**Program Name** : **Diploma in Automobile Engineering**

**Program Code** : **AE**

**Semester** : **Third**

**Course Title** : **Automobile Engineering Drawing**

**Course Code** : **22023**

## 1. RATIONALE

Automobile engineering technologists, irrespective of their field of operation in an automobile industry, is expected to possess a thorough understanding of drawing, which includes clear visualization of objects and automobile components with the proficiency in reading and interpreting variety of production drawings. Besides, they are also expected to possess drafting skills depending upon job function, to perform day to day activity i.e. communicating and discussing innovative ideas and concepts with supervisors and passing on instructions to subordinates unambiguously. This course is enhancing the knowledge and skills acquired in the earlier two courses viz. Engineering Graphics & Engineering Drawing.

## 2. COMPETENCY

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

- Prepare drawings of automobile components using conventional drawing instruments and standards.

## 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. Draw development of lateral surface of various solids.
b. Draw intersection curves of different solids used in the field of automobile engineering.
c. Draw production drawings used to produce products.
d. Draw assembly and detailed drawings of products.
e. Use various drawing codes, conventions and symbols as per IS SP-46.

## 4. TEACHING AND EXAMINATION SCHEME

| Teaching Scheme | | | Credit (L+T+P) | Examination Scheme | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | | | | | | Practical | | | | | |
| L | T | P | | Paper Hrs. | ESE | | PA | | Total | | ESE | | PA | | Total | |
| | | | | | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min |
| 1 | - | 4 | 5 | -- | -- | -- | -- | -- | -- | -- | 50@ | 20 | 50~ | 20 | 100 | 40 |

*(#):No theory Exam; (~[2]): For the courses having ONLY practical examination, the PA has two parts – marks for ~[2] (i) practical part - 30 marks (60%) (ii) micro-project part – 20 marks (40%).*

***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.

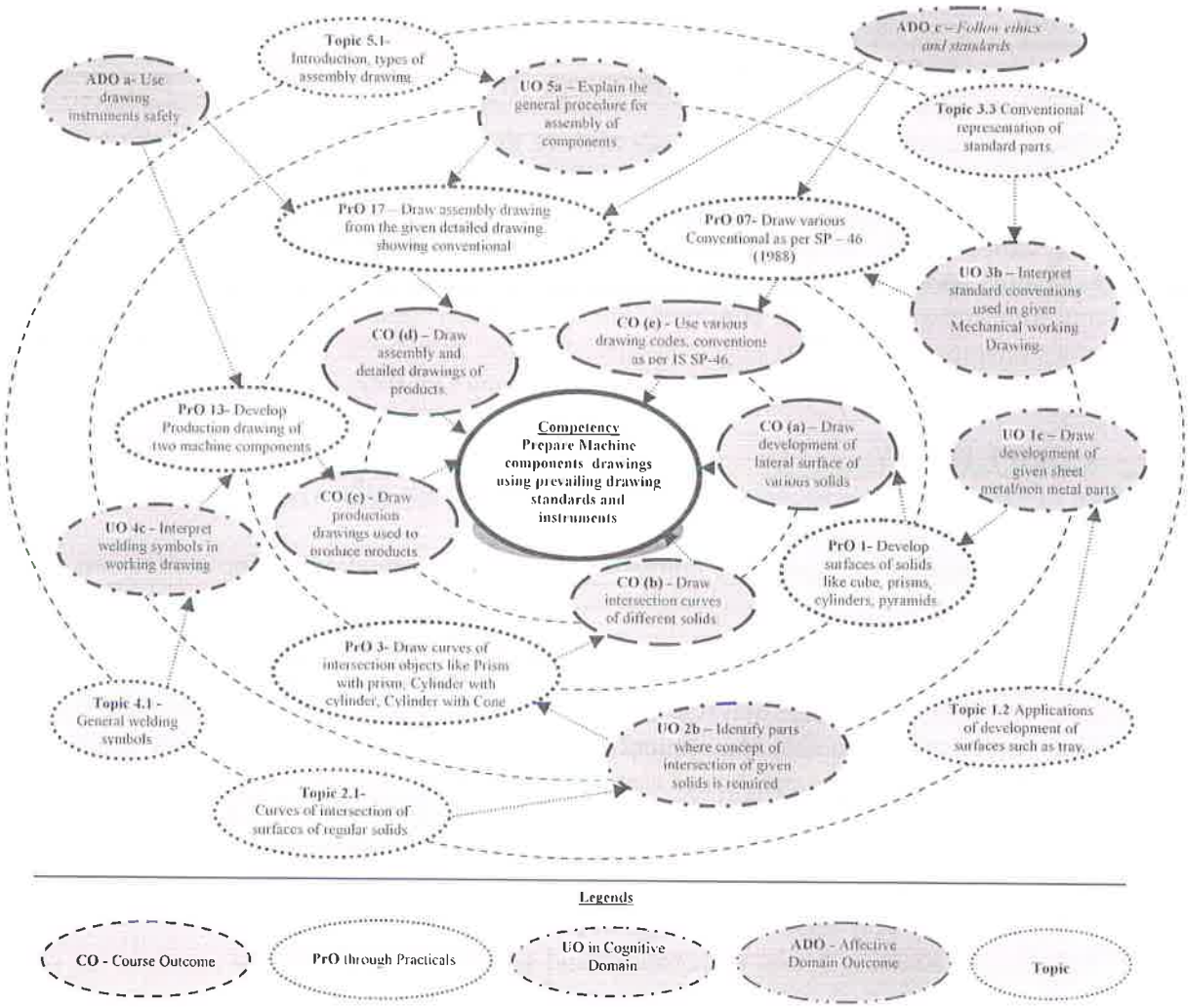


**Figure 1 - Course Map**

## 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 Outcomes (PrOs) | Unit No. | Approx. Hrs. required |
|---|---|---|---|
| **Sheet No.:1** | | | |
| 1 | Develop surfaces of solids like cube, prisms, cylinders, pyramids. (Part I) | I | 02* |
| 2 | Develop surfaces of solids like pyramids, cones. (Part II) | | |
| **Sheet No.:2** | | | |
| 3 | Draw curves of intersection of any two objects like Prism with prism (Tri-angular and square), Cylinder with cylinder, Square | II | 02* |

| S. No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs. required |
|---|---|---|---|
| | Prism with Cylinder, Cylinder with Cone. (Part I) | | |
| 4 | Draw curves of intersection of any two objects like Prism with prism (Tri-angular and square), Cylinder with cylinder, Square Prism with Cylinder, Cylinder with Cone. (Part II) | II | 02 |
| 5 | Draw curves of intersection of any two objects like Prism with prism( Tri-angular and square), Cylinder with cylinder, Square Prism with Cylinder, Cylinder with Cone. (Part III) | II | 02 |
| 6 | Draw curves of intersection of any two objects like Prism with prism( Tri-angular and square), Cylinder with cylinder, Square Prism with Cylinder, Cylinder with Cone. (Part IV) | II | 02 |
| **Sheet No.:3** | | | |
| 7 | Draw various Conventional Representations as per SP – 46 (1988) (Part I) | III | 02* |
| 8 | Draw various Conventional Representations as per SP – 46 (1988) (Part II) | III | 02 |
| 9 | Draw various Conventional Representations as per SP – 46 (1988) (Part III) | III | 02 |
| **Sheet No.:4** | | | |
| 10 | Draw Dimensional and Geometrical Tolerances, welding symbols, surface roughness and Machining Symbols on given figures and tables. (Part I) | IV | 02* |
| 11 | Draw Dimensional and Geometrical Tolerances, welding symbols, surface roughness and Machining Symbols on given figures and tables. (Part II) | IV | 02 |
| 12 | Draw Dimensional and Geometrical Tolerances, welding symbols, surface roughness and Machining Symbols on given figures and tables. (Part III) | IV | 02 |
| **Sheet No.:5** | | | |
| 13 | Develop Production drawing of at least two machine components showing dimensional and geometrical tolerance, surface finish etc. (Part I) | IV | 02* |
| 14 | Develop Production drawing of at least two machine components showing dimensional and geometrical tolerance, surface finish etc. (Part II) | IV | 02 |
| 15 | Develop Production drawing of at least two machine components showing dimensional and geometrical tolerance, surface finish etc. (Part III) | IV | 02 |
| 16 | Develop Production drawing of at least two machine components showing dimensional and geometrical tolerance, surface finish etc. (Part IV) | IV | 02 |
| **Sheet No.:6** | | | |
| 17 | Draw assembly drawing from the given detailed drawing showing conventional representations, Dimensional and Geometrical tolerances and surface finish symbols. (Part I) | V | 02* |
| 18 | Draw assembly drawing from the given detailed drawing showing conventional representations, Dimensional and Geometrical tolerances and surface finish symbols. (Part II) | V | 02 |

| S. No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs. required |
|---|---|---|---|
| 19 | Draw assembly drawing from the given detailed drawing showing conventional representations, Dimensional and Geometrical tolerances and surface finish symbols. (Part III) | V | 02 |
| 20 | Draw assembly drawing from the given detailed drawing showing conventional representations, Dimensional and Geometrical tolerances and surface finish symbols. (Part IV) | V | 02 |
| 21 | Draw assembly drawing from the given detailed drawing showing conventional representations, Dimensional and Geometrical tolerances and surface finish symbols. (Part V) | V | 02 |
| 22 | Draw assembly drawing from the given detailed drawing showing conventional representations, Dimensional and Geometrical tolerances and surface finish symbols. (Part VI) | V | 02 |
| 23 | Draw assembly drawing from the given detailed drawing showing conventional representations, Dimensional and Geometrical tolerances and surface finish symbols. (Part VII) | V | 02 |
| 24 | Draw assembly drawing from the given detailed drawing showing conventional representations, Dimensional and Geometrical tolerances and surface finish symbols. (Part VIII) | V | 02 |
| **Sheet No.:7** | | | |
| 25 | Draw detailed drawings from given assembly drawing of Rocker arm showing conventional representation, Dimensional and Geometrical tolerances and surface finish symbols. (Part I) | VI | 02* |
| 26 | Draw detailed drawings from given assembly drawing of Rocker arm showing conventional representation, Dimensional and Geometrical tolerances and surface finish symbols. (Part II) | VI | 02 |
| 27 | Draw detailed drawings from given assembly drawing of Rocker arm showing conventional representation, Dimensional and Geometrical tolerances and surface finish symbols. (Part III) | VI | 02 |
| 28 | Draw detailed drawings from given assembly drawing of Rocker arm showing conventional representation, Dimensional and Geometrical tolerances and surface finish symbols. (Part IV) | VI | 02 |
| 29 | Draw detailed drawings from given assembly drawing of Rocker arm showing conventional representation, Dimensional and Geometrical tolerances and surface finish symbols. (Part V) | VI | 02 |
| 30 | Draw detailed drawings from given assembly drawing of Rocker arm showing conventional representation, Dimensional and Geometrical tolerances and surface finish symbols. (Part VI) | VI | 02 |
| 31 | Draw detailed drawings from given assembly drawing of Rocker arm showing conventional representation, Dimensional and Geometrical tolerances and surface finish symbols. (Part VII) | VI | 02 |
| 32 | Draw detailed drawings from given assembly drawing of Rocker arm showing conventional representation, Dimensional and Geometrical tolerances and surface finish symbols. (Part VIII) | VI | 02 |
| | **Total** | | **64** |

***Note***

*i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 24 or more practical need to be*

*performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

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. | Interpretation of given problem | 20 |
| 2. | Draw sheet using different drafting instrument | 35 |
| 3. | Follow line work for neat and accurate drafting | 10 |
| 4. | Dimensioning the given drawing and writing text | 10 |
| 5. | Answers to sheet related questions | 10 |
| 6. | Submit the assigned sheet on time | 5 |
| 7. | Follow cleanliness and housekeeping in Drawing Hall | 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. Use drawing instruments safely.
b. Practice cleanliness and neatness.
c. Follow ethics and standards.

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 | PrO. Unit.No. |
|---|---|---|
| 1. | Drawing Table with Drawing Board of Full Imperial/ A1 size | All |
| 2. | Paper Models of objects for development of Lateral surfaces of solid | 01, 02 |
| 3. | Models of solids showing intersection curves | 03 to 06 |
| 4. | Models of machine components for conventional representation | 07 to 09 |
| 5. | Actual assemblies mentioned in unit V | 13 to 32 |
| 6. | Set of various production drawings being used by industries | All |
| 7. | Specimen library of various machine components | All |
| 8. | Set of drawings sheets mentioned in section 6.0 could be developed by experienced teachers and made available on the MSBTE portal to be used as reference/standards | All |

| S. No. | Equipment Name with Broad Specifications | PrO. Unit.No. |
|---|---|---|
| 9. | Drawing equipment's and instruments for class room teaching-large size:<br>a. T-square or drafter (Drafting Machine)<br>b. Set squares ($45^0$ and $30^0$- $60^0$)<br>c. Protractor<br>Drawing instrument box (containing set of compasses and dividers) | All |
| 10. | Interactive board with LCD overhead projector | All |

## 8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

| Unit | Unit Outcomes (UOs) (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| **Unit– I Development of Surfaces** | 1a. Identify parts where concept of development of the given surfaces is required.<br>1b. Describe the procedure to draw development of lateral surfaces of the given solid.<br>1c. Describe the procedure to draw development of given sheet metal/non metal parts. | 1.1 Developments of Lateral surfaces of cube, prisms, cylinder, pyramids, cone. (Parallel and Radial Line methods)<br>1.2 Applications of development of surfaces such as tray, funnel. |
| **Unit-II Intersection of Solids** | 2a. Identify parts where concept of intersection of the given solids is required.<br>2b. Describe different methods of Intersection of surfaces of solids<br>2c. Describe the procedure to draw curves of intersection of the given solid combinations. | 2.1 Method of Intersection of surfaces of two solids: Line Method, Cutting Plane Method.<br>2.2 Curves of intersection of surfaces of the regular solids in the following cases: Prism with prism( Tri-angular and square), Cylinder with cylinder, Square Prism with Cylinder when<br>(i) the axes are at 90° and intersecting.<br>(ii) The axes are at 90° and Offset.<br>2.3 Cylinder with Cone: when axis of cylinder is parallel to both the reference planes and cone resting on base on HP with axis intersecting and offset from axis of cylinder. |
| **Unit– III Conventional Representation** | 3a. Use IS SP-46 (1988) codes.<br>3b. Interpret standard conventions used in the given mechanical working drawing.<br>3c. Select the standard | 3.1 Conventional breaks in pipe, rod and shaft.<br>3.2 Conventional representation of common features like slotted head, radial rib, knurling, serrated shaft, splined shaft, ratchet and pinion, repeated parts, square on shafts, holes on circular pitch, internal |

| | | |
|---|---|---|
| | conventions in practice for the given situation. | and external thread.<br>3.3 Conventional representation of standard parts like ball and roller bearing, keys, gears, springs.<br>3.4 Pipe joints and valves.<br>3.5 Counter sunk and Counter bored holes.<br>3.6 Tapers<br>( As per standard conventions using IS SP – 46 (1988) |
| **Unit– IV Conventional Representation and Production Drawings** | 4a. Calculate tolerances of the given machine components.<br>4b. Identify fit required between mating parts of the given machine components based on the given tolerance values.<br>4c. Interpret welding symbols in the given working drawing.<br>4d. Interpret surface roughness characteristics from the values the given on component drawing.<br>4e. Describe the procedure to draw above conventional representations for the given situation. | 4.1 Limits, Fits and Tolerances:<br>a) Definitions, introductions to ISO system of Tolerance.<br>b) Dimensional tolerances:-Terminology, selection and representation of dimensional tolerance- number and grade method. Definitions concerning Tolerance and Limits system, unilateral and bilateral tolerance, Hole and shaft base systems, Types of fits- Clearance, transition and Interference, Selection of fit for engineering applications. Calculation of limit sizes and identification of type of fit from the given sizes like Ø50 H7/s6, Ø30 H7/d9 etc.<br>4.2 Geometrical Tolerances: Types of geometrical tolerances, terminology for deviation, Tolerances of form and position and its geometric representation. Tolerance frame, datum feature, magnitude of tolerance and symbol, representation and interpretation of geometrical tolerance on drawing.<br>4.3 General welding symbols, length and size of weld, surface contour and finish of weld, all round and site weld, symbolic representation in Engineering practices and its interpretation.<br>4.4 Machining symbol and surface texture: Indication of machining symbol showing direction of lay, sampling length, roughness grades, machining allowances, manufacturing methods. Representation of surface roughness on drawing. |
| **Unit– V Details to Assembly** | 5a. Explain the general procedure for assembly of components.<br>5b. State details of components and the sequence of components | 5.1 Introduction, types of assembly drawing, accepted norms to be observed for assembly drawings, sequence for preparing assembly drawing. Bill of Material. Assembly drawings of:<br>a) Couplings - Universal couplings |

| | | |
|---|---|---|
| | of the given assembly.<br>5c. Describe the procedure to draw assembly drawing from the given detailed drawing. | b) Bearing –Pedestal Bearing<br>c) Tool Post – Lathe Square tool post.<br>d) Screw Jack<br>e) Drilling Jig |
| **Unit– VI Assembly to Details** | 6a. Identify various components in the given assembly and the sequence of dismantling it.<br>6b. Describe the procedure for dismantling the assembly into components.<br>6c. Describe the procedure to draw detailed drawing from the given assembly drawing. | 6.1 Basic principles of process of dismantling the assembly into components.<br>6.2 Details of following assemblies<br>a) Non - Return Valve<br>b) Piston & connecting rod assembly,<br>c) Single plate clutch assembly<br>d) Rotary Gear pump.<br>e) Fuel injector. |

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

## 9. SUGGESTED SPECIFICATION TABLE FOR QUESTION 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 in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Student should maintain a separate A3 size sketch book which will be the part of term work and submit it along with drawing sheets. Following assignment should be drawn in the sketch book
   i. Minimum 5 problems each on Unit No I and II.
   ii. Convention Representation of material, gear, spring, bearings, internal threads, external threads, welding joints, machining symbol, direction of lays.
b. Students should collect Production drawings from nearby workshops/industries and try to visualize the part from the given views.
c. Prepare paper models of development of lateral surfaces of solids
d. Visit any sheet metal workshop and prepare a report related to type of components, dimensions, material, area of application, raw material required, name of operations performed.
e. Prepare clay/ paper models of solids showing curves of intersection.
f. Each student should explain at least one problem for construction and method of drawing in sheet to all batch colleagues.
g. Each student will assess at least one sheet of other students (May be a group of 5-6 students identified by teacher can be taken) and will note down the mistakes committed by them. Student will also guide the students for correcting the mistakes, if any.
h. Student to make assembly and dismantling physically of at least one automobile assembly.

## 11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various 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. Demonstrate students thoroughly before they start doing the practice.
g. Encourage students to refer different websites to have deeper understanding of the subject.
h. Observe continuously and monitor the performance of students during practice.
i. Arrange visit to nearby industries and workshops for understanding various production drawings.
j. Show video, animation films, solid modeling software to explain intersection of solid, Assembly and details
k. Prepare wall charts for Dimensional and Geometrical Tolerances.

## 12. SUGGESTED MICRO-PROJECTS

***Only one micro-project*** is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably 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. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. 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. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:

a. Visit nearby fabrication workshop and prepare report on various types of welding symbols used for fabrication work.
b. Visit nearby process industries like sugar factory, chemical industries etc and prepare report representing conventional representation of various piping joints.
c. Visit Institute's Power engineering Lab and prepare detailed drawings of Various IC Engine components using proper measuring instruments.
d. Visit Institute's workshop and prepare assembly drawing and working drawing of machine vice/ lathe tailstock/ tool post etc.
e. Create models showing types of fits.
f. Any other micro-projects suggested by subject faculty on similar line.

## 13. SUGGESTED LEARNING RESOURCES

| S. No. | Title of Book | Author | Publication |
|---|---|---|---|
| 1 | Machine Drawing | Bhatt N.D., Panchal V.M. | Charotar Publishing house pvt ltd., Anand, Gujarat, 2013, ISBN 9789380358635 |
| 2 | Engineering Drawing practice for schools and colleges IS:SP- 46 | Bureau of Indian standard | BIS, New Delhi, Third reprint, Octomber 1998 ISBN 8170610912 |
| 3 | Production Drawing | Narayanan L.K., Kannaich P., VenkatReddy K. | New Age International Publication, New Delhi, 2009, ISBN: 9788122435016 |
| 4 | Engineering Drawing | Bhatt N.D. | Charotar Publishing house pvt ltd. Anand, Gujarat, ISBN:9789380358178 |
| 5 | A text book of Machine Drawing | Gill P.S. | S.K.Kataria and Sons, New Delhi,2007, ISBN: 9789350144169 |
| 6 | Machine Drawing | Sidheshwar | McGraw Hill, New Delhi, 2009, ISBN : 9780074603376 |
| 7 | Machine Drawing | Ajeet Singh | McGraw Hill Education, New Delhi, ISBN No.: 007065992-3 |
| 8 | Engineering Drawing | Basant Agrawal, C.M. Agrawal | McGraw Hill Education, New Delhi 2009, ISBN No. 978-00-7066-863-8 |

## 14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. sketch up 7 software for solid modelling
b. http://www.weldingtechnology.org
c. http://www.newagepublishers.com
d. Engineering graphics and Drawing v 1.0 from cognifront
e. http://www.youtube.com/watch?v=o1YPja2wCYQ
f. http://www.youtube.com/watch?v=9AGD4tihjCg&feature=plcp
g. http://www.youtube.com/watch?v=n65NU32inOU
h. http://www.youtube.com/watch?v=tyRVsSsNiUQ
i. http://www.youtube.com/watch?v=_M5eYB6056M
j. http://www.youtube.com/watch?v=UyROI-bAMu4
k. http://www.youtube.com/watch?v=eix8xbqb93s
l. http://www.youtube.com/watch?v=kWOl6ttDTBc
m. http://www.youtube.com/watch?v=gJbrO2jtoa8&feature=related
n. http://www.youtube.com/watch?v=PXgkBadGHEE
o. Engineering Graphics & Drawing v 1.0 from Cognifront