **Task :** • Connect direct on line starter (DOL). **Standards:** • DOL should be connected as per drawing.	- Introduction of direct on line starter. - Introduction of 3 phase supply system.

Safety Precautions:

- Handle all electrical apparatus and equipment carefully.
- Replace broken switches and plugs immediately as and when seen.
- Never pulls the flexible cable or wire to disconnect the plug.
- Never place bare wire seen on plugs and sockets.

Duty:5: PERFORM MOTOR CONTROL AND INSTALLATION SYSTEM

5.2 Connect forward/reverse motor control.

Time: 6.0 hrs.
Exercise: 4.0 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instruction plan, control and power diagram. 2. Obtain electrical accessories as per diagram. 3. Mark on the board as per plan diagram. 4. Prepare the auxiliary accessories as per diagram measurement. 5. Install the auxiliary accessories on the board. 6. Lay wire according to the control and power diagram. 7. Connect all electrical accessories according to the control and power diagram. 8. Re-check all control and power circuit. 9. Clean and store the electrical instrument used in safe and sound place.	**Condition :** Fully equipped Electrical workshop with forward / reverse motor control and Multi meter. **Task :** • Connect forward/reverse motor control. **Standards:** • Forward / reverse motor control should be connected as per drawing.	- Introduction of forward / reverse motor starter. - Different type of motor starter.

Safety Precautions:

- Handle all electrical apparatus and equipment carefully.
- Replace broken switches and plugs immediately as and when seen.
- Never pulls the flexible cable or wire to disconnect the plug.
- Never place bare wire seen on plugs and sockets.

Duty:5: PERFORM PROJECT WORK OF ELECTRICAL REPAIR

Time: 32.0 hrs.
Exercise: 32.0 hrs
Demo: 0.0 hrs

5.3 Project work of electrical repair.

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instruction plan, control and power diagram. 2. Obtain electrical hand tools as required. 3. Find / diagnose faults. 4. Switch off the main connection. 5. Replace and connect the accessories. 6. Check the faults repairs. 7. Switch on the main connection. 8. Re-check all control and power circuit. 9. Clean and store the electrical instrument used in safe and sound place.	**Condition :** Fully equipped Electrical plant machines. **Task :** • Project work of electrical repair. **Standards:** • Electrical connections of plant machines should be repaired.	- Introduction of forward / reverse motor starter. - Different type of motor starter.

Safety Precautions:

- Handle all electrical apparatus and equipment carefully.
- Replace broken switches and plugs immediately as and when seen.
- Never pulls the flexible cable or wire to disconnect the plug.
- Never place bare wire seen on plugs and sockets.

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Structural Fabrication

Total: 195 hrs
Class/week: 5 hrs

S. No.	Duties and Tasks	Time (hrs.)	
A.	**Steel Fabrication**	**Demo**	**Practical**
1	**Prepare material**		
1.1	Perform Sawing	-	2
1.2	Cuts the material by Oxy acetylene gas cutting	1	3
1.3	Perform off hand grinding	-	2
2	**Perform forming a steel**	-	
2.1	Perform Bending	1	3
2.2	Perform Twisting	1	2
2.3	Perform Forging	1	4
3	**Prepare Jigs and Fixture**		
3.1	Prepare drill jigs	2	22
3.2	Prepare welding fixture	2	18
4	**Finish the Assembly Structure**	-	
4.1	Clean with emery	1	2
4.2	Clean with surface grinding	1	4
4.3	Clean with wire/emery wheel	1	2
5	**Perform Painting**		
5.1	Perform enamel coating by brush painting	-	2
5.2	Perform spray painting	1	3
6	**Project Work**	-	36
6.1	Fabricate a windows grill	-	
6.2	Fabricate a helical fixed stair	-	
6.3	Fabricate a collapsible gate	-	
	Sub Total	***12***	***105***
	Total	***117***	
B.	**Aluminium Fabrication**		
1	**Perform Bench work on Aluminum profile**		**24**
1.1	Perform cutting		
1.2	Perform drilling		
1.3	Perform filling		
1.4	Perform punching		
1.5	Perform screwing		
1.6	Perform riveting		
2	**Fabricate windows**	-	
2.1	Fabricate casement windows panel	1	5
2.2	Fabricate multi panel sliding windows frame	1	5
3	**Fabricate doors**		
3.1	Fabricate flush door panel	1	5
3.2	Fabricate swing door panel	1	5
3.3	Fabricate glass door panel	1	5
4	**Fix partition**	-	
4.1	Fix half partition	1	5
4.2	Fix partition of casement section	1	5

4.3	Fix partition with sliding door	1	5
5	**Finish the fabricate members**		
5.1	Perform glass /board fitting	0.5	1
5.2	Perform clipping	0.5	1
5.3	Perform press gasket	0.5	1
5.4	Perform silicon filling	0.5	1
	Sub Total	***10***	***68***
	Total	***78***	
	Total (A + B)	***117 + 78 =195***	

Task Analysis

Duty:1: PREPARE MATERIAL

1.1. Saw the Metal by Hacksaw.

Time: 2 hrs.
Exercise: 2 hrs
Demo: 0.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain work-piece material. 2. Obtain Steel scale. 3. Obtain Marking scriber. 4. Obtain center punch, Hammer. 5. Obtain Hand hacksaw frame with blade. 6. Mark the symmetrically lines. 7. Punch dotted on marked line. 8. Clamp the work-piece so that the marked line must be outside from the vice. 9. Check the blade. 10. Set up the blade on the hacksaw frame. 11.Take a small triangular file, 12. Mark a small vee notch at starting point. 13. Hold hacksaw frame as for the rough file. 14. Start cutting slowly moving the blade forward. 15.Apply pressure only during the forward stroke 16. Return the blade faster without touching blade. 17. Repeat the same motion to complete the stroke as for filling. 18. Check the cutting ways that goes straight down. 19. Move slows down while finishing a cut. 20. Check the part that has sawed.	**Condition :** Fully equipped fitting workshop / Tool room with Hand hacksaw frame, Blade and bench vice. **Tasks :** Saw the metal by Hacksaw. **Standards:** - Set blades on Hacksaw frame. - Apply 'V' notch. - Apply reciprocating motion to complete the cutting stroke. - Cut cutting straight down. - Follow safety precaution.	- Introduction of Hacksaw & blade - Types of hacksaw and blade - Holding different sections of work-piece for hack sawing. - Procedure of sawing the metal by hand.

Safety Precautions :

- Hold the job so as to be cut on the flat side rather than the edge or the corner.
- The teeth of the hacksaw blade should point in the direction of the cut and away from the handle.
- The cutting movement should be steady and the full length of the blade should be used.
- At least two to three teeth should be in contact with the work while cutting.
- Avoid moving the blade too fast, while finishing a cut, slow down.
- Avoid clamping the work-piece over hang.

Duty:1: PREPARE MATERIAL

1.2 Cut the material by Oxy-acetylene gas equipment.

Time: 4 hrs.
Exercise: 3 hrs
Demo: 1 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain a workpiece material (MS Plate) 2. Set up all gas welding equipment. 3. Place the plate on the cutting table in such a way that the place to be cut comes over the hole or slot in the cutting table 4. Mark a chalk line about ¾" from one edge of the plate. 5. Select and set up the correct nozzle for the thickness of the metal to be cut. 6. Light the torch, adjust preheated flame. 7. Observe the nature of the cutting flame by pressing down the oxygen control lever. The valve is operated either with the thumb or forefinger. 8. Adjust the flame if necessary to keep the preheating cones burning with a neutral flame. 9. Bring the preheated flame on the edge to be cut & heat edge to cherry – red. 10. Press down the oxygen pressure lever. 11. Move the torch forward slowly along the chalk line. A shower of sparks will be seen to fall from the underside, indicating that the penetration is complete and the cut is proceeding correctly. 12. Reheat from the beginning if the cut does not seem to go through the metal. 13. Blow with hammer to separate the two sections.	**Condition :** Fully equipped workshop with Gas welding equipments with Flame cutting nozzle. **Tasks :** Cuts the material by Oxy-Acetylene gas equipment. **Standards:** - Set up the gases and welding nozzle for flame cutting - Cut the MS material in any profile.	- Introduction of oxy-acetylene - Oxy-acetylee equipments - Process of Flame cutting by gas welding equipment. - Safety precautions

Safety Precautions :

- Wear safety apparels safety goggles, safety gloves, Safety helmet.
- Place apiece of steel close to the line of cut to slide the torch along.
- If the edges of the cut appear to melt and have a very ragged appearance, the metal is not burning through and torch is being moved too slowly.
- When an exceptionally straight cut is desired, clamp a bar across the plate alongside the cutting line to act as a guide for the torch to follow.

Duty:1: PREPARE MATERIAL

1.3. Perform Off hand grinding.

Time: 2 hrs.
Exercise: 2 hrs
Demo: 0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instruction. 2. Obtain pre-welded workpiece material. 3. Obtain accessories and tools required. 4. Set the workpiece. 5. Wear safety equipments. 6. Connect electrical line to machine. 7. Start grinding from end of the beads. 8. Make clear surface grinding all welding spots. 9. Hold workpiece material into vice. 10. Grind 45 degree on all surface corners. 11. Check the angle and even surface. 12. Grind to confirm even surface.	**Condition :** Fully equipped workshop with Arc welding transformer and Hand vice and Hand surface grinder. **Task :** Perform Off hand grinding. **Standards:** - Prepared the edges for groove weld. - Chamfered the burrs. - Grinded the welding beads to prepare re weld.	- Introduction - Types of offhand grinding machine - Types of grinding wheel

Safety Precautions :

- Avoid using Welding holder with broken handle.
- Always use Chipping hammer and Wire brush to clean up the welding slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.

Duty :2: PERFORM COLD FORMING THE MATERIALS

2.1. Perform Bending manually.

Time: 4.0 hrs.
Exercise: 3.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instructional drawing. 2. Obtain prepared work-piece material. 3. Mark layout line on the work-piece. 4. Confirm the process of bending. 5. Hold the work-piece manually placing on the anvil. 6. Hold a steel hammer on other hand. 7. Strike on marked line. 8. Repeat striking both side of the mark line simultaneously. 9. Check the radius of the bend at finishing curve. 10. Continue striking until the curve shaped as per drawing read. 11. Align the level of the curve and rest of the part.	**Condition :** Fully equipped workshop with Hot and cold forging work facilities. **Tasks :** Perform Bending manually. **Standards:** - Radius of bending should be as specied.	• Introduction of bending. • Types of bending. • Equipments and tools of bending. • Process of bending manually.

Safety Precautions :

- Never use broken or loose handle fitted hammer.
- Use safety gloves.
- Perform hot work far as possible.
- Never beaten on top of the vice or any clamping devices.

Duty :2: PERFORM COLD FORMING THE MATERIALS

2.2. Perform Twisting manually.

Time: 3.0 hrs.
Exercise: 2.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instructional drawing. 2. Obtain prepared work-piece material. 3. Mark layout line on the work-piece. 4. Confirm the process of twisting. 5. Clamp one end of work piece in vice and hold the work-piece manually. 6. Insert and clamp other end tap handle. 7. Start twisting turning clock wise or counter clockwise. 8. Turn the handle to the number of your requirement. 9. Align the level of the curve and rest of the part.	**Condition :** Fully equipped workshop with Hot and cold forging work facilities. **Tasks :** Perform Twisting manually. **Standards:** - Level shoud be alligned.	• Introduction of Twisting. • Types of Twists. • Equipments and tools of Twisting. • Process of twisting manually.

Safety Precautions :

- Never use broken or loose handle fitted tap handle.
- Use safety gloves.
- Perform hot work far as possible.
- Never beaten on top of the vice or any clamping devices.

Duty :2: PERFORM COLD FORMING THE MATERIALS

2.3. Perform Forging manually.

Time: 5.0 hrs.
Exercise: 4.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instructional drawing. 2. Obtain layout or marked work-piece material. 3. Confirm the process of Forging. 4. Obtain the machine or tools equipments to forge the material. 5. Hold with tongs keeping the material on top of the anvil as per layout. 6. Hammer on the work piece so that the material change into the shape as required. 7. Use performed blocks if necessary. 8. Check the angle and shape. 9. Repeat the same process for another side of folding. 10. Align the level of the curve and rest of the part.	**Condition :** Fully equipped workshop with Hot and cold forging tools and Blacksmiths fire facilities. **Tasks :** Perform Forging manually. **Standards:** - Forged shuface should be smooth. - Dimension of workpiece should be as per drawing.	• Introduction of Forging. • Types of forging operations. • Equipments and tools for forging. • Process of forging manually.

Safety Precautions :

- Do not use broken handled hammer.
- Use safety gloves, helmet and goggles.
- Deburr every corner and edges before holding by hand.
- Use gauges instead of measuring instruments to check the forge dimensions.
- Use some pre formed blocks for ease shaping the parts.

Duty :4: PREPARE JIGS AND FIXTURE

4.1. Prepare Drill Jigs.

Time: 24 hrs.
Exercise: 22 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain details of instructional Drill Jigs drawing. 2. Prepare work-piece materials. 3. Confirm the process of fabrications. 4. Obtain the machine or tools equipments to fabricate the materials. 5. Perform welding joints, drilling, taping, and other fitting works. 6. Perform assembly works required as design. 7. Check the dimensions 8. Take trail performance. 9. Check the center distance of drilling dimensions. 10. Make corrections if necessary. 11. Complete the jigs fabrication. 12. Store it in safe and special place.	**Condition :** Fully equipped workshop with Bench work, Drilling machine and welding facilities. **Tasks :** Prepare Drill Jigs. **Standards:** - Drill jigs should be as per drawing. - Center distance of drilling dimension should be match with given drawing.	• Introduction of Drill Jigs. • Advantage of using Drill Jigs. • Types of Drill Jigs. • Designing concept of drill jigs.

Safety Precautions :

- Use safety gloves, helmet and goggles.
- Follow the safety of Prepare materials.
- Follow the safety of Welding.
- Follow the safety of Bench work.

Duty:4 : PREPARE JIGS AND FIXTURE

4.2. Prepare Welding Fixtures.

Time: 20 hrs.
Exercise: 18 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain details of instructional welding fixture's drawing. 2. Prepare work-piece materials. 3. Confirm the process of fabrications. 4. Obtain the machine or tools equipments to fabricate the materials. 5. Perform welding joints, drilling, taping, and other fitting works. 6. Perform assembly works required as design. 7. Check the dimensions 8. Take trail performance. 9. Make corrections if necessary. 10. Complete the Welding fixture fabrication. 11. Store it in safe and special place.	**Condition :** Fully equipped workshop with Bench work, Drilling machine and welding facilities. **Tasks :** Prepare Welding fixtures. **Standards:** - Dimension should be as per drawing. - Allembled as per drawings.	• Introduction of welding fixtures. • Advantage of using Fixtures. • Types of Welding Fixtures. • Designing concept of Welding fixtures.

Safety Precautions :

- Use safety gloves, helmet and goggles.
- Follow the safety of Prepare materials.
- Follow the safety of Welding.
- Follow the safety of Bench work.

Duty :5: FINISH THE STRUCTURE

5.1. Emery the surface.

Time: 3.0 hrs.
Exercise: 2.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain pre – fabricated structures. 2. Obtain instructions. 3. Chips off the surfaces by chisels or chipping hammer. 4. Cut and fold emery as required size. 5. Rub the surfaces repeatedly until the surface free from oxides. 6. Clean the rub surfaces by brush.	**Condition :** Fully equipped workshop with Bench work, Drilling machine welding machine and Denting Painting facilities. **Tasks :** Emery the surface. **Standards:** - Rusted surfaces of the structural fabrication work should be cleaned. - Oiled surfaces should be cleaned. - The steel fabrication is protected from corrosion	- Introduction of emery - Types of emery - Grade of emery

Safety Precautions :

- Use safety gloves.
- Use chipping hammer to clean the welding spatters and welding beads.
- Follow the safety of Prepare materials.
- Follow the safety of Welding.
- Follow the safety of Bench work.

Duty :5: FINISH THE STRUCTURE

5.2. Grind the surface.

Time: 5.0 hrs.
Exercise: 4.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain pre – fabricated structures. 2. Obtain instructions. 3. Chips off the surfaces by chisels or chipping hammer. 4. Set the grinding machine with flexible abrasive wheel as required size. 5. Grind the surfaces repeatedly until the surface free from oxides. 6. Clean the rub surfaces by brush.	**Condition :** Fully equipped workshop with Bench work, Drilling machine welding machine and Denting Painting facilities. **Tasks :** Grind the surface. **Standards:** - Surface should be smooth.	- Introduction - Grinding types - Types of grinding machine - Types of wheel

Safety Precautions :

- Wear safety gloves, safety goggles and safety helmet
- Use chipping hammer to clean the welding spatters and welding beads.
- Follow the safety of Prepare materials.
- Follow the safety of Welding.
- Follow the safety of Bench work.

Duty :5: FINISH THE STRUCTURE

5.3. Clean the surface by wire/emery wheel

Time: 3.0 hrs.
Exercise: 2.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain pre – fabricated structures. 2. Obtain instructions. 3. Chips off the surfaces by chisels or chipping hammer. 4. Set the Hand grinding machine with Cup / disc wire wheel as required size. 5. Perform as grinding task to clean surfaces. 6. Repeat until the surface free from oxides. 7. Clean the rub surfaces by brush.	**Condition :** Fully equipped workshop with Bench work, Drilling machine welding machine and Denting Painting facilities. **Tasks :** Clean the surface by wire wheel. **Standards:** - Rusted surfaces of the structural fabrication work should be cleaned. - Oiled surfaces should be cleaned. - Protected the steel fabrication from corrosion.	- Introduction - Types of emery wheel

Safety Precautions :

- Wear safety gloves, safety goggles and safety helmet.
- Use chipping hammer to clean the welding spatters and welding beads.
- Follow the safety of Prepare materials.
- Follow the safety of Welding.
- Follow the safety of Bench work.

Duty:6 : PERFORM THE PAINTING

6.1. Paint enamel coating by brush.

Time: 2.0 hrs.
Exercise: 2.0 hrs
Demo: 0.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain pre-primer coated fabricated structures. 2. Obtain instructions. 3. Obtain desired color enamel paint, painting brush, flat screw driver, kerosene oil, cotton waste, gloves and turpentine oil. 4. Open the lid of enamel paint. 5. Stir the paint thoroughly to mix uniformly. 6. Add turpentine oil to thinner the paint as required. 7. Dip the brush and side splash to control over flow. 8. Brush the surface up and down ward from the left upward corner. 9. Continue the brushing from the end of the painting enamel until finish the complete structure. 10. Clean up the brush with kerosene oil. 11. Cover the lid tightly and store in safe place.	**Condition :** Fully equipped workshop with Bench work, Drilling machine welding machine and Denting Painting facilities. **Tasks :** Paint enamel coating by brush **Standards:** - Painted surface should be smooth. - Cleaned the painting area or zone.	- Introduction of paint/enamel - Types of paints - Function of turpentine

Safety Precautions :

- Wear safety gloves, safety goggles and safety helmet.
- Clean the over floated paints on surface or painting zone.
- Use flat screw driver or iron rod to stir the paint.

Duty:7 : PERFORM THE PAINTING

7.1. Spray enamel coating.

Time: 4.0 hrs.
Exercise: 3.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain pre-primer coated fabricated structures. 2. Obtain instructions. 3. Obtain desired color enamel paint, flat screw driver, kerosene oil, cotton waste, gloves, painting mask and turpentine oil. 4. Obtain the Air compressor with set of spray painting gun. 5. Clean the spray paining gun with kerosene oil. 6. Check the condition of air compressor and pressure of air filled. 7. Open the lid of enamel paint. 8. Stir the paint thoroughly to mix uniformly. 9. Add turpentine oil to thinner the paint as required. 10. Dip the brush and side splash to control over flow. 11. Brush the surface up and down ward from the left upward corner. 12. Continue the brushing from the end of the painting enamel until finish the complete structure. 13. Clean up the brush with kerosene oil. 14. Cover the lid tightly and store in safe place.	**Condition :** Fully equipped workshop with Bench work Denting Painting and Air compressor with set of Spray painting facilities. **Tasks :** Spray enamel coating. **Standards:** - Sprayed enamel coating should be smooth. - Cleaned the painting area or zone.	• Introduction of spray painting. • Handling of machine equipments for spray painting • Methods of spray painting.

Safety Precautions :

- Wear safety gloves, safety goggles, painting mask and safety helmet.
- Clean the over floated paints on surface or painting zone.
- Use flat screw driver or iron rod to stir the paint.
- Check the gun nozzle before filling the enamel on spray gun.
- Use hanger to paint for small parts.
- Make protector guard in sides and rear of the sprayer platform.
- Avoid over spray on same surface.
- Use light emery after 1st coat then spray 2nd coat.

Duty:8 : FABRICATE PROJECT STRUCTURES

8.1. Fabricate windows grills

Time: 7.0 hrs.
Exercise: 6.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain details of instructional Grill drawing. 2. Prepare work-piece materials. 3. Prepare re-formed designed materials 4. Obtain the machine or tools equipments to fabricate the materials. 5. Perform drilling on required size. 6. Perform assembly works tacking welding joints as design. 7. Check the dimensions 8. Weld full tacks welding. 9. Make 1st set as fixture for next set of assembly. 10. Store it in safe and special place.	**Condition :** Fully equipped workshop with Bench work, Drilling machine Grinding machine and welding facilities. **Tasks :** Fabricate grills **Standards:** - The outer dimension of grill should be match with given drawing. - Design should be match as per drawing.	• Calulation for cutting length of metal for grill • Design of grill

Safety Precautions :

- Use safety gloves, helmet and goggles.
- Follow the safety of Prepare materials.
- Follow the safety of Welding.
- Follow the safety of Bench work.

Duty:8 : FABRICATE PROJECT STRUCTURES

8.2. Fabricate Helical fixed stair

Time: 11 hrs.
Exercise: 10 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain details of instructional Helical Fixed stair drawing. 2. Prepare work-piece materials. 3. Prepare re-formed designed materials 4. Obtain the machine or tools equipments to fabricate the materials. 5. Perform drilling on required size. 6. Perform assembly works tacking welding joints as design. 7. Check the dimensions 8. Perform full welding. 9. Store it in safe and special place.	**Condition :** Fully equipped workshop with Bench work, Drilling machine Grinding machine and welding facilities. **Tasks :** Fabricate Helical Fixed stair **Standards:** - Dimension of stair shouldbe match with given drawing.	• Designing of Helical Fixed stair • Fabrication of Helical Fixed stair.

Safety Precautions :

- Use safety gloves, helmet and goggles.
- Follow the safety of Prepare materials.
- Follow the safety of Welding.
- Follow the safety of Bench work.

Duty:8 : FABRICATE PROJECT STRUCTURES

8.3. Fabricate Collapsible gate.

Time: 18 hrs.
Exercise: 18 hrs
Demo: 0.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain details of instructional Collapsible gate drawing. 2. Prepare work-piece materials. 3. Prepare re-formed designed materials 4. Obtain the machine or tools equipments to fabricate the materials. 5. Perform drilling on required size. 6. Perform assembly works riveting on joints as design. 7. Check the dimensions. 8. Store it in safe and special place.	**Condition :** Fully equipped workshop with Bench work, Drilling machine Grinding machine and welding facilities. **Tasks :** Fabricate Collapsible gate. **Standards:** - Dimension of gate should be match with given drawing.	• Designing of Collapsible gate. • Fabrication of Collapsible gate

Safety Precautions :

- Use safety gloves, helmet and goggles.
- Follow the safety of Prepare materials.
- Follow the safety of Welding.
- Follow the safety of Bench work.

Task Analysis

Aluminum Fabrication

Duty:1: PERFORM BENCH WORK ON ALUMINIUM PROFILE

1.1. Perform cutting by Hacksaw.

Time: 2 hrs.
Exercise: 2 hrs
Demo: 0.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain work-piece material. 2. Obtain Steel scale. 3. Obtain Marking scriber. 4. Line up the mark on as dimension given 5. Obtain center punch, Hammer. 6. Obtain Hand hacksaw frame with blade. 7. Mark the symmetrically lines. 8. Punch dotted on marked line. 9. Clamp the work-piece so that the marked line must be outside from the vice. 10. Check the blade. 11. Set up the blade on the hacksaw frame. 12. 11.Take a small triangular file, 13. Mark a small vee notch at starting point. 14. Hold hacksaw frame as for the rough file. 15. Start cutting slowly moving the blade forward. 16. 15.Apply pressure only during the forward stroke 17. Return the blade faster without touching blade. 18. Repeat the same motion to complete the stroke as for filling. 19. Check the cutting ways that goes straight down. 20. Move slows down while finishing a cut. 21. 20. Check the part that has sawed.	**Condition :** Fully equipped fitting workshop / Tool room with Hand hacksaw frame, Blade and bench vice. **Tasks :** Perform cutting by Hacksaw. **Standards:** - Holds panels securely. - Cutting line is straight. - Cutting dimension is checked as per given drawing.	- Holding different sections of work-piece for hack sawing. - Hack saw blade

Safety Precautions :

- Hold the job so as to be cut on the flat side rather than the edge or the corner.
- The teeth of the hacksaw blade should point in the direction of the cut and away from the handle.
- The cutting movement should be steady and the full length of the blade should be used.
- At least two to three teeth should be in contact with the work while cutting.
- Avoid moving the blade too fast, while finishing a cut, slow down.
- Avoid clamping the work-piece over hang.

Duty:1: PERFORM BENCH WORK ON ALUMINIUM PROFILE

1.2 Perform drilling

Time: 4 hrs.
Exercise: 3 hrs
Demo: 1 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain a workpiece material 2. Obtain center punch, Hammer. 3. Obtain drawing. 4. Mark the symmetrically lines. 5. Punch dot on marked line. 6. Change the drill bit as required. 7. Select and set up the RPM. 8. Place the panel on the drill vice in such a way that the dot marked should be in spindle center. 9. Switch on the machine and start pressing till drill hole through. 10. Switch off the machine and change countersink on chuck. 11. Switch on the machine and start pressing till burrs removed from drill hole. 12. Repeat it on other side of the hole. 13. Remove job material and countersink. 14. Clean the machine table 15. Restore all tools and equipments.	**Condition :** Fully equipped workshop with Drilling machine and drill bits. **Tasks :** Perform drilling. **Standards:** - Hold section panel without damaging the section panel. - Drill hole is circular and as given Dimension.	- Introduction - Drill bit - Types of drill bit - Types of drill machine - Drilling speed - RPM selection

Safety Precautions :

- Wear safety apparels safety goggles, safety gloves, Safety helmet.
- Secure vice on machine table with nut and bolts.
- Frequent apply of coolant.
- Maintain the RPM of the machine spindle.

Duty:1: PERFORM BENCH WORK ON ALUMINIUM PROFILE

1.3. Perform filling.

Time: 2 hrs.
Exercise: 2 hrs
Demo: 0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instruction. 2. Obtain workpiece material. 3. Obtain tools required. 4. Set the workpiece. 5. Wear safety equipments. 6. Hold file. 7. Start filing. 8. Make sure the surface is even & and straight. 9. Deburr the edges. 10. Remove the workpiece from clamping. 11. Clean all area 12. Restore all tools equipments.	**Condition :** Fully equipped workshop with set of files and Bench vice. **Task :** Perform filling. **Standards:** - Clamped the section panel without damage. - Filing surface is even. Filined wirk piece should be match with given drawing.	- Introduction - Types of file - Filing procedure

Safety Precautions :

- Avoid using file with broken handle.
- Always clamp the workpiece on vice securely.
- Never beaten on top of the vice or any clamping devices.

Duty :1: PERFORM BENCH WORK ON ALUMINIUM PROFILE

1.4. Perform Punching.

Time: 4.0 hrs.
Exercise: 3.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instructional drawing. 2. Obtain prepared work-piece material. 3. Mark layout line on the work-piece. 4. Confirm the process of punching. 5. Hold the work-piece manually. 6. Hold a steel hammer on other hand and strike on marked line.	**Condition :** Fully equipped workshop with punches and hammers facilities. **Tasks :** Perform Punching. **Standards:** - Punch is marked on as layout.	- Introduction - Types of punch

Safety Precautions :

- Never use broken or loose handle fitted hammer.
- Use safety gloves.

Duty :1: PERFORM BENCH WORK ON ALUMINIUM PROFILE

1.5. Perform Screwing.

Time: 3.0 hrs.
Exercise: 2.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instructional drawing. 2. Obtain prepared work-piece material. 3. Hold both workpiece together securely. 4. Insert a tip of screw on hole and screw driving on its head. 5. Make full tightening	**Condition :** Fully equipped workshop with Bench work tools facilities. **Tasks :** Perform screwing. **Standards:** - Screw in on as dimension. - Screw is straight and insert full.	• Introduction of screws. • Types and application of screws.

Safety Precautions :

- Never use broken or loose handle fitted on screwdriver.
- Use safety gloves.
- Never beaten on top of the handle.

Duty :1: PERFORM BENCH WORK ON ALUMINIUM PROFILE

1.6. Perform Riveting

Time: 5.0 hrs.
Exercise: 4.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instructional drawing. 2. Obtain layout or marked work-piece material 3. Clamp both workpiece together 4. Drill a hole according to the size of rivet diameter. 5. Obtain pop riveting machine and insert the nozzle as rivet size. 6. Insert a rivet on hole and other end to riveting machine. 7. Clamp it fully till the rivet broke down. 8. Checked the joint 9. Repeat it till the joint is complete	**Condition :** Fully equipped workshop with rivets and riveting tools facilities. **Tasks :** Perform riveting. **Standards:** - Rivets are on as dimension. - Joint is securely hold.	• Introduction of Rivets. • Types of Rivets. • Fundamental of riveting.

Safety Precautions :

- Do not use broken handled hammer.
- Use safety gloves, helmet and goggles.
- Maintain the length of the rivet as per the thickness of the work.

Duty :2: FABRICATE WINDOWS

2.1. Fabricate casement windows panel.

Time: 6 hrs.
Exercise: 5 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain details of instructional drawing. 2. Prepare work-piece materials. 3. Confirm the process of fabrication. 4. Obtain the machine or tools equipments to fabricate the materials. 5. Perform benchworks, cutting , drilling, and punching. 6. Perform assembly works required as design. 7. Check the dimensions. 8. Store it in safe and special place.	**Condition :** Fully equipped workshop with hand tools and punches and punching facilities. **Tasks :** Fabricate casement windows panel. **Standards:** - Joints are fixed. - Casement window is as per design in drawing sheet.	• Introduction of aluminium. • Different sections and profiles of panel member.

Safety Precautions :

- Use safety gloves, helmet and goggles.
- Follow the safety of Prepare materials.
- Follow the safety of Bench work.

Duty:2 : FABRICATE WINDOWS

2.2. Fabricate multi panel sliding windows frame

Time: 6 hrs.
Exercise: 5 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain details of instructional drawing. 2. Prepare work-piece materials. 3. Confirm the process of fabrication. 4. Obtain the machine or tools equipments to fabricate the materials. 5. Perform benchworks, cutting , drilling, and punching. 6. Perform assembly works required as design. 7. Check the dimensions. 8. Store it in safe and special place.	**Condition :** Fully equipped workshop with hand tools and punches and punching facilities. **Tasks :** Fabricate multi panel sliding windows frame. **Standards:** - Joints are fixed. - Multi panel sliding window is as per design in drawing sheet.	• Designs of casement windows panel. • Designs of multi panel sliding windows frame.

Safety Precautions :

- Use safety gloves, helmet and goggles.
- Follow the safety of Prepare materials.
- Follow the safety of Bench work.

Duty :3: FABRICATE DOORS

3.1. Fabricate flush door panel

Time: 6.0 hrs.
Exercise: 5.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain details of instructional drawing. 2. Prepare work-piece materials. 3. Confirm the process of fabrication. 4. Obtain the machine or tools equipments to fabricate the materials. 5. Perform benchworks, cutting , drilling, and punching. 6. Perform assembly works required as design. 7. Check the dimensions. 8. Store it in safe and special place.	**Condition :** Fully equipped workshop with hand tools and punches and punching facilities. **Tasks :** Fabricate flush door panel. **Standards:** - Joints are fixed. - Flush door is as per design in drawing sheet.	• Types of door • Design of flush door panel

Safety Precautions :

- Use safety gloves, helmet and goggles.
- Follow the safety of Prepare materials.
- Follow the safety of Bench work.

Duty :3: FABRICATE DOORS

3.2. Fabricate swing door panel.

Time: 6.0 hrs.
Exercise: 5.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain details of instructional drawing. 2. Prepare work-piece materials. 3. Confirm the process of fabrication. 4. Obtain the machine or tools equipments to fabricate the materials. 5. Perform benchworks, cutting , drilling, and punching. 6. Perform assembly works required as design. 7. Check the dimensions. 8. Store it in safe and special place.	**Condition :** Fully equipped workshop with hand tools and punches and punching facilities. **Tasks :** Fabricate swing door panel. **Standards:** - Joints are fixed. - Swing door is as per design in drawing sheet.	• Introduction of door • Types of panel • Design of swing door panel

Safety Precautions :

- Use safety gloves, helmet and goggles.
- Follow the safety of Prepare materials.
- Follow the safety of Bench work.

Duty :3: FABRICATE DOORS

3.3. Fabricate glass door panel

Time: 6.0 hrs.
Exercise: 5.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain details of instructional drawing. 2. Prepare work-piece materials. 3. Confirm the process of fabrication. 4. Obtain the machine or tools equipments to fabricate the materials. 5. Perform benchworks, cutting , drilling, and punching. 6. Perform assembly works required as design. 7. Check the dimensions. 8. Store it in safe and special place.	**Condition :** Fully equipped workshop with hand tools and punches and punching facilities. **Tasks :** Fabricate glass door panel. **Standards:** - Joints are fixed. - Glass door is checked as per design in drawing sheet.	• Material used in windows panel • Types of glass used in door panel • Design of glass door panel

Safety Precautions :

- Use safety gloves, helmet and goggles.
- Follow the safety of Prepare materials.
- Follow the safety of Bench work.

Duty:4 : FIX PARTITION

4.1. Fix half partition.

Time: 6.0 hrs.
Exercise: 5.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain details of instructional drawing. 2. Prepare work-piece materials. 3. Confirm the process of fabrication. 4. Obtain the machine or tools equipments to fabricate the materials. 5. Perform benchworks, cutting , drilling, and punching. 6. Perform assembly works required as design. 7. Check the dimensions. 8. Store it in safe and special place.	**Condition :** Fully equipped workshop with hand tools and punches and punching facilities. **Tasks :** Fix half partition. **Standards:** - Joints are fixed. - Fixed half partition is checked as per design in drawing sheet.	• Introduction of partition. • Concepts

Safety Precautions :

- Use safety gloves, helmet and goggles.
- Follow the safety of Prepare materials.
- Follow the safety of Bench work.

Duty:4 : FIX PARTITION

4.2. Fix partition of casement section.

Time: 6.0 hrs.
Exercise: 5.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain details of instructional drawing. 2. Prepare work-piece materials. 3. Confirm the process of fabrication. 4. Obtain the machine or tools equipments to fabricate the materials. 5. Perform benchworks, cutting , drilling, and punching. 6. Perform assembly works required as design. 7. Check the dimensions. 8. Store it in safe and special place.	**Condition :** Fully equipped workshop with hand tools and punches and punching facilities. . **Tasks :** Fix partition of casement section. **Standards:** - Joints are fixed. - Fixed partition of casement is checked as per design in drawing sheet.	• Introduction of casement • Design of casement section partition

Safety Precautions :

- Use safety gloves, helmet and goggles.
- Follow the safety of Prepare materials.
- Follow the safety of Bench work.

Duty:4 : FABRICATE PROJECT STRUCTURES

4.3. Fix partition with sliding door

Time: 6.0 hrs.
Exercise: 5.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain details of instructional drawing. 2. Prepare work-piece materials. 3. Confirm the process of fabrication. 4. Obtain the machine or tools equipments to fabricate the materials. 5. Perform benchworks, cutting , drilling, and punching. 6. Perform assembly works required as design. 7. Check the dimensions. 8. Store it in safe and special place.	**Condition :** Fully equipped workshop with hand tools and punches and punching facilities. **Tasks :** Fix partition with sliding door. **Standards:** - Joints are fixed. - Fixed partition with sliding door is checked as per design in drawing sheet.	• Types of door • Advantages and diadvantages of sliding door.

Safety Precautions :

- Use safety gloves, helmet and goggles.
- Follow the safety of Prepare materials.
- Follow the safety of Bench work.

Duty:5 : FINISH THE FABRICATE MEMBERS

5.1. Perform glass/board fitting

Time: 1.5 hrs.
Exercise: 1 hrs
Demo: 0.5 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain details of instructional drawing. 2. Prepare work-piece materials. 3. Confirm the process of fitting. 4. Obtain the machine or tools equipments to fabricate the materials. 5. Perform benchworks, cutting , drilling, and punching. 6. Perform assembly works fitting glass / board as required as design. 7. Check the dimensions. 8. Store it in safe and special place.	**Condition :** Fully equipped workshop with hand tools and punches and punching facilities. **Tasks :** Perform glass/board fitting. **Standards:** - Glass / Board fitting is rigid. - Glass /Board fitting is checked as per design in drawing sheet.	• Finish the fabricate members. • Design of glass/board fittings.

Safety Precautions :

- Use safety gloves, helmet and goggles.
- Follow the safety of Prepare materials.
- Follow the safety of Bench work.

Duty:5 : FINISH THE FABRICATE MEMBERS

5.2. Perform clipping.

Time: 1.5 hrs.
Exercise: 1 hrs
Demo: 0.5 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain details of instructional drawing. 2. Prepare work-piece materials. 3. Confirm the process of fitting. 4. Obtain the machine or tools equipments to fabricate the materials. 5. Perform benchworks, cutting , drilling, and punching. 6. Perform assembly works clipping as required as design. 7. Check the dimensions. 8. Store it in safe and special place.	**Condition :** Fully equipped workshop with hand tools and punches and punching facilities. **Tasks :** Perform clipping. **Standards:** - Clipping on the panel is rigid. - Clipping is checked as per design in drawing sheet.	• Introduction and purpose of clipping.

Safety Precautions :

- Use safety gloves, helmet and goggles.
- Follow the safety of Prepare materials.
- Follow the safety of Bench work.

Duty:5 : FINISH THE FABRICATE MEMBERS

5.3. Perform gasket pressing.

Time: 1.5 hrs.
Exercise: 1 hrs
Demo: 0.5 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain details of instructional drawing. 2. Prepare work-piece materials. 3. Confirm the process of fitting. 4. Obtain the machine or tools equipments to fabricate the materials. 5. Perform benchworks, cutting , drilling, and punching. 6. Perform assembly works pressing gaskets as required as design. 7. Check the dimensions. 8. Store it in safe and special place.	**Condition :** Fully equipped workshop with hand tools and punches and punching facilities. **Tasks :** Perform gasket pressing. **Standards:** - Gasket is pressed uniformly. - Gasket is pressed all corner as required by design.	• Introduction of gasket • Material used for gasket.

Safety Precautions :

- Use safety gloves, helmet and goggles.
- Follow the safety of Prepare materials.
- Follow the safety of Bench work.

Duty:5 : FINISH THE FABRICATE MEMBERS

5.4. Perform silicon filling.

Time: 1.5 hrs.
Exercise: 1 hrs
Demo: 0.5 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain details of instructional drawing. 2. Prepare work-piece materials. 3. Confirm the process of fitting. 4. Obtain the machine or tools equipments to fabricate the materials. 5. Perform benchworks, cutting , drilling, and punching. 6. Perform assembly works fitting glass / board as required as design. 7. Check the dimensions. 8. Store it in safe and special place.	**Condition :** Fully equipped workshop with hand tools and punches and punching facilities. **Tasks :** Perform silicon filling. **Standards:** - Silicon is filled uniformly. - Silicon filled on as required as design.	• Introduction • Purpose of silicon material • Types of silicon material.

Safety Precautions :

- Use safety gloves, helmet and goggles.
- Follow the safety of Prepare materials.
- Follow the safety of Bench work.

BIBLIOGRAPHY

SN	Name	Author	Publication
1.	All about MACHINE TOOLS	- Heinrich Gerling	
2.	Elementary Metal Course Training Section I	- BBF.	
3.	Fitter trade Practical		- CIMI, Madras.
4.	Mechanical engineering.	ILO learning element	
5.	Hand Book of Fabrication process	Orville D. Lascoe	ASM International
6.	Hand Book of Aluminium work	SORBET.	ASM International

Welding Technology – II (Gas/ TIG/MIG)

Total: 234 hrs
Class/week: 6 hrs

S. No.	Duties and Tasks	Time (hrs.)	
A.	**Oxy-Acetylene Gas Welding (OAW)**	**Demo**	**Practical**
1	**Set up Gas Welding Equipment**		
1.1	Prepare acetylene gas	2	4
1.3	Set up welding equipments and nozzles	2	4
1.3	Adjust neutral flame	1	3
2	**Run Beads in a Line**		
2.1	Run fusion without filler rod	2	13
2.2	Run fusion with filler rod	4	14
3	**Perform Flat Position Welding**		
3.1	Weld edge joint	3	6
3.2	Weld square butt joint	-	4
3.3	Weld lap joint in the flat position.	1	4
3.4	Weld T – joint in the flat position.	2	4
3.5	Weld pipe + pipe	1	8
4	**Perform Oxy-Acetylene Flame Cutting**		
4.1	Cut MS plate by gas welding equipment manual	1	8
5	**Perform Hard Soldering (Brazing)**		
5.1	Braze brass in mild steel plate	3	6
5.2	Braze MS plate with MS pipe		5
5.3	Weld Butt joint in Copper plate	-	6
5.4	Weld Butt joint in Brass plate	-	6
	Sub Total	***23***	***94***
	Total	***117***	
B.	**Tungsten Inert Gas Welding (TIG)**	**Demo**	**Practical**
1	**Set up Welding Equipment**	2	3
2	**Perform Surface Welding**		
2.1	Perform Surface welding without filler rod.	1	6
2.2	Perform Surface welding with filler rod.	1	8
3	**Weld in Flat Position Welding**		
3.1	Weld square butt joint without temporary backing bar with filler rod in flat position.	1	8
3.2	Weld square butt joint with temporary backing bar with filler rod in flat position.	1	8
	Total	***6***	***33***
	Total	***39***	
C.	**Metal Inert Gas Welding (MIG)**	**Demo**	**Practical**
1	**Set up Welding Equipment**	**2**	**2**
2	**Perform Flat Position Welding**		
2.1	Perform surface weld in flat position	1	12
2.2	Weld butt joint in Flat position	1	12
2.3	Weld lap joint in flat position		10
2.4	Weld T – joint in flat position.	1	10

3	**Perform Vertical Position Welding**		
3.1	Perform surface weld in Vertical position	1	8
3.2	Weld butt joint in Vertical position	1	8
3.3	Weld T – joint in Vertical position.	1	8
	Total	***8***	***70***
	Total	***78***	
	Total (A + B + C)	***117 + 39 + 78 =234***	

Duty:1: SET UP GAS WELDING EQUIPMENT

1.1. Prepare Acetylene gas

Time: 8.0 hrs.
Exercise: 6.0 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain Instruction. 2. Close down the valves (checking gas indicator shows zero). 3. Carry out the gas cylinder to the open place 4. Open main cover. 5. Remove the calcium carbide tray. 6. Clean up all parts and cylinder. 7. Fill up the water in tank up to the marked level. 8. Fill up required amount of calcium carbide in carbide bucket. 9. Put inside the water tank on cylinder. 10. Put inside the carbide bucket in water tank. 11. Tighten the main cover. 12. Open main valve. 13. Check the manometer for increments of the gas level. 14. Connect acetylene rubber hose pipe. 15. Check all connection and cylinder lid to ensure not leaking.	**Condition :** Fully equipped workshop with Gas welding equipments with different sizes of nozzles. **Task :** Prepare Acetylene gas **Standards:** • Use Calcium carbide. • Prepare acetylene gas from calcium carbide. • Check gas level.	• Introduction of Acetylene gas • Types of acetylene gas generator. • Main parts and their functions of cylinders • Substitute of acetylene gas.

Safety Precautions:

- Avoid using hammer or wrench to open cylinders valves.
- Ensure with soap water that all connections are tight.
- Never use acetylene at pressure over 15 P.S.I.
- When welding is to be stopped temporarily, release the pressure adjusting screws of the regulators by turning them to the left. It it is to be stopped for long time close the cylinder valves and release all pressure from regulators.

Duty: 1: SET UP GAS WELDING EQUIPMENT

1.2. Set up welding equipments and nozzles

Time: 6.0 hrs.
Exercise: 4.0 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain Instruction. 1. Set up oxygen gas cylinder and regulator to rubber hose. 2. Set up acetylene gas cylinder/generator and regulator to rubber hose 3. Set up torch handle to attach the nozzle. 4. Identify set up the nozzle to be attached. 5. Adjust the regulators to pressures suited to the nozzles in use. 6. Check all the fittings are leak proof	**Condition :** Fully equipped workshop with Gas welding equipments with different sizes of nozzles. **Tasks:** Set up welding nozzles. **Standards:** • Connect oxygen gas cylinder to rubber hose • Adjust the regulators to obtain desired pressure on the pressure gauge.	• Gas welding nozzles and their types. • Regulators and hose fittings

Safety Precautions :

- Avoid hanging a torch with its hose on regulator or cylinder valves.
- Avoid relighting a blown out torch without first closing both torch valves.
- Stop using acetylene at pressure over 15 P.S.I.
- Avoid opening the valve too much that the flame separates from the tip.
- If the nozzle tip is dirty, use a tip cleaner of the proper diameter.
- The orifice or hole in the tip may be worn by constant cleaning and will not give a round-nosed inner cone.

Duty: 1: SET UP GAS WELDING EQUIPMENT

1.3. Adjust neutral flame

Time: 4 hrs.
Exercise: 3 hrs
Demo: 1 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Check all the fittings 2. Place all the tools equipment and materials 3. Adjust the regulators to pressures suited to the nozzles in use. 4. Adjust acetylene pressure 5. Adjust oxygen pressure 6. Open the acetylene valve on the torch one half of a turning and ignite the gas with a spark lighter. 7. Adjust the acetylene valve till the flame burns clean with minimum smoke. 8. Open the oxygen valve on the torch slowly. As the amount of oxygen is increased, the flame will become short and will become bluish. 9. Follow this process till the last trace of green un-burnt acetylene disappears from the blue cone at the end of the nozzle tip. 10. To shut off the torch, first close the oxygen valve on the torch and then acetylene valve.	**Condition :** Fully equipped workshop with Gas welding equipments with different sizes of nozzles. **Tasks:** Set up welding nozzles. **Standards:** • Recognize a flame type as required for gas welding. • Process of setting gas welding flames.	• Types of flames • Characteristic and uses of gas welding flame • Flame control.

Safety Precautions :

- Avoid hanging a torch with its hose on regulator or cylinder valves.
- Avoid relighting a blown out torch without first closing both torch valves.
- Stop using acetylene at pressure over 15 P.S.I.
- Avoid opening the valve too much that the flame separates from the tip.
- If the nozzle tip is dirty, use a tip cleaner of the proper diameter.
- The orifice or hole in the tip may be worn by constant cleaning and will not give a round-nosed inner cone.

Duty:1: RUN BEADS IN LINE

2.1. Run fusion without filler rod

Time: 18 hrs.
Exercise: 16 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related knowledge
1. Obtain instructions. 2. Obtain work piece material (MS Sheet). 3. Set up welding equipment and nozzle. 4. Adjust pressure on regulator suitably. 5. Clean up the surface of work piece material. 6. Light the torch and adjust till neutral flame is obtained. 7. Hold the torch on the work piece at an angle of 60°. 8. Maintain the inner core of the flame should be about 3 to 5 mm above the metal surface. 9. Move the torch in a semi-circle of about 5 mm radius. 10. Form a puddle of molten metal. 11. Maintain the depth of the puddle as much as the thickness of the work piece. 12. Advance the torch slowly along the required line with semicircular movements. 13. Let the molten metal left behind solidifies in the form of nipples. 14. Repeat till lines of beads of uniform width, penetration and pattern are produce.	**Condition :** Fully equipped workshop with Gas welding equipments with different sizes of nozzles. **Tasks :** - Run fusion without filler rod. **Standards:** - Obtain neutral flame. - Hold gas welding torch. - Play fusion wave on melting zone. - Maintain the depth of the puddle. - Produce uniform width and pattern.	➢ Procedure for running a line of fusion or puddling without a filler rod. ➢ Position and motion of the torch. ➢ Backfire and flashback

Safety Precautions :

- Maintain a consistent travel speed to prevent burn – through in the work piece.
- Move the torch from right side of the work piece to left side in manipulating the semicircle.
- Maintain the inner cone of the flame to touch the work piece or the puddle.
- Avoid using match to light a torch. Use a regulation spark lighter.
- Wear safety apparel (safety goggles, working apron, leather apron and dark glass)
- Avoid conditions that may cause a backfire or flashback.

Duty:1: RUN BEADS IN LINE

2.2. Run fusion with filler rod.

Time: 20 hrs.
Exercise: 16 hrs
Demo: 4.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Repeat the steps from 1 to 8 of the fusion run without filler rod. 2. Obtain filler rod. 3. Hold filler rod at an angle 30° to 40°. 4. Hold the torch at an angle about 60° to the plate. 5. Put one end in of filler rod to the molten puddle. 6. Melt the rod till a bead of 5 to 10 mm wide and 3 mm high is formed. 7. Advance the torch and rod along the desired line on the workpiece. 8. Withdrawn the torch at the end of the pass, fill the crater by adding filler rod. 9. Practice running consistent straight beads.	**Condition :** Fully equipped workshop with Gas welding equipments, filler rod with different sizes of nozzles. **Tasks :** Run fusion with filler rod. **Standards:** - Obtain uniform ripple surface. - Filled up holes and heavy weld. - Establish and maintain of molten puddle. - Produce uniform bead width and straightness.	- Laying beads with a filler rod. - Introduction of filler rod. - Characteristics and use of filler rod. - Left ward welding techniques. - Right ward welding techniques. - Procedure of run fusion with filler rod.

Safety Precautions :

- Refer to the Run fusion without filler rod.

Duty:3: PERFORM FLAT POSITION WELDING

3.1. Weld Edge Joint

Time: 9.0 hrs.
Exercise: 6.0 hrs
Demo: 3.0 hrs

Steps	Terminal Performance Objective	Related knowledge
1. Obtain instructional drawing. 2. Refer steps no 1 to 5 of Run fusion without filler rod. 3. Clamp the workpiece together so that the edges to be weld parallel each other by C-clamp or welding vice. 4. Position the workpiece on the welding table. 5. Refer steps no 6 to 8 of the Run fusion without filler rod. 6. Tack weld at each ends and middle of the total length with filler rod. 7. Advance the torch and rod along the desired line on the edge of the workpiece. 8. Continue in this manner till the whole lengths of edges are welded together.	**Condition :** Fully equipped workshop with Gas welding equipments, filler rod with different sizes of nozzles **Task :** Weld Edge Joints **Standards:** - Prepare workpiece. - Produce gas welding penetration. - Control undercuts. - Perform gas welding burnt and melt through.	- Purpose of root gap. - Distortion in welding causes and control. - Common welding defects in gas welding. - Flux – characteristic, types and application.

Safety Precautions :

- Refer to the Task Run fusion with filler rod.

Duty:3: PERFORM FLAT POSITION WELDING

3.2. Weld Square Butt Joints

Time: 4.0 hrs.
Exercise: 4.0 hrs
Demo: 0.0 hrs

Steps	Terminal Performance Objective	Related knowledge
1. Obtain instructional drawing. 2. Refer steps no 1 to 5 of Run fusion without filler rod. 3. Place the two workpiece on fire bricks side by side in position. 4. taper gap should be maintain o.8 in beginning and about 3 mm at the end for about 2 mm sheet . 5. Refer steps no.6 to 8 of the Run fusion without filler rod. 6. Tack weld on both ends. 7. Warm up the edges of each workpiece slightly by running the flame along the edges quickly. 8. Heat both the workpiece at the point where welding has to start, giving the torch a weaving motion across the edges of both the plates so as to bring them to welding temperature simultaneously. 9. Bring the tip of the filler rod under the flame and into the puddle as the puddle forms. 10. Allow a correct size (about 3mm wide and 0.5mm high) bead to form. 11. Continue in this manner till the whole lengths of edges are welded together.	**Condition :** Fully equipped workshop with Gas welding equipments with different sizes of nozzles. **Tasks :** Weld Square Butt Joints **Standards:** - Prepare workpiece for butt joint welding. - Follow the procedure of welding square butt joint.	

Safety Precautions :

- As the welding goes on, the two MS sheet should come together ahead of the weld, with a gap of 0.8mm. If the sheets come close too fast, tack weld ahead of the weld. If they are to a slow allow the weld to cool a little.
- Refer safety precautions of the Run fusion weld with filler rod.

Duty:3: PERFORM FLAT POSITION WELDING

3.3. Weld Lap joint in the flat position.

Time: 5.0 hrs.
Exercise: 4.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain a instructional drawing. 2. Obtain a workpiece material. 3. Set up all gas welding equipment. 4. Lay one plate on top of the other plate on the welding table as per given drawing. 5. Refer steps no.6 to 8 of the Run fusion without filler rod. 6. Tack weld on both sides. 7. Start welding from right to left maintaining the move meet to bottom parts. 8. If additional build – up is required, filler rod may be added as the puddle is carried across the joint. 9. Weld one side of the plate and then practice on the reverse side.	**Condition :** Fully equipped workshop with Gas welding equipments with different sizes of nozzles. **Tasks :** Weld a Lap joint in the flat position. **Standards:** - Prepare workpiece for lap joint welding. - Follow the procedure of welding Lap joint.	- Inspection and testing of the gas welding joints.

Safety Precautions :

- Refer to the Task Weld edge joint.

Duty:3: PERFORM FLAT POSITION WELDING

3.4. Weld T – Joint in the Flat Position. **Time: 6.0 hrs.**
Exercise: 4.0 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related knowledge
3.4. Weld T – Joint in the Flat Position. 1. Obtain a instructional drawing. 2. Obtain a workpiece material. 3. Prepare the dimension as per drawing on the workpiece material. 4. Set up all gas welding equipment. 5. Stand one plate on top of the other plate on the welding table forming T – Joint as per given drawing. 6. Refer steps no.6 to 8 of the Run fusion without filler rod. 7. Realign the position if needed. 8. Tilt the tacked pieces 45 to the work surface, placing the fire brick under one side to support the pieces. 9. Hold the torch so the tip forms and angle of about 45 to the bottom plate. 10. Maintain the heat on both plates while manipulating the torch. 11. If additional build – up is required, filler rod may be added as the puddle is carried across the joint. 12. Weld one side of the plate and then practice on the reverse side.	**Condition :** Fully equipped workshop with Gas welding equipments with different sizes of nozzles. **Tasks :** Weld T – Joint in the Flat Position. **Standards:** - Prepare workpiece for Fillet 'T' joint welding. - Follow the procedure of welding Fillet 'T' joint.	- Procedure of welding Fillet 'T' joint.

Safety Precautions:

- Refer to the Task Weld Square butt joints.

Duty:3: PERFORM FLAT POSITION WELDING

3.5. Weld pipe to pipe (M .S .).

Time: 9.0 hrs.
Exercise: 8.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain a workshop drawing. 2. Obtain a work-piece material. 3. Prepare Vee shape on work-piece material for welding. 4. Set up all gas welding equipment. 5. Place the tube in a Vee Block, leaving a gap of about 2mm to 3mm between the two edges to be welded. 6. Refer steps no.6 to 8 of the Run fusion without filler rod. 7. Weld tacks the joint in min. three places. 8. Realign the pipe if necessary. 9. Start welding from one of the tack weld joint keeping at top side. 10. Advance the torch to the bottom in operator side with criss – cross motion of the torch and rod.(not semi – circular) 11. Keep the first 10mm of the weld deposit narrow and flat but proper fusion and penetration into the joint. 12. Keep the welding tip straight with the line of travel as the welding advances the pipe. 13. Turn the pipe when the welding nears the ¼ of the pipe. 14. Start from the other side of the joint & continue as before reaching the next ¼ of the pipe. 15. Fuse well in to the end of the previously deposited weld. 16. Finish the weld at remaining part of pipe smoothly referring above steps. 17. If additional build – up is required, filler rod may be added as the puddle is carried across the joint.	**Condition :** Fully equipped workshop with Gas welding equipments, filler metal with different sizes of nozzles. **Tasks :** Weld Pipe + Pipe black. **Standards:** - Prepare Pipes for welding. - Follow the procedure of welding Pipe to pipe joint.	- Process of welding on Pipes

Safety Precautions :

- Refer to the Task Weld edge joint.

Duty:4: PERFORM OXY-ACETYLENE FLAME CUTTING

4.1 Cut MS plate by gas welding equipment manually

Time: 9.0 hrs.
Exercise: 8.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain a work piece material (MS Plate) 2. Set up all gas welding equipment. 3. Place the plate on the cutting table in such a way that the place to be cut comes over the hole or slot in the cutting table 4. Rule a chalk line about ¾" from one edge of the plate. 5. Select and set up the correct nozzle for the thickness of the metal to be cut. 6. Light the torch, adjust preheated flame. 7. Observe the nature of the cutting flame by pressing down the oxygen control lever. The valve is operated either with the thumb or forefinger. 8. Adjust the flame if necessary to keep the preheating cones burning with a neutral flame. 9. Bring the preheated flame on the edge to be cut & heat edge to cherry – red. 10. Press down the oxygen pressure lever. 11. Move the torch forward slowly along the chalk line. A shower of sparks will be seen to fall from the underside, indicating that the penetration is complete and the cut is proceeding correctly. 12. Reheat from the beginning if the cut does not seem to go through the metal. 13. Blow with hammer to separate the two sections.	**Condition :** Fully equipped workshop with Gas welding equipments, Flame cutting nozzles with different sizes of gas welding nozzles. **Tasks :** Perform Oxy-Acetylene Flame Cutting by gas welding equipment. **Standards:** - Set up the gases and welding nozzle for flame cutting - Cut the MS material in any profile.	- Process of Flame cutting by gas welding equipment.

Safety Precautions :

- Wear safety apparels safety goggles, safety gloves, Safety helmet.
- Place apiece of steel close to the line of cut to slide the torch along.
- If the edges of the cut appear to melt and have a very ragged appearance, the metal is not burning through and torch is being moved too slowly.
- When an exceptionally straight cut is desired, clamp a bar across the plate along side the cutting line to act as a guide for the torch to follow.

Duty:5: PERFORM HARD SOLDERING (BRAZING)

5.1. Braze brass in Mild steel plate.

Time: 9.0 hrs.
Exercise: 6.0 hrs
Demo: 3.0 hrs

Task and Steps	Terminal Performance Objective	Related Knowledge
1. Obtain a instructional drawing. 2. Obtain a workpiece material. 3. Set up all gas welding equipment. 4. Remove grease, paint and rust on the joining part with a wire brush and sandpaper. 5. Hold the material with a welding grip. 6. Refer steps no 6 to 8 of the Run fusion without filler rod. 7. Hold the blowpipe at an angle of 45 against the base plate and preheat around the piece with the white core a little separated until it becomes reddish. 8. Heat the end of the brazing rod and attach flux there. 9. Hold the brazing rod at an angle to 45 against the base plate, and move the rod, so to pulling it back. 10. Continue to heat the place between the base plate and piece, feeding molten brazing material with blowpipe. 11. Move the blow pipe in an oval form and the filler rod slightly up and down, melting it above the welding line. 12. Attach flux to the brazing rod from time to time, and continue brazing. 13. cool the work as it being held by grip and clamp. 14. Remove the jelly oxide on the brazed surface with a wire brush . 15. Clean the blowpipe removing attached material in the nozzle with a cleaning needle.	**Condition :** Fully equipped workshop with Gas welding equipments with different sizes of nozzles. **Tasks :** Braze brass in Mild steel plate. **Standards:** - Prepare Workpiece. - Perform fusion the filler rod - Produce brazing penetration. - Control undercut. - Follow procedure of butt joint welding in brass in mild steel plate.	- Introduction of Hard soldering (brazing). - Characteristics of brazing. - Classification of brazing and filler rod. - Characteristics of brass brazing material. - Substitute of flux. - Process of brazing or hard soldering.

Safety Precautions :

- Refer the safety precautions of the task Run fusion with filler rod.

Duty: 5: PERFORM HARD SOLDERING (BRAZING)

5.2. Braze MS plate with MS pipe.

Time: 5 hrs.
Exercise: 5 hrs
Demo: hrs

Task and Steps	Terminal Performance Objective	Related Knowledge
1. Obtain a instructional drawing. 2. Obtain a work piece material. 3. Set up all gas welding equipment. 4. Remove grease, paint and rust on the joining part with a wire brush and sandpaper. 5. Place Ms pipe on Ms Plate. 6. Hold the blowpipe at an angle of 45 against the base plate and preheat around the piece with the white core a little separated until it becomes reddish. 7. Heat the end of the brazing rod and attach flux there. 8. Hold the brazing rod at an angle to 45 against the pipe and plate, and move the rod, so to pulling it back. 9. Continue to heat the place between the base plate and pipe, feeding molten brazing material with blowpipe. 10. Move the blow pipe in an oval form and the filler rod slightly up and down, melting it above the welding line. 11. Attach flux to the brazing rod from time to time, and continue brazing. 12. Cool the work as it being held by grip and clamp. 13. Remove the jelly oxide on the brazed surface with a wire brush or file. 14. Clean the blowpipe removing attached material in the nozzle with a cleaning needle.	**Condition :** Fully equipped workshop with Gas welding equipments with different sizes of nozzles. **Tasks :** Braze brass in Mild steel plate. **Standards:** - Prepare Work piece. - Perform fusion the filler rod - Produce brazing penetration. - Control undercut. - Follow procedure of butt joint welding in brass in mild steel plate.	- Introduction of Hard soldering (brazing). - Characteristics of brazing. - Classification of brazing and filler rod. - Characteristics of brass brazing material. - Substitute of flux. - Process of brazing or hard soldering.

Safety Precautions :

- Refer the safety precautions of the task Run fusion with filler rod.

Duty:5: PERFORM HARD SOLDERING (BRAZING)

5.3. Weld Butt joint in Copper plate.

Time: 6.0 hrs.
Exercise: 6.0 hrs
Demo: 0.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instructional drawing. 2. Obtain a work piece material. 3. Set up all gas welding equipment. 4. Clean the surface of the joining part with emery cloth. 5. Make flux pastry, and coat the whole area of joining part with it. 6. Coat the end of filler rod the length of about 50mm with flux. 7. Refer steps no 6 of the run fusion without filler rod. 8. Hold the blowpipe at an angle to 60°-80° and the filler rod at the angle of 25°-30°. 9. Maintain the inner cone 6-9 mm away from the molten metal. 10. Preheat the whole area of the joining part about 500 ~ 600° C. 11. Immerse the filler rod at the end of molten pool, and advance the blowpipe and the rod straight as they are. 12. Apply flux to the filler rod from time to time in order to supply it to the joining part. 13. Wash away the flux with warm water.	**Condition :** Fully equipped workshop with Gas welding equipments with different sizes of nozzles. **Tasks :** Weld Butt joint in Copper plate. **Standards:** - Prepare Workpiece. - Perform fusion the filler rod - Produce brazing penetration. - Control undercut. - Follow procedure of butt joint welding in copper plate.	

Safety Precautions :

- Refer the safety precautions of the task Run fusion with filler rod

Duty:5: PERFORM HARD SOLDERING (BRAZING)

5.4. Weld Butt joint in Brass plate.

Time: 6.0 hrs.
Exercise: 6.0 hrs
Demo: 0.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instructional drawing. 2. Obtain a workpiece \ material. 3. Refer the steps no.3 to 6 of the task weld butt joint in copper plate. 4. Adjust flux to make it a little oxidizing. 5. Preheat the whole area of the joining part. 6. When base plate is melted, insert the filler rod into the end of molten pool. 7. Advance the blowpipe and filler rod straight as they are. 8. Apply flux to filler rod from time to time in order to supply it to molten joining part while advancing. 9. Wash away flux with warm water.	**Condition :** Fully equipped workshop with Gas welding equipments with different sizes of nozzles. **Tasks :** Weld Butt joint in Brass plate. **Standards:** - Prepare Workpiece. - Perform fusion the filler rod - Produce brazing penetration. - Control undercut. - Follow procedure of butt joint welding in brass plate.	

Safety Precautions :

- Refer the safety precautions of the task Run beads in vertical position.

Duty:1: SET UP WELDING EQUIPMENT

1.1 Set Up Welding Equipment

Time: 5.0 hrs.
Exercise: 3.0 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1 Obtain instruction. 2 Obtain accessories and tools required. 3 Prepare TIG welding machine 4 Connect the electrical power. 5 Switch the machine. 6 Connect the torch to the machine. 7 Connect the gas cylinder. 8 Fix tungsten electrode. 9 Adjust the gas pressure and voltage. 10 Take any arrangements as required.	**Condition :** Fully equipped workshop with TIG welding AC / DC rectifier, tungsten rod/wire, accessories and different filler material. **Task :** Set up welding equipment. **Standards:** - Connect hose pipe on gas holder. - Set up current and tungsten wire on holder.	- Introduction to TIG welding - Use of TIG welding tools.

Safety Precautions :

- Avoid using torch with broken handle
- Always check the connection of Holder, Shield, and .grips .
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the torch on hanger after welding.
- Keep the workplace dry.

Duty:2: PERFORM SURFACE WELDING

2.1. Perform surface welding without filler rod.

Time: 7.0 hrs.
Exercise: 6.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Refer and follow of set up welding equipment of TIG from 1 to 3. 2. Clamp the work piece and return lead to a clean and of the table. 3. Keep the material in welding position and clean thoroughly. 4. Hold the torch at the corner angle 60-80° and height. 5. Put the helmet down. 6. Now start welding from right to left till the end. 7. Perform another runs clam the previous runs by steel works. 8. Weld again if necessary. 9. Restore the tools and equipments. 10. Clean the working area.	**Condition :** Fully equipped workshop with TIG welding AC / DC rectifier, tungsten rod/wire, accessories and different filler material. **Task :** Perform surface welding without filler rod. **Standards:** - Transverse welding wave in TIG welding. - Procedure of deposition of TIG welding beads without filler rod.	- Introduction of welding wave of TIG Welding. - Procedure of deposition of TIG welding beads without filler rod.

Safety Precautions :

- Avoid using torch with broken handle
- Always check the connection of torch, shield, and grips.
- Keep always the inflammable material.
- Always place the torch on hanger after .welding.
- Avoid using damp torch
- Keep the workplace dry.

Duty:2:PERFORM SURFACE WELDING

2.2. Perform surface welding with filler rod.

Time: 9.0 hrs.
Exercise: 8.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Refer and follow set up welding equipment of TIG no 1 to 3. 2. Refer and follow surface welding with filler rod 2 & 3. 3. Hold the torch at an angle of 60-80° and the filler rod at an angle 20 -30°. 4. Refer and follow surface welding without filler rod 3 to 8. 5. Restore the tools and equipments. 6. Clean the working area.	**Condition :** Fully equipped workshop with TIG welding AC / DC rectifier, tungsten rod/wire, accessories and different filler material. **Task :** Perform surface welding with filler rod. **Standards:** - Transverse welding wave in TIG welding. - Procedure of deposition of TIG welding beads with filler rod.	- Introduction of welding wave of TIG Welding. - Procedure of deposition of TIG welding beads with filler rod.

Safety Precautions:

- Avoid using torch with broken handle
- Always check the connection of torch, Shield, and Grips.
- Keep away the inflammable material.
- Always place the torch on hanger after welding.
- Keep the workplace dry.

Duty:3: WELD IN FLAT POSITION

3.1. Weld square butt joint without temporary backing bar with filler rod in Flat position.

Time: 9.0 hrs.
Exercise: 8.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Refer and follow of set up welding equipment of TIG no 1 to 3. 2. Clamp the work return lead to a clean area of the table. 3. Keep the material in welding position without temporary bar. 4. Refer and follow of surface weld with filler rod 3 to 4. 5. Restore the tools and equipments. 1. Clean the working area	**Condition :** Fully equipped workshop with TIG welding AC / DC rectifier, tungsten rod/wire, accessories and different filler material. **Task :** Weld square butt joint without temporary backing bar with filler rod in Flat position. **Standards:** - Transverse welding wave in square butt joint welding. - Procedure of deposition of filler rod in TIG welding beads with filler rod.	- Introduction to welding wave of TIG Welding. - Procedure of deposition of TIG welding beads with filler rod.

Safety Precautions :

- Avoid using torch with broken handle
- Always check the connection of torch, Shield, and Grips.
- Keep away the inflammable material.
- Always place the torch on hanger after welding.
- Keep the workplace dry.

Duty:3: WELD IN FLAT POSITION

3.2. Weld square butt joint with temporary backing bar with filler rod in Flat position

Time: 9.0 hrs.
Exercise: 8.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Refer and follow set up welding equipment of TIG no 1 to 3. 2. Clamp the work return lead to a clean are of table. 3. Keep the material in welding position with temporary bar. 4. Refer and follow surface welding with filler rod 3 to 4. 5. Restore the tools and equipments. 1. Clean the working area.	**Condition :** Fully equipped workshop with TIG welding AC / DC rectifier, tungsten rod/wire, accessories, pieces of temporary backing bar and different filler material. **Task :** Weld square butt joint with temporary backing bar with filler rod in Flat position. **Standards:** - Transverse welding wave in square butt joint welding. - Procedure of deposition of filler rod in TIG welding beads with temporary backing bar with filler rod.	- Introduction of welding wave of TIG Welding. - Procedure of deposition of TIG welding beads with temporary backing bar with filler rod.

Safety Precautions :

- Avoid using torch with broken handle
- Always check the connection of torch, Shield, and Grips.
- Keep away the inflammable material.
- Always place the torch on hanger after welding.
- Keep the workplace dry.

Duty:1: SET UP WELDING EQUIPMENT (MIG)

1. Set Up Welding Equipment

Time: 4.0 hrs.
Exercise: 2.0 hrs
Demo: 2.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Obtain instruction. 2. Obtain accessories and tools required. 3. Prepare MIG welding machine. 4. Connect the electrical power. 5. Switch on the machine. 6. Load the wire reel. 7. Connect torch to the machine. 8. Set the speed of wire. 9. Connect the gas cylinder. 10. Adjust the pressure, voltage and flow of gas. 11. Make any arrangements as required.	**Condition :** Fully equipped workshop with MIG welding DC rectifier, MIG filler metal wire and accessories. **Task :** Set up welding equipment. **Standards:** - Set filler wire roll onto machine. - Set up current. - extrude filler rod on welder holder.	- Introduction to MIG welding - Use of MIG welding tools.

Safety Precautions :

- Avoid using welding gun with broken handle.
- Always check the connection of gun, Shield, and wire end.
- Avoid using damp MIG wire.
- Use cutting pliers to cut fusion tipped at wire end.
- Keep away the inflammable material.
- Always place the gun on hanger after welding.
- Keep the workplace dry.

Duty:2: PERFORM FLAT POSITION WELDING

2.1. Perform surface weld in Flat position.

Time: 21 hrs.
Exercise: 20 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Refer and follow the steps of set up welding machine (MIG) from 1 to 3. 2. Clamp the work return lead to a clean of the table. 3. Clean the materials thoroughly. 4. Put the materials on working position. 5. Hold the torch approximately 10 mm from the work piece and approximately 70° to the work piece. 6. Press switch/trigger from the point where you want to start and allow the arc to be struck. 7. Weld continuous till the end point. 8. Protect contact tip and gas nozzle against spatter by a thin layer using silicon free spray. 9. Restore the tools and equipments. 10. Clean the working area.	**Condition :** Fully equipped workshop with MIG welding DC rectifier, MIG filler metal wire and accessories. **Task :** Perform surface weld in flat position. **Standards:** - Transverse welding wave in MIG welding. - Procedure of deposition of MIG welding straight beads in Flat position.	- Introduction of welding wave of MIG Welding. - Procedure of deposition of MIG welding beads without filler rod.

Safety Precautions :

- Avoid using welding gun with broken handle.
- Always check the connection of gun, Shield, and wire end.
- Avoid using damp MIG wire.
- Use cutting pliers to cut fusion tipped at wire end.
- Keep away the inflammable material.
- Always place the gun on hanger after welding.
- Keep the workplace dry.

Duty:2: PERFORM FLAT POSITION WELDING

2.2. Weld butt joint in Flat position.

Time: 10 hrs.
Exercise: 10 hrs
Demo: hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Refer and follow of the steps of set up welding equipment (MIG) from 1 to 3. 2. Tack weld the materials at both ends with correct gap. 3. Refer and follow the steps of surface weld in flat position from 2 to 8. 4. Restore the tools and equipments. 5. Clean the working area.	**Condition :** Fully equipped workshop with MIG welding DC rectifier, MIG filler metal wire and accessories. **Task :** Weld butt joint in flat position. **Standards:** - Transverse welding wave in MIG welding. - Procedure of deposition of MIG welding straight beads in Flat position.	- Introduction to welding wave of MIG Welding. - Procedure of deposition of MIG welding beads without filler rod.

Safety Precautions :

- Avoid using welding gun with broken handle.
- Always check the connection of Holder, Shield, and wire end.
- Avoid using damp MIG wire.
- Use cutting pliers to cut fusion tipped at wire end.
- Keep away the inflammable material.
- Always place the gun on hanger after welding.
- Keep the workplace dry.

Duty:2: PERFORM FLAT POSITION WELDING

2.3. Weld lap joint in Flat position.

Time: 13 hrs.
Exercise: 12 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Refer and follow of the steps of set up welding equipment (MIG) from 1 to 3. 2. Tack weld the materials at both ends as per drawing. 3. Refer and follow the steps of surface weld in flat position from 2 to 8. 4. Restore the tools and equipments. 5. Clean the working area.	**Condition :** Fully equipped workshop with MIG welding DC rectifier, MIG filler metal wire and accessories. **Task :** Weld butt joint in flat position. **Standards:** - Transverse welding wave in MIG welding. - Procedure of deposition of MIG welding straight beads in Flat position.	- Introduction of welding wave of MIG Welding. - Procedure of deposition of MIG welding beads without filler rod.

Safety Precautions :

- Avoid using welding gun with broken handle.
- Always check the connection of Holder, Shield, and wire end.
- Avoid using damp MIG wire.
- Use cutting pliers to cut fusion tipped at wire end.
- Keep away the inflammable material.
- Always place the gun on hanger after welding.
- Keep the workplace dry.

Duty:2: PERFORM FLAT POSITION WELDING

2.3. Weld 'T' joint in Flat position.

Time: 13 hrs.
Exercise: 12 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Refer and follow of the steps of set up welding equipment (MIG) from 1 to 3. 2. Tack weld the materials at both ends as per the drawing. 3. Refer and follow the steps of surface weld in flat position from 2 to 8. 4. Restore the tools and equipments. 1. Clean the working area.	**Condition :** Fully equipped workshop with MIG welding DC rectifier, MIG filler metal wire and accessories. **Task :** Weld 'T' joint in flat position. **Standards:** - Transverse welding wave in MIG welding. - Procedures of deposition of MIG welding straight beads for Fillet weld in Flat position.	- Introduction of welding wave of MIG Welding. - Procedures of deposition of MIG welding straight beads for Fillet weld.

Safety Precautions :

- Avoid using welding gun with broken handle.
- Always use Wire brush to clean up the welding beads.
- Always check the connection of Holder, Shield, and wire end.
- Avoid using damp MIG wire.
- Use cutting pliers to cut fusion tipped at wire end.
- Keep away the inflammable material.
- Always place the gun on hanger after welding.
- Keep the workplace dry.

Duty:3: PERFORM VERTICAL POSITION WELDING

3.1. Perform surface weld in Vertical position.

Time: 9.0 hrs.
Exercise: 8.0 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Refer and follow of the steps of set up welding equipment (MIG) from 1 to 3. 2. Refer and follow the steps of surface weld in flat position from 2 to 4. 3. Hold the torch approximately 10 mm from the work and the angle approximately 80° to the work piece. 4. Refer and follow the steps of weld in flat position from 6 to 8. 5. Restore the tools and equipments. 6. Clean the working area.	**Condition :** Fully equipped workshop with MIG welding DC rectifier, MIG filler metal wire, welding stand fitted at table and accessories. **Task :** Perform surface weld in vertical position. **Standards:** - Transverse welding wave in vertical position welding. - Procedures of deposition of MIG welding straight beads surface weld by upward process in vertical position.	- Introduction of welding wave in vertical position welding. - Procedures of deposition of MIG welding straight beads surface weld by upward process in vertical position.

Safety Precautions :

- Avoid using Welding gun with broken handle.
- Always use Wire brush to clean up the welding beads.
- Always check the connection of gun, Shield, and wire end.
- Avoid using damp MIG wire.
- Use cutting pliers to cut fusion tipped at wire end.
- Keep away the inflammable material.
- Always place the gun on hanger after welding.
- Keep the workplace dry.

Duty:3: PERFORM VERTICAL POSITION WELDING

3.2. Weld butt joint in Vertical position.

Time: 13 hrs.
Exercise: 12 hrs
Demo: 1.0 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Refer and follow of the steps of set up welding equipment (MIG) from 1 to 3. 2. Refer and follow the steps of surface weld in flat position from 2 to 3. 3. Tack weld both ends as per the drawing. 4. Refer and follow the steps of weld in vertical position from 3 to 4. 5. Restore the tools and equipments. 6. Clean the working area.	**Condition :** Fully equipped workshop with MIG welding DC rectifier, MIG filler metal wire, welding stand fitted at table and accessories. **Task :** Weld butt joint in vertical position. **Standards:** - Transverse welding wave in MIG welding. - Procedure of deposition of MIG welding straight beads in vertical upward process position.	- Introduction of welding wave of MIG Welding. - Procedure of deposition of MIG welding straight beads in vertical upward process position

Safety Precautions :

- Avoid using Welding gun with broken handle.
- Always use Wire brush to clean up the welding beads.
- Always check the connection of gun, Shield, and wire end.
- Avoid using damp MIG wire.
- Use cutting pliers to cut fusion tipped at wire end.
- Keep away the inflammable material.
- Always place the gun on hanger after welding.
- Keep the workplace dry.

Duty:3: PERFORM VERTICAL POSITION WELDING

3.3. Weld "T" joint in Vertical position.

Time: 13 hrs.
Exercise: 12 hrs
Demo: 1 hrs

Steps	Terminal Performance Objective	Related Knowledge
1. Refer and follow of the steps of set up welding equipment (MIG) from 1 to 3. 2. Refer and follow the steps of surface weld in flat position from 2 to 3. 3. Tack weld both ends as per the drawing. 4. Refer and follow the steps of weld in vertical position from 3 to 4. 5. Restore the tools and equipments. 6. Clean the working area.	**Condition :** Fully equipped workshop with MIG welding DC rectifier, MIG filler metal wire, welding stand fitted at table and accessories. **Task :** Weld "T" joint in vertical position. **Standards:** - Transverse welding wave in MIG welding. - Procedure of deposition of MIG welding straight beads in vertical upward process position.	- Introduction of welding wave of MIG Welding. - Procedure of deposition of MIG welding straight beads in vertical upward process position

Safety Precautions :

- Avoid using welding gun with broken handle.
- Always use Wire brush to clean up the welding beads.
- Always check the connection of gun, Shield, and wire end.
- Avoid using damp MIG wire.
- Use cutting pliers to cut fusion tipped at wire end.
- Keep away the inflammable material.
- Always place the gun on hanger after welding. Keep the workplace dry.

BIBLIOGRAPHY

SN	Name	Author	Publication
1.	Job Sheets of Welding		Ministry of Japan
2.	Welder Trade Manual	Kakkar	
3.	Welding Skill	Joseph W. Giachino, William	
4.	Welder Trade Theory		Central Instructional Media Institute, Madras
5.	Prinicples of Welding Technology	L M Gourd	Viva Books Private Limited
6.	Welding Engineering and Technology	Dr. R. S. Parmar	Khanna Publishers

Workshop Technology – II

Total: 78 hrs
Class/week: 2 hrs

Unit/sub unit	Areas and Topics	Time (hrs.)
1	**Lubrication and Cutting Fluid**	**2**
1.1	Introduction	
1.2	Characteristic of Lubricants	
1.3	Types and Application	
1.4	Characteristic of Cutting oil	
1.5	Types and Application	
2	**Cutting Tool Geometry**	**1**
2.1	Introduction	
2.2	Angles of cutting tool	
2.3	Effects of angles on cutting tool	
2.4	Cutting tool material	
2.5	Recommended angles for cutting different materials	
3	**Precision Instrument**	**3**
3.1	Introduction	
3.2	Dial Test Indicator	
3.3	Slip gauge	
3.4	Ring gauge and plug gauge	
3.5	Telescopic gauge	
3.6	Micrometer	
4	**Lathe Machine**	
4.1	***Introduction / Occupational Safety***	**1**
4.2	***Types of Machine***	***2***
4.2.1	Introduction of Engine Lathe	
4.2.2	Introduction of Capstan Lathe	
4.2.3	Introduction of Wheel Lathe (turret)	
4.2.4	Introduction of Vertical Lathe	
4.2.5	Introduction of Copy Lathe	
4.2.6	Introduction of Special Purpose Lathe	
4.2.7	Introduction of NC/CNC lathe machine.	
4.3	***Parts and Function of machine***	***1***
4.3.1	Head Stock	
4.3.2	Tail Stock	
4.3.3	Carriage	
4.3.4	Bed	
4.3.5	Feed Gear Box	
4.4	***Accessories of machine***	2
4.4.1	Work holding devices	
4.4.2	Chucks : 3 Jaws and 4 jaws (self centering & independent)	
4.4.3	Face plate	
4.4.4	Dog Plate	
4.4.5	Mandrel	
4.4.6	Sleeves and adaptors	

4.4.7	Centers	
4.4.8	Follower and Steady rest	
4.5	**Attachments of the machine**	**1**
4.5.1	Taper turning	
4.5.2	Grinding	
4.5.3	Relieving	
4.5.4	Copying	
4.6	**Types of Tool**	**1**
4.6.1	Left hand and right hand	
4.6.2	Solid and Tipped	
4.6.3	Form tool	
4.6.4	Thread cutting	
4.6.5	Parting off / Grooving	
4.6.6	Knurling tool	
4.7	**Lathe Operations**	**2**
4.7.1	Truing, plain turning	
4.7.2	Step turning	
4.7.3	Grooving	
4.7.4	Taper Turning	
4.7.5	Thread cutting	
4.7.6	Knurling	
4.7.7	Center to Center turning	
4.7.8	Parting Off	
4.7.9	Eccentric Turning	
5	**Milling Machine**	**18**
5.1	Introduction	
5.1.1	Introduction milling machine (Conventional)	
5.1.2	Introduction to NC/CNC milling machine	
5.2	Machine safety	
5.3	Types of machine	
5.3.1	Column and Knee type	
5.3.2	Horizontal, vertical and universal	
5.4	Main parts and their function of the machine	
5.4.1	Over Arm	
5.4.2	Column	
5.4.3	Spindle	
5.4.4	Table	
5.4.5	Knee	
5.4.6	Saddle	
5.4.7	Base	
5.4.8	Elevating Shaft	
5.5	Milling Accessories	
5.5.1	Work holding devices	
5.5.1.1	Machine Vice	
5.5.1.2	T-bolts and Clamps	
5.5.1.3	V- blocks	
5.5.1.4	Angle plate	
5.5.2	Cutter mounting devices	
5.5.2.1	Short arbor, Stub arbor	
5.5.2.2	Long arbor	

5.5.2.3	Adopter / sleeve	
5.5.2.4	Collects	
5.6	Milling Attachments	
5.6.1	Vertical Head	
5.6.2	Slotting Head	
5.6.3	Rotary Table	
5.6.4	Indexing Head and it types	
5.6.5	Indexing method	
5.7	Cutting Speed, Feed and Depth of Cut	
5.8	Milling Fundamentals	
5.8.1	Up milling and down milling	
5.8.2	Face and peripheral milling- methods & operation.	
5.9	Milling Cutters and operations	
5.9.1	Shank type cutter	
5.9.2	Bore type cutter	
5.9.3	Fly cutter	
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5.10	Gear milling and gear cutter(Gear wheel dimension)	
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6.3	Parts and their function	
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6.3.6	Base	
6.4	Stroke adjustment / Feed mechanism	
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6.6.1	Machine vice	
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6.8.1	Plain shaping	
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7.1.2	Gas welding and cutting safety	
7.1.3	Gases used in gas welding	

7.1.4	Acetylene generator	
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7.1.6	Types and setting of gas welding flames	
7.1.7	Position and motion of the gas torch	
7.1.8	Introduction argon welding and types	
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7.2.4	Welding current	
7.2.5	Shielding gas uses in TIG welding	
7.2.6	Setting up a welding machine with water cooling system.	
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7.3.1	Introduction and Safety Precaution	
7.3.2	Shielding gas uses in MIG welding	
7.3.3	Filler metal and deposition rate	
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8.2	Types of Grinding	
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8.2.3	Hand surface Grinder	
8.2.4	Cutting off grinder	
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8.2.6	Swing Grinder	
8.2.7	Belt type Grinder	
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9.2	Thread types and applications	
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Annex –I: Tools & Equipments Required for First year

Mechanical Fitting

S. No.	Description	Size	Remarks
1.	Working Bench	80 x 89 x 280 cm	
2.	Bench vice	5"	
3.	Tool Box		
4.	Flat file (big)	12"	
5.	Flat file (medium)	10"	
6.	Flat file (small)	8"	
7.	Flat file (fine)	8"	
8.	Triangular file (medium)	10"	
9.	Triangular file (small)	8"	
10.	Half round file (medium)	10"	
11.	Half round file (small)	8"	
12.	Round file (medium)	10"	
13.	Round file (small)	8"	
14.	Square file (medium)	10"	
15.	Square file (small)	8"	
16.	Needle file		
17.	Back square		
18.	Steel rule	300 mm	
19.	Vernier caliper	150 mm	
20.	Tool maker square		
21.	Angular gauge		
22.	Bevel protractor	150 mm	
23.	Center square		
24.	Dial gauge		
25.	Radius gauge	1 - 50 mm	
26.	Straight edge		
27.	Steel hammer	500 g	
28.	Mallet		
29.	Center punch		
30.	Number punch	3 mm, 5 mm, 8 mm	
31.	Letter punch	3 mm, 5 mm, 8 mm	
32.	Marking scriber		
33.	Divider		
34.	Hand hacksaw Frame		
35.	Screw driver	1 - 7 nos.	
36.	Universal plair	6"	
37.	Soluble oil (cutting oil)		
38.	File brush		
39.	Anvil		
40.	Impact shield		
41.	Chip guard		
42.	Chisel flat		
43.	Chisel cross cut		
44.	Engineering blue		
45.	Surface plate	40 x 3.5 x 60 cm	
46.	Boring Head		
47.	Counter boring tool	4.5 mm - 30.5 mm	
48.	Counter sink	90	
49.	Counter sink	60	
50.	Boring tool		
51.	Wheel dresser		
52.	Apron		
53.	Safety shoe		

54.	Open spanner		
55.	Safety goggle		
56.	Depth gauge		
57.	Bench/Pedestal drilling machine		
58.	Drill bits	Ø 1 to 30 mm	
59.	Reamers	3H7 to 30H7	
60.	Hand taps metric	M3 to M24	
61.	Tap handle		
62.	Hand dies metric	M3 to M24	
63.	Die handle		
64.	Sleeves		
65.	Drill chuck		
66.	Drill drift		
67.	Hacksaw blade		
68.	Drill vice		
69.	Clamps / nuts / bolts		
70.	Marking block		
71.	Angle plate		
72.	V block		
73.	Vernier height gauge		
74.	Bench / Pedestal grinding machine		
75.	Hand surface grinding machine		
76.	Hand drilling machine		
77.	Cleaning brush	35 mm	

Sheet metal Fabrication;

S. No.	Description	Size	Remarks
1.	Working bench		
2.	Bench Vice		
3.	Tool Box		
4.	Key and Pad lock		
5.	Flat file medium	10"	
6.	Triangular file	8"	
7.	Round file	8"	
8.	Half round file	10'	
9.	Steel rule	300mm	
10.	do	1m	
11.	do	2m	
12.	Back square	Medium	
13.	Marking scriber		
14.	Brass scriber		
15.	Mallet		
16.	Straight snips		
17.	Curved snips		
18.	Combination snips		
19.	Protractor		
20.	C-clamps	Medium	
21.	Trammel	500mm	
22.	Compass		
23.	Try square		
24.	Flat chisel		
25.	Center punch		
26.	Number Punch	5mm	
27.	Rivet head punch		
28.	Rivet align punch		
29.	Marking bar		
30.	Steel Hammer	500 gms	

31.	Bar folder		
32.	Flat steel square bar		
33.	Straight edge		
34.	Setting hammer		
35.	Straight hardies		
36.	Stake hatchet		
37.	Hand grover		
38.	Shim	1mm	
39.	Folding machine		
40.	Beading machine		
41.	Shearing machine		
42.	Slip roll folding machine		
43.	Drill machine	Bench, hand	
44.	Drill bits	Set	
45.	Zinc chloride		
46.	Soldering hammer		
47.	Soldering flux		
48.	Safety gloves		

Welding Technology-I;

S. No.	Description	Size	Remarks
1.	Welding Table		
2.	Flat file (rough)	12"	
3.	Welding transformer	250 amps.	
4.	Welding holder	500 amps.	
5.	Ground Clamps	8 inch	
6.	Welding electrodes – 6013E / 6012E	Ø 2.5	
7.	Do	Ø 3.15	
8.	Cast iron electrodes	Ø 3.15	
9.	Chipping Hammer	10 inch	
10.	Wire brush		
11.	Toungs		
12.	Welding gloves		
13.	Hand Shield		
14.	Safety goggles		
15.	Safety shoe		
16.	Leather Apron		
17.	Leather sleeves		
18.	Steel Scale		
19.	Bevel Protractor		
20.	Center punch	60°	
21.	Steel Hammer	500 gms	
22.	Try Square		
23.	Spindle Press	15 ton	
24.	Hand Hacksaw Frame		
25.	Pipe cutter		
26.	Power sawing cut off	lever type	
27.	Hand grinder	4”	
28.	Hand grinder	7”	

Lathe Operation-I;

S. No.	Description	Size	Remarks
1.	Center Lathe Machine		
2.	Three Jaw universal Chuck	According to m/c spindle	
3.	Lathe centers: Live, Dead, Revolving	According to m/c spindle	
4.	Drill chuck with chuck keys		
5.	Spanner	Set	
6.	Allen keys	Set	
7.	HSS tool bit	½" x 6"	
8.	Center Drill	5 x 3	
9.	Drill bits	Set	
10.	Boring tool	R, C, Thread 60 , 55	
11.	Vernier caliper		
12.	Bevel Protractor		
13.	Safety goggles		
14.	Grinding machine	Bench or Pedestrian	
15.	Grinding wheel dresser		
16.	Threading Die with handle set	60 and 55	
17.	Knurling tool hand or machine	Diamond	
18.	Dial test indicator with magnetic stand		
19.	Cleaning brush	36mm	
20.	Mobil Oil		

Annex – II: Tools & Equipments Required for Second Year

Structural Fabrication

S. No.	Description	Size	Remarks
	STEEL		
1.	Working Bench	80 x 89 x 280 cm	
2.	Bench vice	5"	
3.	Flat file (medium)	10"	
4.	Back square		
5.	Steel rule	300 mm	
6.	Vernier caliper	150 mm	
7.	Bevel protractor	150 mm	
8.	Steel hammer	500 g	
9.	Center punch		
10.	Number punch	3 mm, 5 mm, 8 mm	
11.	Letter punch	3 mm, 5 mm, 8 mm	
12.	Hand hacksaw Frame		
13.	Screw driver	1 - 7 nos.	
14.	Universal plair	6"	
15.	Anvil		
16.	Chisel flat		
17.	Counter sink	90	
18.	Open spanner		
19.	Safety goggle		
20.	Bench/Pedestal drilling machine		
21.	Drill bits	Ø 1 to 30 mm	
22.	Sleeves		
23.	Drill chuck		
24.	Drill drift		
25.	Drill vice		
26.	Bench / Pedestal grinding machine		
27.	Hand surface grinding machine		
28.	Hand drilling machine		
	ALUMINIUM		
1	Tool kit box		
2	Measuring tape		
3	Try Square		
4	Hacksaw		
5	Abrasive cut off machine		
6	File (flat, triangular, round, square)		
7	Screwdriver (Phillips, flat)		
8	Pop rivet gun		
9	Pliers		
10	Hand drill and drill bits		
11	Jigs saw machine		
12	Aluminum profile cutting machine		
13	Spirit level		
14	Silicon gun		
15	Plum bob		
16	Router machine		

Welding Technology - II

S. No.	Description	Size	Remarks
1.	MIG welding machine AC/DC		
2.	Carbon dioxide gas cylinder		
3.	Argon gas cylinder		
4.	Anti spatter		
5.	Argon gas regulator		
6.	CO2 gas regulator		
7.	Rubber Hose pipe		
8.	Hose pipe clamp		
9.	Spark lighter		
10.	Welding Holder		
11.	Nozzle cleaning brush	wire	
12.	Wire cutter		
13.	Flat file (rough)		
14.	Wire brush		
15.	Tongs		
16.	Welding gloves		
17.	Safety goggles		
18.	Safety shoe		
19.	Leather Apron		
20.	Steel Scale		
21.	Bevel Protractor		
22.	Steel Hammer	500 gms	
23.	Pipe cutter		
24.	Hand shear	lever type	
25.	Hand grinder	4”	
26.	Gas welding table		

Lathe Operation- II

S. No.	Description	Size	Remarks
1.	Center Lathe Machine		
2.	Three Jaw independent Chuck	According to m/c spindle	
3.	Four Jaw chuck	According to m/c spindle	
4.	Collect chuck with draw bar	Set	
5.	Face plate	According to m/c spindle	
6.	Lathe dog clamps with face plate	Set	
7.	Lathe centers: Live, Dead, Revolving	According to m/c spindle	
8.	Drill chuck with chuck keys		
9.	Spanner	Set	
10.	Allen keys	Set	
11.	Steady Rest		
12.	Follower Rest		
13.	HSS tool bit	½” x 6”	
14.	Center Drill	5 x 3	
15.	Drill bits	Set	
16.	Steel Hammer	500 g	
17.	Center punch	60°	
18.	Boring tool	R, C, Thread 60 , 55	
19.	Counter Sink	60 and 90	
20.	Hand hacksaw Frame with blade		

21.	Vernier caliper		
22.	Odd leg caliper	Outside, Inside	
23.	Marking height gauge		
24.	Vernier height gauge with marking block		
25.	Bevel Protractor		
26.	Tool grinding gauge	Angle	
27.	Safety goggles		
28.	Grinding machine	Bench or Pedestrian	
29.	Grinding wheel dresser		
30.	Bench vice with working bench		
31.	Set of file	Medium	
32.	Thread plug gauge set	Metric	
33.	Thread Pitch gauge	60 and 55	
34.	Check nut set	60 and 55	
35.	Threading Die with handle set	60 and 55	
36.	Knurling tool hand or machine	Diamond	
37.	Dial test indicator with magnetic stand		
38.	Clamping set with T bolts and nuts	M10, M12	
39.	Cleaning brush	36mm	
40.	Mobil Oil		

Milling Operation

S. No.	Description	Size	Remarks
1.	Angular milling cutter	45° and 60°	
2.	Angular plate		
3.	Boring Head	according to spindle	
4.	Centro fix	Ø 10 mm	
5.	Collect chuck arbor with ring wrench	according to spindle	
6.	Dial test indicator with magnetic stand	Lever type	
7.	Direct indexing head with tail stock		
8.	Fine file	Medium	
9.	Fly cutter	according to spindle	
10.	Hole type angular milling cutter	45° and 60°	
11.	Horizontal draw in bar	according to spindle	
12.	Horizontal milling machine		
13.	HSS tool bit	according to Fly cutter	
14.	HSS tool bit	according to Boring head	
15.	Long arbors	1 set	
16.	Marking Scriber		
17.	Milling Vice with handle	12"	
18.	Open Spanners	1 set	
19.	Parallel block	sets	
20.	Parallel clamps with step block	according to T-bolts	
21.	Plain milling cutter	according to arbor	
22.	Safety goggles		
23.	Safety shoe		
24.	Set of Adaptor arbor	according to spindle	
25.	Set of end mill cutter	according to collect chuck and adaptor	
26.	Set of Key way cutter		
27.	Set of Vee block and Clamps		
28.	Sets of Allen keys	1 set	
29.	Sets of Drill bits	5 mm to 30 mm	
30.	Sets of T-bolts and nuts	according to machine table	
31.	Shell end mill cutter	according to arbor	
32.	Short arbors	1 set	

33.	Soft hammer (mallet)		
34.	Steel hammer		
35.	Tool maker square (Try square)		
36.	Vernier bevel Protractor		
37.	Vernier caliper	150 mm	
38.	Vertical draw in bar	according to spindle	
39.	Vertical milling machine		
40.			

haping Operation

S.N.	Description	Size	Remarks
1	Shaper Machine		
2	Shaper Vice		
3	Vice handle		
4	Tee Bolts and Nuts	According to tee slot	
5	Dial Test Indicator with Magnetic Stand		
6	Parallel Blocks	Set of paid	
7	Fine File	Medium	
8	Open Spanner (Metric)	1 set	
9	Soft Hammer	Aluminum	
10	Parallel Clamp with Step Block	1 set	
11	HSS Tool Bit	Rough tool	
12	HSS Tool Bit	Corner tool	
13	HSS Tool Bit	Grooving tool	
14	HSS Tool Bit	Dovetail tool	
15	Grinding Gauge		
16	Back Square (Try square)	90º	
17	Vernier Height Gauge	150mm	
18	Steel Scale	300mm	
19	Marking Scriber		
20	Safety Goggles		
21	Center Punch		
22	Steel Hammer		
23	Bevel Protactor		
24	Vernier Caliper	150mm	
25	Vernier Depth Caliper		

Repair and Maintenance

Preventive Maintenance

S. No.	Description	Size	Remarks
1.	Oil can		
2.	Oil gun		
3.	Grease gun		
4.	Funnel		
5.	Oil Spenser		
6.	Cleaning brush		
7.	Oil paper		
8.	Oil sprayer		
9.	Oil tray		
10.	Set of repair tools		

Breakdown Maintenance

S. No.	Description	Size	Remarks
1.	Tool box	3storied	
2.	Files (set of 8 pcs)		
3.	Screw driver (Phillips)	No. 1, 3, 5, 7	
4.	Screw driver (flat)	No. 1, 3, 5, 7	
5.	Allen Key (metric)	Set 3 – 20 mm	
6.	Allen Key (imperial) assorted in size	Set upto 1”	
7.	Bore gauge		
8.	Telescopic gauge		
9.	Tachometer		
10.	Steel mirror		
11.	Safety glove		
12.	Safety belt		
13.	Safety harness		
14.	Air plug / air muff		
15.	First Air box with medicines		
16.	Combination pliers		
17.	Cutting pliers		
18.	Knife		
19.	Wire Stripper		
20.	Side cutter		
21.	Measuring tape		
22.	St nose pliers		
23	Bend nose pliers	3 m	
24	Monkey pliers		
25	Pin punch set in assorted size		
26	Slide wrench		
27	Double side open spanner		
28	Double side ring spanner		
29	Hook spanner		
30	Box socket wrench		
31	Tire lever flat		
32	Tire lever bend		
33	Screw extractor		
34	Torque wrench		
35	C-clamp		
36	Hand vice		
37	Pipe wrench		
38	Plum bob		
39	Pop rivet pliers		
40	Bearing puller		
41	Bearing puller		
42	Circlip pliers		
43	Circlip pliers		
44	Counter bore		
45	Flat tongues		
46	Chain socket puller		
47	Conveyer clipper		
48	Spider coupling		
49	Hydraulic press machine		
50	Precision screwdriver		

S. No.	Description	Size	Remarks
1.	Screw driver (set of 8 pcs)	No. 1 - 3	
2.	Combination plair		
3.	Knife		
4.	Wire Stripper		
5.	Side cutter		
6.	Measuring tape	3 m	
7.	Line Tester		
8.	Multi meter		
9.	Solder		
10.	DOL Starter		
11.	Isolator		
12.	Bulb Holder		
13.	Round block		
14.	Connector	15 A	
15.	P. V. C. Hard Conduit	½”	
16.	Saddle	½”	
17.	Wooden Screws	25mm	

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