Program Name : **Mechanical Engineering Program Group**

Program Code : **AE / ME**

Semester : **Second**

Course Title : **Mechanical Engineering Workshop**

Course Code : **22010**

1. RATIONALE

Diploma Automobile engineer is expected to develop advanced workshop skills, furniture making, fitting, smithy operations, fabrication work, lathe and shaper operations. These operations are useful in manufacturing, fabrication and construction industries. Working in workshop develops the skills related to cost effectiveness, team working, and safe practices. The technologists have to apply advanced workshop skills industrial jobs using hand tools, equipment and machineries and accordingly, this course has been designed.

2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Perform repairing work of utility jobs in the mechanical engineering workshop.**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following ***industry oriented*** COs associated with the above mentioned competency:

a. Select tools and machinery according to job.
b. Use hand tools in different shops for performing different operations.
c. Operate equipment and machines in various shops.
d. Prepare composite / utility jobs according to drawing.
e. Maintain workshop related tools, instruments and machines.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory						Practical					
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
L	T	P			Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
--	--	4	4	--	--	--	--	--	--	--	50#	20	50~	20	100	40

*(~): For the **practical only courses,** the PA has two components under practical marks i.e. the assessment of practicals (seen in section 6) has a weightage of 60% (i.e. 30 marks) and micro-project assessment (seen in section 12) has a weightage of 40% (i.e. 20 marks). This is designed to facilitate attainment of COs holistically, as there is no theory ESE.*

***Legends:** L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit, ESE - End Semester Examination; PA - Progressive Assessment.*

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

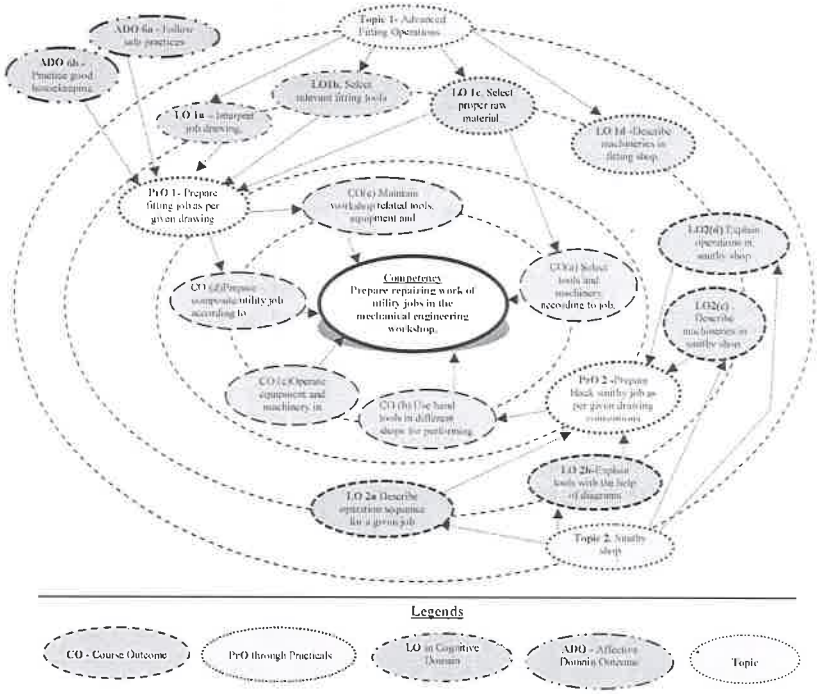

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

S. No.	Practical Outcome (PrOs)	Unit No.	Approx. Hrs. required
1	Prepare fitting job (male and female assembly type) as per given drawing or job with following operations: ***Marking operation, Punching operation, Drilling operation, Cutting operation, Filing operation, Fitting operation (male and female assembly), Checking correctness of fit of mating parts***. Part I	I	2*
2	Prepare fitting job (male and female assembly type) as per given drawing or job with following operations: ***Marking operation, Punching operation, Drilling operation, Cutting operation,***	I	2*

S. No.	Practical Outcome (PrOs)	Unit No.	Approx. Hrs. required
	Filing operation, Fitting operation (male and female assembly), Checking correctness of fit of mating parts. Part II		
3	Prepare fitting job (male and female assembly type) as per given drawing or job with following operations: ***Marking operation, Punching operation, Drilling operation, Cutting operation, Filing operation, Fitting operation (male and female assembly), Checking correctness of fit of mating parts***. Part III	I	2
4	Prepare fitting job (male and female assembly type) as per given drawing or job with following operations: ***Marking operation, Punching operation, Drilling operation, Cutting operation, Filing operation, Fitting operation (male and female assembly), Checking correctness of fit of mating parts.*** Part IV	I	2
5	Prepare fitting job (male and female assembly type) as per given drawing or job with following operations: ***Marking operation, Punching operation, Drilling operation, Cutting operation, Filing operation, Fitting operation (male and female assembly), Checking correctness of fit of mating parts***. Part V	I	2
6	Prepare fitting job (male and female assembly type) as per given drawing or job with following operations: ***Marking operation, Punching operation, Drilling operation, Cutting operation, Filing operation, Fitting operation (male and female assembly), Checking correctness of fit of mating parts***. Part VI	I	2
7	Prepare fitting job (male and female assembly type) as per given drawing or job with following operations: ***Marking operation, Punching operation, Drilling operation, Cutting operation, Filing operation, Fitting operation (male and female assembly), Checking correctness of fit of mating parts***. Part VII	I	2
8	Prepare black smithy job (like Hook, peg, flat chisel, bolt head or any hardware item)as per given drawing or job with following operations: ***Cutting operation, Heating operation, Upsetting operation, Punching operation, Swaging operation, Fullering operation, Bending operation***. Part I	II	2*
9	Prepare black smithy job (like Hook, peg, flat chisel, bolt head or any hardware item)as per given drawing or job with following operations: ***Cutting operation, Heating operation, Upsetting operation, Punching operation, Swaging operation, Fullering operation, Bending operation***. Part II	II	2
10	Prepare black smithy job (like Hook, peg, flat chisel, bolt head or any hardware item)as per given drawing or job with following operations: ***Cutting operation, Heating operation, Upsetting operation, Punching operation, Swaging operation, Fullering operation, Bending operation***. Part III	II	2
11	Prepare black smithy job (like Hook, peg, flat chisel, bolt head or any hardware item)as per given drawing or job with following operations: ***Cutting operation, Heating operation, Upsetting operation, Punching operation, Swaging operation, Fullering***	II	2

S. No.	Practical Outcome (PrOs)	Unit No.	Approx. Hrs. required
	operation, Bending operation. Part IV		
12	Prepare black smithy job (like Hook, peg, flat chisel, bolt head or any hardware item)as per given drawing or job with following operations: ***Cutting operation, Heating operation, Upsetting operation, Punching operation, Swaging operation, Fullering operation, Bending operation***. Part V	II	2
13	Prepare bill of material along with estimated cost according given drawing of jobs, such as -repairing of classroom furniture/ book shelves/ metallic doors/motor saree guard/ battery stand with locking device considering the following applicable operations: a. Marking operation as per drawing b. Cutting operation as per drawing c. Cleaning operation as per drawing d. Edge preparation operation as per drawing e. Filing operation as per drawing f. Bending operation as per drawing g. Welding operation as per drawing	III	2*
14	Prepare steel frame / structure of utility job (like stool, benches, tables, drawing desk, window grill, ventilator, door frame or similar job) involving arc welding joint as per given drawing or job. Part I	III	2
15	Prepare steel frame / structure of utility job (like stool, benches, tables, drawing desk, window grill, ventilator, door frame or similar job) involving arc welding joint as per given drawing or job. Part II	III	2
16	Prepare steel frame / structure of utility job (like stool, benches, tables, drawing desk, window grill, ventilator, door frame or similar job) involving arc welding joint as per given drawing or job. Part III	III	2
17	Perform fabrication operations to prepare job (wire mesh tray/ drawing sheet holder/tree guard/shoe stand as per given drawing. Part I	III	2*
18	Perform fabrication operations to prepare job (wire mesh tray/ drawing sheet holder/tree guard/shoe stand as per given drawing. Part II	III	2
19	Perform fabrication operations to prepare job (wire mesh tray/ drawing sheet holder/tree guard/shoe stand as per given drawing. Part III	III	2
20	Perform ***Cutting operation*** operations to prepare small notice board for your workshop/institute using soft board, velvet cloth with bidding as per given drawing.	IV	2*
21	Perform ***Planing operation*** operations to prepare small notice board for your workshop/institute using soft board, velvet cloth	IV	2

S. No.	Practical Outcome (PrOs)	Unit No.	Approx. Hrs. required
	with bidding as per given drawing.		
22	Continue experiment No. 20 and perform ***Wood turning*** operations to prepare small notice board for your workshop/institute using soft board, velvet cloth with bidding as per given drawing.	IV	2*
23	Continue experiment No. 20 and perform ***Joining*** operations to prepare small notice board for your workshop/institute using soft board, velvet cloth with bidding as per given drawing.	IV	2
24	Continue experiment no. 20 and 22 and complete the small notice board for your workshop/institute using soft board, velvet cloth with bidding as per given drawing by performing ***Finishing*** operations.	IV	2
25	Continue experiment no. 20 and 22 and complete the small notice board for your workshop/institute using soft board, velvet cloth with bidding as per given drawing by performing ***Varnishing*** operations.	IV	2
26	Prepare simple turning job with facing operation as per drawing	V	2*
27	Perform centering operation as per drawing to prepare simple turning job.	V	2
28	Prepare simple turning job with ***Plane*** turning operation as per drawing.	V	2
29	Prepare simple turning job with ***Step*** turning operation as per drawing.	V	2
	Total		**58**

Note

i. A suggestive list of practical PrOs is given in the above table, more such practical PrOs can be added to attain the COs and competency.

ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
1.	Prepare experimental set up	20
2.	Prepare Job using different operations	30
3.	Follow Safety measures	10
4.	Check the quality of finished job	20
5.	Answers to job related questions	5
6.	Submit journal report on time	5
7.	follow Housekeeping	5
8.	Attendance and punctuality	5
	Total	**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safe practices.
b. Practice good housekeeping.
c. Practice energy conservation.
d. Function as a team member.
e. Function as a team leader.
f. Follow ethics.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by administrators.

S. No.	Equipment Name with Broad Specifications	Exp. S.No.
1.	**Marking table with scribers** : Black Granite surface flat, non magnetic non glaring, planning accuracy as per IS- size 1000mm x 630mm x 150mm of workshop grade with slab carbide scriber 150mm.	1
2.	**Surface plate:** C.I. Surface plate, planed, hand swapped and seasoned, Brown and sharp type ribbing complete with handles for lifting and wooden protector cover. Conforming to IS- 2285 - 1963. 1) 450 mm x 450 mm. or 2) 450 mm x 600 mm	1
3.	**Measuring Instruments, Marking Instruments, Fitting Hand Tools:** Vice block, height gauges, vernier calipers, outside and inside calipers, micrometers, bevel protractor, files of different sizes and grades, Hacksaw frames, chisels, steel rules, try squares, drills, surface gauge, Number punch, dot punch, Divider , Angle plate, screw drivers, spanners etc.	1
4.	**Tap and Die Set:** Both tap and die set complete in box with accessories 0 - 10 BA , 1/4 " to 1 " BSF,1/2"to 3/4" NF ,1/4" to 3/4 " NC,6mmto 16mm metric, one set each .	1
5.	**Bench Drilling Machine**: 13mmcapacity motorized Drilling Machine, with 0. 5 HP / AC / 230 / 1 / 1420r. p. m., with motor starter switch, 13mmcapacity drilling chuck, V belt with 100 mm machine vice.	1
6.	**Bench Grinder:** Double ended bench grinder wheel size 150mmx 16mm x 12mm with standard accessories with single phase 0. 25 HP motor high speed.	1
7.	**Vice:** Bench Vice 150 mm	1
8.	**Electrically operated Hand Drilling Machine (pistol Type)**: 8mm capacity steel drilling . Power Input300- 400 W.	1
9.	**Power Hack Saw Machine:** Mechanical type hacksaw machine equipped	1

S. No.	Equipment Name with Broad Specifications	Exp. S.No.
	with coolant pump , vice, length gauge, machine drive belt guard , with capacity to cut / round materials up to175mmand square materials 150mm x 150mm, Blade size 350mm x 25mm and 1 HP /AC440 / 3 / 50 / 1440 RPM Electric motor and starter.	
10.	**Pedestal Grinder**: 200mm Spindle speed 2600 to 3000 rpm, diameter of wheel 200 mm width 25mm	1
11.	**Hand Grinder**: Two speed flexible shaft, 370watts, full load speed, 6410 rpm and 665 rpm.	1
12.	**Work Bench:** 1800x1200x750mm	1
13.	**Hearth with blower**: Centrifugal motorized blower 3 HP / 440/3 / 50 with Forges, pipe Fittings valves, Hearth Size Made of M. S. Sheets 750 mm x 750 mm with water jacket, Height of 2.5 m (with chimney)	2
14.	**Anvil:** Single Horn 150 kg malleable cast iron with stand.	2
15.	LegVice:1 5cm size.	2
16.	**Swage Black:** Wrought Iron or Malleable cast Iron.1)450 x 450 x100 mm. Or 2)500 x500 x 150 mm	2
17.	**Tools and Gauges**: Hammers of different size , Tong, Chisels flatteners pullers, Dies, Punch , Drift etc.	2
18.	**Power Hammer:**1Tonne capacity, motorised, equipped with foot lever operated, clutch to control strokes, spring loaded hand lever for adjustment of strokes, ram and C. I. anvil and the vertical pull rod , 3HP / 440 V A.C. / 3 / 50 Hz. / 960 rpm electric motor and starter. Having ram weight about 70 kgs. maximum lift 190mm, strokes / minute 160 to 200, hammers upto diameter 56 mm to 80 mm.	2
19.	**Bench Grinder:** Double ended bench grinder with 1HP 3Phase50 cycles 440 V and one side rough and other side smooth 250mm x 25mm x16mmgrinding wheel complete with wheel guard , tool rest and rotary switch.	2
20.	**Work Bench With vice**:1800x1200x750mm	2
21.	**Arc welding transformer three phase with standard accessories** – Welding Transformer to provide current from 50 amps to 600 amps for Single operator and 25 amps to 300 amps for two operators at 80 v open current , alternate voltage of 100 V open circuit provision, rotary switch for quick selection of current with following technical specifications conforming to IS 1851 -1975 Standard Accessories : 1. Copper cable single core conforming to IS - 9857 / 1981 for 600 amps. 2. Electrode holder up to 600 amps. 3. Hand Screw. 4. Earth clamp, tommy bar type. 5. Pair of welders Goggles. 6. Welders apron. 7. Welders glass	3,4,5
22.	**Single Phase Air-cooled arc Welding Transformer with Accessories:** Single phase air cooled arc welding, transformer, step less variable current regulator for welding current range 40 to300amps. Conforming to IS- 1851 – 1975.	3,4,5
23.	**Light Duty Spot Welding Machine**: Portable type spot Welder rating 2.5 KVA. for welding up to 2mm + 2mm M. S. Sheet, Max throat depth 20 cms.	3,4,

S. No.	Equipment Name with Broad Specifications	Exp. S.No.
24.	**Band Saw**: Heavy duty vertical bend saw machine, size of cast iron table 600 mm x 600 mm, 2HP / AC , 440 V, 50 Hz,3 phase AC motor with starter , Dia of wheel 450mm , width of wheel 38mm , depth of cut 300mm with standard accessories including dust collector .	6
25.	**Band saw and Circular Saw Sharpner:** 150 mm to 1054 mm dia circular saw 06 mm to 150 mm width bend saw blades, alternate saw, sharpening machine, equipped with roller swelling of arm spindle having pivoting motion for level of blade teeth. Feeds 40 and 80 teeth per minute. provided with 1 HP / AC 440 v, 3 Phase50Hz. Electric motor with starter, cast Iron pedestal grinding wheel. Motor pulley and V Belt .	6
26.	**Chain and Chisel Mortising Machine:** Floor model provided with endless chain cutter or chisel, headstock counter balanced, table having compound slide for lateral movement by screw adjustment and longitudinal traverse by hand wheel, provided with quick screw clamp, having capacity maximum size of chain 9mm to19mm, max. size of chisel 9mm, depth of bore150 mm, longitudinal table movement 225 mm, lateral movement150 mm, complete with 3ph A. C. 440 v 50 hz electric motor and switch .	6
27.	**Vertical Sander:** Vertical sander sands and polishes flat surfacescapacity180 mm Input (full load):-500watts No load speed 2200 rpm Full load speed :- 1200 rpm	6
28.	**Heavy Duty Circular Saw:**1400 watts/5800rpm. Compact and well balanced. Powerful motor for maximum performance.100 % ball and roller bearings construction. Reversible inner clamp flange.	6
29.	**Heavy Duty Variable Speed Reciprocating Saw Kit:** 640 watts/0-2,400rpm,Variable speed, ball and roller bearings construction. Low vibration. Rubber boot. Flush cutting blade position. Externally replaceable brushes. Capacity-184 mm	6
30.	**Single Speed Impact Drill:** Powerful motor for maximum performance. Compact and well balanced. Helical gear system. Bearing block for precision gear and spindle alignment. Capacity -10mm	6
31.	**Angle Grinder:** Powerful long life motor, spindle lock. Durable and reliable design. Maximum airflow with aero-dynamic fan system. Compact gear case External brush access panel. Capacity-100mm	4
32.	Riveting Gun, Hammers, Spanners and torque wrench, Punch, Allen keys	
33.	**Centre Lathe (General type):** Max. Swing over bed: 450 mm. Max swinging gap770 mm Admit between centers: 555 mm Spindle bore:52 mm. Power of motor:3hp, 3phase, 50Hz. With accessories.	7
34.	**Hydraulic Power - Hacksaw Machine:** Length of stroke (Max.) 200mm for cutting round and square material (Max.) 300mm speed1440 rpm. Power of motor 1.5 kW (AC 3 phase440volt). Accessories Vice for holding bars, saw blade, coolant pump with fittings limit switch, bar rest assembly set of wrenches and belts.	7
35.	**Shaping Machine:** Max. Length ofstroke630mm.Length and width ofram bearing 914x 279 mm Max. distance table to ram 490 mm. Min. distance tabletoram100mm. Max. Horizontal travelof table610 mm. Max. Vertical travel of table 390 mm. No of speedsofram4.Max.Traveloftoolslide 152mm. Swiveling of tool slide on either side ofthevertical60Deg. Power of maindrivemotor3HP, 440V,3 phase, 950 rpm. Accessories Auto Lubrication,	7

S. No.	Equipment Name with Broad Specifications	Exp. S.No.
	operating handle, Vice, key way cutting attachment.	
36.	**Measuring Instruments and Tools:** Vernier Caliper- 0 to 300mm, Dial Caliper- 0-300 mm, Vernier Depth Gauge-0 to 300 mm, Digital Height Gauge- 0 to 4 50mm, Digital Micrometer- 0 to 25 mm, Combination Set	7

8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics is to be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency:

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit– I Advanced Fitting Operations	1a. Interpret the given job drawing. 1b. Select relevant fitting tools for the specified data. 1c. Select proper raw material for the given condition. 1d. Describe the specified machinery in fitting shop. 1e. Explain the maintenance procedure of the given tool/ equipment in fitting shop.	1.1 Fitting tools-holding tools like bench vice, V-block with clamp, C-clamp. Marking and measuring tools like surface plate, angle plate , universal scribing block, try square , combination set, scriber, odd leg caliper, divider, punches, calipers, Vernier caliper, Vernier depth gauge, Vernier height gauge, outside micrometer, inside micrometer , hammers, screw driver, spanners and their Specifications 1.2 Cutting tools-Hacksaw, Chisels, combination plier, nose plier, twist drill, taps and tap wrenches, dies and die holder, bench drilling machine, portable electric drill, reamers 1.3 Finishing tools-Files, Hand file, flat file square file, Triangular file, half round file, round file 1.4 Fitting shop machineries-drilling machine, power saw, grinder, their specification, care and maintenance 1.5 Basic processes - chipping, filing, scrapping, grinding, marking, sawing, drilling, tapping, dieing, reaming 1.6 Marking and measuring angles, safety practices.
Unit-II Smithy shop work	2a. Describe operation sequence for a given job. 2b. Explain the function of the given tools with the help of diagrams. 2c. Describe the given machinery in smithy shop. 2d. Describe the specified operations in the smithy shop. 2e. Explain the maintenance procedure for tools, equipment and machinery.	2.1 Tools and equipment- hearth, anvil, swage block, leg vice, hammers, tongs- flat bit tongs, square bit tongs, round bit tongs, pick up tongs. 2.2 Forging operations-upsetting, drawing down and fullering, flattening, waging, bending, twisting, piercing, punching and drifting, welding, finishing, riveting, cutting(hot and cold chisels 2.3 Safe practices
Unit– III Domestic fabrication work	3a. Select the relevant arc welding tool for welding the given job. 3b. Describe the function of the given machinery in fabrication shop. 3c. Describe the fabrication proceedure in given situation. 3d. Explain maintenance procedure for the given equipment in the fabrication shop.	3.1 Arc welding equipment: Power sources for arc welding - transformers, motor generators and rectifiers 3.2 Arc welding hand tools- welding cables, electrodes, electrode holder, ground clamp, wire brush, chipping hammer, working table and cabin, face shield, apron, hand gloves. 3.3 Technique of welding- preparation of work, striking an arc, weaving, effect of current and speed, welded joints, welding positions 3.4 Operation of machinery in welding shop-arc welding transformer their specification and maintenance 3.5 Safe practices
Unit– IV Advanced carpentry work	4a. Describe with sketches the function of the given advanced furniture making and carpentry tool(s). 4b. Select the relevant furniture making tools for the given job. 4c. Describe the operation of the given wood working machine. 4d. Explain maintenance procedure for the given equipment in carpentry shop.	4.1 Types of artificial wood such as plywood, block board, hand board, laminated boards, veneer, fibre boards and their applications. 4.2 Furniture making hand tools- Marking and measuring tools-steel rule, steel tape, marking gauge, try square, compass and divider, scriber or marking knife, bevel 4.3 Holding tools-carpenters vice, c- clamp, bar cramp. 4.4 Planning tools-jack plane, smoothening plane, rebate plane, plough plane. 4.5 Cutting tools- saws, crosscut and hand saw, rip saw, tenon saw, compass saw, chisels, firmer chisel, dovetail chisel, mortise chisel. 4.6 Drilling and boring tools-carpenters brace hand drill, auger bit, hand drill, gimlet, 4.7 Miscellaneous tools-mallet, pincer, claw hammer, screw driver, wood rasp file, bradawl. 4.8 Safe practices.
Unit– V Workshop machines	5a. Describe with sketches the function of the given work and tool holding device. 5b. Explain with sketches the working principle of the given lathe operation. 5c. Calculate speed, feed, depth of cut of lathe machine for the given	5.1 Working principle and types of lathe 5.2 Parts of lathe, bed, headstock, tailstock, carriage or saddle, compound rest, tool post, lead screw, centres 5.3 Work holding devices- three jaw chuck, four jaw chuck, face plate,lathe dogs and driving plate 5.4 Measuring instruments- outside and inside caliper, vernier caliper, micrometer 5.5 Cutting parameters-cutting speed, feed,

	job 5d. Explain working principle of the given workshop machine	depth of cut, tools materials, tools geometry. 5.6 Lathe operations- turning Shaper machine- Working principle and operation, classification, main parts and their functions

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.

9. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

- Not applicable -

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes:

a. Prepare work diary based on practical performed inworkshop. Work diary consist of job drawing, operations to be perform, required raw materials, tools, equipment's, date of performance with teacher signature.
b. Prepare journals consist of free hand sketches of tools and equipment's in each shop, detail specification and precautions to be observed while using tools and equipment.
c. Prepare/Download a specifications of followings:
   a) Various tools and equipment in various shops.
   b) Precision equipment in workshop
   c) Various machineries in workshop
d. Undertake a market survey of local dealers for procurement of workshop tools, equipment machineries and raw material.
e. Visit any fabrication/wood working/sheet metal workshop and prepare a report.

11. SUGGESTEDSPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies which the teacher can use to accelerate the attainment of the various learning outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.
f. Arrange visit to nearby industries and workshops for understanding various manufacturing process.
g. Show video/animation films to explain functioning of various processes of turning operations and shaping operations.
h. Prepare maintenance charts for various workshop machineries.
i. In respect of item 10 above, teachers need to ensure to create opportunities and provisions for such co curricular activities.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs, ADOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course.

In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty:

a. **Black Smithy Jobs:** Each batch will collect minimum 5 different utility jobs of black smithy from the local workshop / market. Each student will measure the significant parameters and draw the sketch. Each student will also note the material of the utility jobs and their field applications.
b. **Fabrication Utility Jobs:** Each batch will collect information related to fabrication utility jobs including name of job, sketch, material used, fabrication process and their field applications of minimum 5 different jobs of fabrication used in civil construction from the local market.
c. **Fabrication Utility Jobs:** Each batch will select at least one fabrication utility job used in civil construction and prepare steel frame / structure of utility job like window grill, ventilator, door frame or similar job involving arc welding including drawing, field application of selected job.
d. **Wood Related Jobs:** Each batch will collect minimum 4 different samples of artificial woods such as plywood, block board, hand board, laminated boards, veneer, fiber board's etc and write their applications.
e. **Wood Related Jobs**: Each batch will collect and record the information related to furniture making tools and furnitures used in educational institutes from the local carpentry / furniture workshops with their major specifications and sketch.
f. **Miscellaneous Jobs**: Each batch will prepare jobs (like tree guard/shoe stand etc.) by using appropriate material and method of fabrication.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1.	Workshop Practice	Bawa, H.S.	McGraw Hill Education, Noida: ISBN-13: 978-0070671195
2.	A Textbook of Manufacturing Process (Workshop Tech.)	Gupta, J.K.; Khurmi,R.S.	S. Chand and Co. New Delhi ISBN:81-219-3092-8
4.	Introduction to Basic Manufacturing Process and Workshop Technology	Singh, Rajender	New Age International, New Delhi; 2014, ISBN: 978-81-224-3070-7
6	Workshop Technology Vol-I and II	Raghuvanshi B.S	Dhanpat Rai New Delhi; 2014, ISBN 4567144376

14. SOFTWARE/LEARNING WEBSITES

a. http://www.asnu.com.au
b. http://www.abmtools.com/downloads/Woodworking%20Carpentry%20Tools.pdf
c. http://www.weldingtechnology.org
d. http://www.newagepublishers.com/samplechapter/001469.pdf
e. http://www.youtube.com/watch?v=TeBX6cKKHWY
f. http://www.youtube.com/watch?v=QHF0sNHnttwandfeature=related
g. http://www.youtube.com/watch?v=Kv1zo9CAxt4andfeature=relmfu
h. http://www.piehtoolco.com
i. http://sourcing.indiamart.com/engineering/articles/materials-used-hand-tools/
j. https://www.youtube.com/watch?v=9_cnkaAbtCM