Government Polytechnic Pune

(An Autonomous Institute of Government of Maharashtra)

Curriculum Revision 2019
(180 OB)

Department of Mechanical

Government Polytechnic, Pune

'180OB' – Scheme

Programme	Diploma in ET/CE/EE//**ME**/MT/CM/IT/DDGM
Programme code	01/02/03/**04**/05/06/07/08/16/17/18/21/22/23/**24**/26
Name of Course	**Fundamental of Engineering Graphics**
Course Code	**ME2101**
Prerequisite course code and name	**NIL**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	***ESE**	**PA**	
02	00	02	04	**Marks**	80	20	00	25	125
				Exam Duration	4 Hrs	1.30 Hr	--	--	

(*):*OE/POE (Oral Examination/Practical&Oral Examination mention whichever is applicable)*

Legends: L- lecture,T-Tutorial/teacher guided theory practice,P-practical,ESE-End semester examination,PA- Progressive Assesment.

2. RATIONALE :

Engineering drawing is the graphical language. It is used by engineers, designers, planners, supervisors and also the workers to express their thoughts, ideas and concepts. The expression by drawing is very accurate precise and brief. At a glance one can understand detailed description of any part to be manufactured or a dam to be built or an electric circuit to be used. For all technicians through understanding of principles of engineering drawing (Graphic Skills) is essential.

3. COMPETENCY

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

Interpret understand and prepare orthographic and isometric drawing of given component .

4. 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 **:**

1. Draw geometrical figures and Engineering Curves

2. Draw views of given object using principles of orthographic projections
3. Draw isometric view of a given object from orthographic projections
4. Draw free hand sketches of given engineering elements

1. SUGGESTED PRACTICALS/ EXERCISES

The practical's 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 Each student will draw 6 half imperial size drawing sheets as given below and will submit at the end of term.

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
1	Draw horizontal, vertical, 30 degree, 45 degree, 60 and 75 degrees lines, different types of lines, dimensioning styles using Set squares/ drafter. (do this exercise in sketch book)	01	02
2	Line letters and numbers. Dimensioning technique. One problem on Redraw the figure (Sheet No.1).	01	04
3	Engineering curves Any four problems (Sheet No.2)	02	06
4	Draw a problem on orthographic projections using First angle method of projection having plain surfaces. (Sheet No.3-Problem-1)	03	02
5	Draw a problem on orthographic projections using Third angle method of projection having plain surfaces. (Sheet No.3-Problem-2)	03	02
6	Draw a problem on orthographic projections using first angle method of projection having slanting surfaces, cylindrical surfaces, ribs.(Sheet No-4-Problem-1)	03	03
7	Draw a problem on orthographic projections using Third angle method of projection having slanting surfaces, cylindrical surfaces, ribs.(Sheet No-4-Problem-2)	03	03
8	Draw one problems on Isometric view of simple objects having plain and slanting and cylindrical surfaces by using natural scale.(Sheet No.5-Problem-1)	04	03
9	Draw one problems on Isometric projection of simple objects having plain and slanting and cylindrical surfaces by using isometric scale. (Sheet No.5-Problem-2)	04	03
10	Draw neat and proportionate free hand sketches. Any six elements (Sheet No.6)	05	04
	Total		**32**

S.No.	Performance Indicators	Weightage in %
1	Neatness, Cleanliness on drawing sheet	10
2	Uniformity in drawing and line work	10

S.No.	Performance Indicators	Weightage in %
3	Creating given drawing	40
4	Dimensioning the given drawing and writing text	10
5	Answer to sample questions	10
6	Submission of drawing in time	20
Total		**100**

2. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned**.**

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Drawing Table with Drawing Board of Full Imperial/ A1 size.	All
2	Models of objects for orthographic / isometric projections	3,4,5,6, 7,8,9,10
3	Models/ Charts of objects mentioned in unit no. 3,4,5	-
4	Set of various industrial drawings being used by industries.	All
5	Drawing equipment's and instruments for class room teaching-large size: a. T-square or drafter (Drafting Machine) b. Set squares (45^0 and 30^0- 60^0) c. Protractor d. Drawing instrument box (containing set of compasses and dividers)	All
6	Interactive board with LCD overhead projector	All

3. THEORY COMPONENTS

The following topics/subtopics should 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 **Introduction of Drawing Instruments, Lines, Letters etc.** (Weightage00 , Hrs- 04)	1a. Prepare drawing using drawing instruments. 1b. Use IS SP-46 for dimensioning. 1c. Use different types of lines. 1d. Draw regular geometrical figures. 1e. Draw figures having tangency constructions.	1.1 Drawing Instruments and supporting material: method to use them with applications.. 1.2 Standard sizes of drawing sheets (ISO-A series). I.S. codes for planning and layout. Letters and numbers (single stroke vertical) 1.3 Conventions of lines and their applications. Scale - reduced, enlarged and full size 1.4 Dimensioning techniques as per SP-46(Latest edition).
UNIT -II Engineering Curve and Tangential Exercises (Weightage16 , Hrs- 06)	2a. Explain different engineering curves with areas of application. 2b. Draw different conic sections based on given situation. 2c. Draw involute and cycloidal curves based on given data. 2d. Draw helix and spiral curves from given data	2.1 Concept of focus, directrix, vertex and eccentricity. Conic sections. 2.2 To draw an ellipse by concentric circle method and Directrix focus method. 2.3 To draw a parabola by :- 1) Directrix focus method. 2.4 To draw a hyperbola by :- 1) Directrix focus method. 2.5 To draw involute of circle, Regular polygon such as pentagon 2.6 To draw a cylindrical helix (limited to two turns) . 2.7 To draw cycloid, epicycloids and hypocycloid.
UNIT-III Orthographic Projections (Weightage24 , Hrs- 10)	3a. Explain methods of Orthographic Projections. 3b. Draw orthographic views of given simple 2D entities containing lines, circles and arcs only. 3c. Draw the orthographic views from given pictorial views.	3.1 Orthographic projection, First angle and Third angle method, their symbols. 3.2 Conversion of pictorial view into Orthographic Views – object containing plain surfaces, slanting surfaces, slots, ribs, cylindrical surfaces. (use First Angle and Third Angle Projection Method.)
UNIT-IV Isometric Projections (Weightage24 , Hrs- 08)	4a Prepare isometric scale. 4b. Draw isometric views of given simple 2D entities containing lines, circles and arcs only. 4c. Interpret the given orthographic views.	4.1 Isometric view 4.2 Isometric projection. 4.3 Isometric scale and Natural Scale. 4.4 Illustrative problems related to simple objects having plain, slanting, cylindrical surfaces and slots on slanting surfaces. 4.5 Conversion of orthographic views into

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	4d. Draw Isometric views from given orthographic views.	Isometric view/Projection.
UNIT-V Free Hand Sketches (Weightage16 , Hrs- 04)	5.a Sketch proportionate freehand sketches of given machine elements. 5.b Select proper fasteners and locking arrangement for given situation.	5.1 Free hand sketches of machine elements: Thread profiles, nuts, bolts, studs, set screws, washers, Locking arrangements.

4. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to Drawing instruments lines letters etc.	04	--	--	--	--
II	Curve and Tangential exercises	06	--	16	--	16
III	Orthographic Projection	10	--	--	24	24
IV	Isometric Views	08	--	--	24	24
V	Free hand sketches	04	16	--	--	16
Total		32	**16**	**16**	**48**	**80**

5. SUGGESTED STUDENT ACTIVITIES

Following is the list of proposed student activities like:

i. Student should maintain a separate A3 size sketch book which will be the part of term work and submit it along with drawing sheets.

ii. Students should collect Maps, Production drawings, Building Drawings, Layouts from nearby workshops/industries/builders/contractors and try to list
   a. types of lines used
   b. lettering styles used
   c. dimension styles used
   d. IS code referred

iii. List the shapes and curves you are observing around you in real life with name of place and item. (For Ex. ellipse, parabola, hyperbola, cycloid, epicycloids, hypocycloid, involute, spiral helix).

6. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

a. Guide student(s) in fixing the sheet and mini drafter on drawing board..
b. Show video/animation films to explain orthographic and Isometric projection.
c. Demonstrate engineering curves through actual cut sections of cone, pyramid, etc
d. Demonstrate first and third angle method using model.
e. Use charts and industrial drawing to teach standard symbols Teacher should ask the students to go through instruction and Technical manuals

7. SUGGESTED MICRO-PROJECTS
(Only for Class Declaration Courses)

8. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	N.D. Bhatt	Elementary Engg. Drawing (Including plan and solid geometry)	Charotar Publication, Anand.
2	Mali, Chaudhary	Engineering Drawing	Vrinda Prakashan, Jalgaon
3	--	I.S. 696 Latest version	B.I.S.
4	Engineering Drawing Practice for Schools and Colleges IS: SP-46	Bureau of Indian Standards.	Third Reprint, October 1998 ISBN No. 81-7061-091-2
5	K. Venugopal	Engineering Drawing and Graphics + AutoCAD	New Age International Publishers.
6	Engineering Drawing	D.A. Jolhe	Tata McGraw Hill Edu. New Delhi, 2010, ISBN No. 978-0-07-064837-1
7	Engineering Drawing	R. K. Dhawan	S. Chand and Company New Delhi, ISBN No. 81-219-1431-0

9. SOFTWARE/LEARNING WEBSITES

i. https://www.youtube.com/watch?v=TJ4jGyD-WCw
ii. https://www.youtube.com/watch?v=dmt6_n7Sgcg
iii. https://www.youtube.com/watch?v=_MQScnLXL0M
iv. https://www.youtube.com/watch?v=3WXPanCq9LI
v. https://www.youtube.com/watch?v=fvjk7PlxAuo
vi. http://www.me.umn.edu/courses/me2011/handouts/engg%20graphics.pdf

10. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	1	1	1	2
CO2	3	3	2	1	1	1	2
CO3	3	3	2	1	1	1	2
CO4	3	3	2	1	1	1	2

	PSO1	PSO2
CO1	2	1
CO2	3	1
CO3	3	1
CO4	2	1

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'180 OB' – Scheme

Programme	Diploma in ET/CE/EE//**ME**/MT/CM/IT/DDGM
Programme code	01/02/03/**04**/05/06/07/08/16/17/21/22/23/**24**/26
Name of Course	**Mechanical Engineering Drawing**
Course Code	**ME - 2102**
Prerequisite course code and name	**ME2101 Fundamental of Engineering Graphics.**

5. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	***ESE**	**PA**	
02	00	02	04	**Marks**	80	20	00	25	125
				Exam Duration	4 Hrs	1.50 Hr			

(*):*OE/POE (Oral Examination/Practical&Oral Examination mention whichever is applicable)*

Legends: L- lecture,T-Tutorial/teacher guided theory practice,P-practical,ESE-End semester examination,PA- Progressive Assesment.

6. RATIONALE

Engineering drawing is the graphical language. It is used by engineers, designers, planners, supervisors and also the workers to express their thoughts, ideas and concepts. The expression by drawing is very accurate precise and brief. At a glance one can understand detailed description of any part to be manufactured or a dam to be built or an electric circuit to be used. For all technicians through understanding of principles of engineering drawing is essential. The curriculum aims at developing the ability to draw and read orthographic projections, projection of of solids and intersection of solids with skills in drawing sections.

7. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences: Interpret and prepare sectional mechanical working drawing /production drawing of given component and also draw projections of lines planes solids and free hand sketches

8. 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

After studying this course, the student will be able to	
1	Use principles of orthographic projection to draw sectional views of given object.
2	Use principles of orthographic projection to draw missing lines and view of given object.
3	Solve given problems on projections of Lines, Planes, right and regular solids and draw solid in sectional view..
4	Draw free hand sketches of given engineering elements

9. 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**.** Each student will draw 6 half imperial size drawing sheets as given below and will submit at the end of term..

Sr.No	Unit No	Sheet No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevent CO	Approx. Hours
1	1	01	Sectional orthographic views (Two Problems)	1	06
2	2	02	Missing views (Two Problems)	2	06
3	3	03	Projection of Lines (Two Problems)	3	02
4	4	03	Projection of Planes (Two Problems)	3	02
5	5	04	Projection of Solids (Two Problems)	3	06
6	6	05	Sections of solids (Two Problems)	3	06
7	7	06	Free hand sketches. (Any Six elements)	4	04
		Total			**32**

S.No.	Performance Indicators	Weightage in %
1	Neatness, Cleanliness on drawing sheet	10
2	Uniformity in drawing and line work	10
3	Creating given drawing	40
4	Dimensioning the given drawing and writing text	10
5	Answer to sample questions	10
6	Submission of drawing in time	20
Total		**100**

10. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned**.**

S. No.	Equipment Name with Broad Specifications	PrO. No.
7	Drawing Table with Drawing Board of Full Imperial/ A1 size.	All
8	Models/ Charts of objects mentioned in unit no. 1,2,3,4,5,6,7	1,2,3,4, 5,6,7
9	Set of various industrial drawings being used by industries.	All
10	Drawing equipment's and instruments for class room teaching-large size: e. T-square or drafter (Drafting Machine) f. Set squares (45^0 and 30^0- 60^0) g. Protractor h. Drawing instrument box (containing set of compasses and dividers)	All
11	Interactive board with LCD overhead projector	All

11. THEORY COMPONENTS

The following topics/subtopics should 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 1. Sectional orthographic views (Weightage 16 , Hrs-04)	1a. Classify various types of sectional views. 1b.Explain sectioning and hatching conventions. 1c.Convert pictorial views of given object into sectional orthographic views. 1d.Interpret the given Drawing	Cutting plane line ,Types of sectional views: Full section, Half section, Partial or broken section, Revolved section, Removed section, offset section, Aligned section. Sectioning conventions Hatching or section lines. Conversion of pictorial views into sectional orthographic views
UNIT 2. Missing views (Weightage 12 , Hrs-04)	2a.Interpret the given views 2b.Draw the missing view	Draw Missing lines and views from the given orthographic views .
UNIT 3. Projection of Lines (Weightage 06 , Hrs-03)	3a. Classify various positions of lines with respect to projection planes. 3b. Draw projection of lines in different positions.	3.1 Projection of straight lines with following positions: a) Parallel to both the planes. b) Perpendicular to one plane. c) Inclined to one plane and parallel to the other. d) Inclined to both the planes. Traces of Line. (Concept purpose only ,No problems)
UNIT 4. Projection of Planes (Weightage 06 , Hrs-03)	4a. Classify various types of planes according to orientations. 4b. Draw projection of planes with different orientations.	4.1 Projection of Planes with following orientations: a) Plane parallel to one principal plane and perpendicular to the other. b) Plane inclined to one principal plane and perpendicular to the other

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
UNIT 5. Projection of Solids (Weightage 12 , Hrs-04)	5a.Classify various types of solids. 5b.Explain orientation of axis with respect to projection planes. 5c.Draw projection of standard regular solids like polyhedron, prisms, pyramids, solids of revolution	Types of Solids Projection of the following solids: a) Regular Polyhedron – Tetrahedron, Hexahedron (cube) b) Regular prisms and Pyramids – Triangular, Square, Pentagonal, Hexagonal c) Regular solids of Revolution – Cylinder, Cone, Sphere. With Axis: i)Perpendicular to one of the principal projection plane. ii)Inclined to one of the principal plane and parallel to the other. iii)Parallel to both principal planes. .
UNIT6. Sections of solids (Weightage 12 , Hrs-04)	6a.Describe cutting planes and their orientation with respect to given solid and projection planes. 6b.Explain significance of sectional view and true shape. 6c.Draw sectional view of given solid. 6d.Draw true shape of the section of given solid with mentioned axis	Sectional Views and True shape of the section for the solids mentioned in Chapter-3 with section plane in following positions: a) parallel to one of the principal projection plane b) inclined to one and perpendicular to the other principal projection plane Note: Position of solid is restricted to the following: a) Axis parallel to both principal projection planes b) Axis perpendicular to one and parallel to the other principal projection plane
UNIT7. Free Hand sketches/conventional representation (Weightage 16 , Hrs-04)	7aIdentify various engineering components and their materials in the given sectional view. 7bDraw Free hand sketches/conventional representation of commonly used engineering components.	Draw Free hand sketches/conventional representation of: Rivet heads Riveted joints: Lap Joint – Single and Double Riveted Butt Joint – Single strap, Double Strap Foundation bolts: Eye , Lewis and Rag Types of keys –Sunk ,Saddle, Taper, Gib headed, feather Keys, wood ruff Key, Cone Key, splined Shaft Couplings: Muff, Flange, Protected Flange and Pin type Flexible Flange Pulleys: Rope and V-Belt.

12. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Sectional orthographic views	4	--	--	16	16
II	Missing views	4	--	--	12	12
III	Projection of Lines	3	--	--	6	06
IV	Projection of Planes	3	--	--	6	06
V	Projection of Solids	4	--	--	12	12
VI	Sections of solids	4	--	--	12	12
VII	Free Hand sketches/conventional representation	4	8	8	--	16
Total		32	**8**	**8**	**64**	**80**

13. 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:

Student should maintain a separate A3 size sketch book which will be the part of term work and submit it along with drawing sheets.

Students should collect Production drawings, Layouts from nearby workshops/industries and study the drawings.

14. 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:

Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.

Show video/animation films to explain orthographic and sectional orthographic projection.

Encourage students to refer different websites to have deeper understanding of the subject.

15. SUGGESTED MICRO-PROJECTS
(Only for Class Declaration Courses)

16. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
8	Elementary Engg. Drawing (Including plan and solid geometry)	N.D. Bhatt	Charotar Publication, Anand.
9	A Workbook in Engineering Drawing	Curriculum Development Centre, TTTI, Bhopal	Somaiyya Publication Pvt. Ltd., Mumbai
10	Geometrical and Machine Drawing	N.D. Bhatt	Charotar Publication, Anand.
11	Machine Drawing	G.R. Nagpal	--
12	Engineering Drawing and Graphics + AutoCAD	K. Venugopal	New Age International Publishers.

17. SOFTWARE/LEARNING WEBSITES

vii. https://www.youtube.com/watch?v=TJ4jGyD-WCw
viii. https://www.youtube.com/watch?v=dmt6_n7Sgcg
ix. https://www.youtube.com/watch?v=_MQScnLXL0M
x. https://www.youtube.com/watch?v=3WXPanCq9LI
xi. https://www.youtube.com/watch?v=fvjk7PlxAuo
xii. http://www.me.umn.edu/courses/me2011/handouts/engg%20graphics.pdf

18. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	1	1	1	2
CO2	3	3	2	1	1	1	2
CO3	3	3	2	1	1	1	2
CO4	3	3	2	1	1	1	2

	PSO1	PSO2
CO1	2	1
CO2	3	1
CO3	3	1
CO4	2	1

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'180 OB' – Scheme

Programme	Diploma in ET/**CE**/EE//**ME**/**MT**/CM/IT/DDGM
Programme code	01/02/03/04/05/06/07/08/16/17/21/22/23/24/26
Name of Course	**Workshop Practice**
Course Code	**WS2101**
Prerequisite course code and name	**NIL**

19. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	***ESE**	**PA**	
00	00	04	04	**Marks**	00	00	00	50	50
				Exam Duration	--	--			

(*):*OE/POE (Oral Examination/Practical & Oral Examination mention whichever is applicable)*

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, ESE-End semester examination, PA- Progressive Assessment.

20. RATIONALE

To make the students conversant with the use of various workshop tools used in Smithy, Carpentry, Fitting, Welding, Plumbing and Sheet metal shops.

21. COMPETENCY

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

Interpret and use of various workshop tools used in Smithy, Carpentry, Fitting, Welding, Plumbing and Sheet metal shops.

22. 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**:**

After studying this course, the student will be able to

1	Interpret the assigned job drawing.
2	Identify various tools used in different shops of Work shop.
3	Select appropriate tool set to perform a specific job.
4	Use safety practices in workshop during practical.

23. 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**.** Each student should complete one job and it will submit at the end of term.

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
11	One black smithy job involving minimum three operations. e.g. Upsetting, Bending, cutting Drawing Down, Bending, Setting down.	1	08
12	One carpentry job involving carpentry joints and wood turning.	2	14
13	One fitting job involving Marking, Filing, Sawing, Drilling, Tapping.	3	14
14	One welding job involving welding joints.	4	14
15	One job in plumbing of pipe threading and pipe joints.	5	06
16	One job in sheet metal	6	08
	Total		**64**

S.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test rig or model	10
b.	Setting and operation	20
c.	Safety measures	15
d.	Observations and Recording	20
e.	Interpretation of result and Conclusion	15
f.	Answer to sample questions	10
g.	Submission of report in time	10
Total		**100**

24. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will use in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

S. No.	Equipment Name with Broad Specifications	PrO. No.
12	Smithy and forging	1
13	Carpentry	2

S. No.	Equipment Name with Broad Specifications	PrO. No.
14	Fitting and filling	3
15	Welding	4
16	Plumbing	5
17	Sheet Metal	6

25. THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop COs for achieving the COs to attain the identified competency**.**

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
NIL	NIL	NIL

26. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	NIL					
2	NIL					
3	NIL					
4	NIL					
5	NIL					
6	NIL					
Total						

27. 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:

Student should maintain a journal which will be the part of term work and submit it along with job.

Students should visit workshop, other laboratories and industries to study various workshop activities.

28. 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:

Sr. No.	Topic	Instructional strategy
1	Smithy and forging	Explanation, Demonstration, exhibition of Models/Samples pieces.
2	Carpentry	
3	Fitting and filling	
4	Welding	
5	Plumbing	

6	Sheet Metal

29. SUGGESTED MICRO-PROJECTS
(Only for Class Declaration Courses)

30. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
13	Elements of workshop technology - Vol. I	S. K. Hajara Chaudhari A.K. Hajara Chaudhari	Media Promoters and Publishers Pvt. Ltd., Mumbai-7
14	Workshop Practice Manual	V. Kapoor	Dhanpat Rai and Sons, New Delhi-32
15	A course in workshop technology Vol.- I	B.S. Raghuwanshi	Dhanpat Rai and Sons, New Delhi-32

31. SOFTWARE/LEARNING WEBSITES

1.www.carpentryworkshop.com
2. www.weldingworkshop.com
3. www.machineworkshop.com
4. www.turningworkshop.com
5. www.smithyworkshop.com
6.www.plumbingworkshop.com

32. PO - COMPETENCY- CO MAPPING (Mechanical engineering)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	3	2	2	3
CO2	3	3	3	3	2	2	3
CO3	3	3	3	3	2	2	3
CO4	3	3	3	3	2	2	3

	PSO1	PSO2
CO1	3	2
CO2	3	2
CO3	3	2
CO4	3	2

33. PO - COMPETENCY- CO MAPPING (Civil engineering)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	3	2	2	3
CO2	3	3	3	3	2	2	3
CO3	3	3	3	3	2	2	3
CO4	3	3	3	3	2	2	3

	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	2	2
CO3	3	2	2
CO4	3	2	2

34. **PO - COMPETENCY- CO MAPPING (Metallurgical engineering)**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	3	2	2	3
CO2	3	3	3	3	2	2	3
CO3	3	3	3	3	2	2	3
CO4	3	3	3	3	2	2	3

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2
CO2	3	2	2	2
CO3	3	2	2	2
CO4	3	2	2	2

SIGN
M.R.MUNDHE
(Course expert)

SIGN
N.G.Kulkarni
(Head of Department)

SIGN
N.G.Kulkarni
(Programme Head)

SIGN
A.S.Zanpure
(CDC Incharge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	Diploma in **ME**
Programme code	04/18/24
Name of Course	**Programming in C**
Course Code	**ME2105**
Prerequisite course code and name	

35. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	***ESE**	**PA**	
0	0	4	4	**Marks**			100	25	125
				Exam Duration	--	--			

(*):*OE/POE (Oral Examination/Practical&Oral Examination mention whichever is applicable)*

Legends: L- lecture,T-Tutorial/teacher guided theory practice,P-practical,ESE-End semester examination,PA- Progressive Assesment.

RATIONALE: This course describes the basics of problem solving and logic development. It also describes basics of programming using C programming language. C is the most commonly used structured programming language.

36. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences: **To develop C program for simple mechanical engineering problem**

37. 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**:**

1. Design optimum algorithm using flowchart.
2. Use looping statements, functions, and available data types in C,

3. Develop program in'C'.
4. Execute programs in C.

38. 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**:**

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1.	1	To understand the concept of algorithm in 'C' with example	1	2
		To understand the concept of flowchart in 'C' with example		2
2.	2	Write simple 'C' programs based on declaring variables & assigning values to variables. (Minimum 2)	2	2
		Execute simple 'C' programs based on declaring variables & assigning values to variables. (Minimum 2)		2
3.	3	Write four simple C programs using various operators.	2,3,4	4
		execute four simple C programs using various operators		4
4.	4	Write two programs each using nested if-else and switch statement.	2,3,4	2
		Execute two programs each using nested if-else and switch statement.		2
5.	4	Write two programs using while loop .	2,3,4	2
		Execute two programs using while loop		4
6.	4	Write two programs using do- while loop	2,3,4	2
		Execute two programs using do- while loop		2
7.	4	Write two programs each using switch and go to statement	2,3,4	2
		Execute two programs each using switch and go to statement		2
8.	4	Write two 'C' Programs illustrating use of continue and break statements	2,3,4	2
		Execute two 'C' Programs illustrating use of continue and break statements		2
9.	5	Write 2 programs using function based on parameters passing by reference.	2,3,4	2
		Execute 2 programs using function based on parameters passing by reference.		2
10.	5	Write 'C' Programs illustrating use of user defined functions	2,3,4	2
		Execute 'C' Programs illustrating use of user defined functions		4
11.	5	Write two simple programs each using pointers.	2,3,4	2
		Execute two simple programs each using pointers.		2
12.	6	Write a simple program using character array.	2,3,4	2
		Execute a simple program using character array.		2

13.	6	Write two simple programs each using string library functions.	2,3,4	2
		Execute two simple programs each using string library functions.		2
14.	6	Write two simple programs each using 1D and 2D arrays.	2,3,4	2
		Execute two simple programs each using 1D and 2D arrays.		2
		Total Hrs		**64**

S.No.	Performance Indicators	Weightage in %
h.	Writing program and Drawing flow chart	15
i.	Execution of program	05
j.	Question answer	05
Total		**25**

39. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	PrO. No.
1	Desktop PC having I5 or I7 procesor	1 to14
2	LCD PROJECT	1 to14
3	Printer	1 to14

40. THEORY COMPONENTS

The following topics/subtopicsshould betaught and assessed in order to develop UOs for achieving the COs to attain the identified competency**.**

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
UNIT 1: OVERVIEW OF C	

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
1.Define various terms related to Programming 2. Write an algorithm and draw flowchart for simple problems. 3.Describe basic structure of 'C' program	1.1 Problem, definition and analysis, Algorithm, Flow charts 1.2 History of Programming Languages, Development of C 1.3 Basic structure of 'C' program, Programming style, Simple 'C' programs
UNIT 2: DATA TYPES AND EXPRESSION	
1. Enlist C tokens, keywords, various rules, symbols, data types. 2. Identify valid / invalid variable names. 3. Compare various terms.	2.1 Data Types & Character set: C tokens, keywords & identifiers, constants, variables, Declaration of variables, assigning values to variables, defining symbolic constants 2.2 Expressions: Arithmetic expressions, evaluation of expressions, procedure of arithmetic operators, type conversions in expressions, operator precedence & associatively, mathematical functions.
UNIT 3 : OPERATORS IN C	
1.List various operators, their types and uses. 2. Describe various operators, their types and uses	3.1 Operators: Arithmetic, relational, logical, increment & decrement, conditional 3.2 Managing input & output operators: Introduction, reading a character, writing a character, formatted input, formatted output, viz. use of printf(), scanf(), getch(), clrscr(), \n etc.
UNIT 4 : DECISION MAKING IN C	
1.List and write Decision making statements. 2. Write C programs using decision making and loop statements.	4.1 Decision making and branching: if statement (if, if-else, nested if-else). 4.2 Decision making and looping: while, do, do-while, for loop, continue statement, break statement. 4.3 Decision making using switch & go to statement
UNIT 5 FUNCTIONS & POINTERS	
1.Define function and terms related to function. 2.Write programs based on functions.	5.1 Functions: Need of user defined functions, scope, defining functions, calling a function(call by value & call by reference) 5.2. Pointers: Introduction to pointers, declaring pointer variable, initialization of pointer variable, accessing address of a variable, pointer expressions.
UNIT 6 ARRAYS & STRINGS	

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
1.Define Array, string, pointer and their related terms. 2.Write programs based on arrays, strings and pointers.	6.1 Arrays: Defining and declaring one and two dimensional arrays, reading and writing. 6.2 Strings: Declaration and initialization of string variables, string handling functions From standard library like strlen (),strlwr(), strupr(), strcpy(), strcat(), strcmp() etc.

41. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

NA

42. SUGGESTED STUDENT ACTIVITIES

NA

43. 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:

f. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
g. 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).
h. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
i. Guide student(s) in undertaking micro-projects.
j. Correlate subtopics with power plant system and equipments.
k. Use proper equivalent analogy to explain different concepts.
l. Use Flash/Animations to explain various components, operation and
m. Teacher should ask the students to go through instruction and Technical manuals

44. SUGGESTED MICRO-PROJECTS

NA (Only for Class Declaration Courses)

45. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	Let us 'C'	Yashwant Kanitkar	

2	Programming in 'C'	E. Balguru swami	
3	'C' for beginners	Madhusudhan Mothe	
4	Introduction to 'C' programming	Denis Ritchie and Kerninghan	

46. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com
2. **http://www.computer-pdf.com/programming/c-cpp/284-c-programming**

47. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	2	1	2	2
CO2	3	3	2	3	1	2	2
CO3	3	3	2	2	1	2	2
CO4	3	3	3	1	1	2	1

	PSO1	PSO2
CO1	3	-
CO2	2	-
CO3	2	-
CO4	2	-

Sign: Name:P.U.GARGE (Course expert)	Sign: Name: P.S.SARODE (Course expert)
Sign: Name: Dr.N.G.Kulkarni (Head of Department)	Sign: Name: Shri A.S.Zanpure (CDC)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diploma in ME
Programme code	04/18
Name of Course	**Strength of Materials**
Course Code	**AM3104**
Prerequisite course code and name	**AM2101(ENGG. MECHANICS)**

48. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	***ESE**	**PA**	
04	00	02	06	**Marks**	80	20	-	25	125
				Exam Duration	3 Hrs	1 Hr	-		

(*): *OE/POE (Oral Examination/ Practical & Oral Examination mention whichever is applicable)*

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, ESE-End semester examination, PA- Progressive Assessment.

49. RATIONALE

Strength of Materials is a core technology subject which aims at enabling the students to understand & analyze various types of loads, stresses & strains. All Mechanical Engineering components are subjected to different types of loads and behave in a specific way. The subject is pre-requisite for understanding principles of machine design and strengths of various materials used in industries. Understanding mechanical properties and the elastic behavior different mechanical engineering materials will help in selecting the suitable materials for various engineering applications.

50. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- Determine mechanical properties and calculate stresses in Machine components.

51. 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**:**

1. Perform tests for evaluation of mechanical properties of different metals.
2. Estimate axial, bending, shear and combined stresses in machine components..
3. Compute shear force and bending moment in a beam subjected to point load and UDL.
4. Compute Moment of Inertia of symmetric and asymmetric structural sections.
5. Locate principal planes and compute principal stress for given stress conditions.

52. SUGGESTED PRACTICALS/ EXERCISES

The practical 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**:**

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approx. Hrs. Required
17	1	To study Universal Testing machine	I	02
18	1	To determine yield stress, ultimate stress and breaking stress of Mild Steel by conducting Tension test as per IS432 (I)	I	04
19	1	To plot stress-strain diagram for mild steel	I	04
20	1	To calculate compressive strength of Ductile & Brittle materials such as Mild Steel (MS), Aluminium (Al), Brass (Br), Copper (Cu)& Cast Iron (CI), using Compression testing machine as per IS 14858	II	02
21	1	To determine shear strength of various metals such as MS, Al, Br and Cu, (Any two metals) by Single & Double Shear test as per IS 5242	II	04
22	1	To calculate hardness of metals by conducting Brinell Hardness Test on Mild Steel (MS), Aluminium (Al), Brass (Br), Copper (Cu), Cast Iron (CI) (Any four metals) as per IS 1500	I	02
23	1	To evaluate toughness of Ductile & Brittle materials such as MS, Al, Br, CI and Cu, by conducting Izod Impact test on as per IS 1757	I	02
24	5	To find flexural strength by conducting Bending Test on timber beam of Rectangular cross section for both the orientations as per IS 1708, IS 2408	V	04
25	3	To plot SFD and BMD of s imply supported beams, overhanging beams and cantilever beams subjected to UDL and point loads. (2 problems on each type of beam)	IV	04
10	7	To calculate stresses on an inclined plane under given stress condition by analytical and Mohr's Circle method. (2 problems) To locate Principal planes, and calculate principal stresses using analytical and Mohr's circle method. (2 problems)	VII	04
		Total		**32**

S.No.	Performance Indicators	Weightage in %
k.	Arrangement of available equipment / test rig or model	20
l.	Setting and operation	20
m.	Safety measures	10
n.	Observations and Recording	10
o.	Interpretation of result and Conclusion	20
p.	Answer to sample questions	10
q.	Submission of report in time	10
Total		**100**

53. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr. No.	Major Equipment/ Instruments Required	PrO. No.
1	**Universal Testing Machine:** Capacity - 100 tons. Type: Mechanical type digital, electrically Operated. Accessories: (1) Tensile test attachment for flat and round specimen up to32 mm. (2) Compression test attachment (3) Shear test attachment with sizes of bushes 5,6,8,10,12,16,20,24 mm, (4) Transverse test attachment with bending Punch,(5)Service tools,(6) Operation and maintenance manuals - 2 nos. (7)Hardness attachment	**1,2,5,8**
2	**Digital Extensometer:** Least count - 0.001 mm. Max. Extension = 5 mm. Single dial gauge for 30,40 mm. 60 mm, 80 mm, 100 mm, 125 mm gauge length.	**2**
3	**Brinell Hardness Testing Machine:** Test loads from 500 to 3000 kgf in steps of 250kgf; The height X Throat is 380 X 200 mm; Indentation measurement by Brinell Microscope of 25 X Magnification; Special Test fixtures for odd jobs / production testing can be supplied (Optional); Computerized Brinell Impression measurement system (Optional); Manual / Optical /Computerized type Brinell Hardness testing machine are also available; Accuracy conform to IS:2281-2005 and BS:240	**6**
4	**Impact Testing Machine:** IZOD Impact Test Apparatus: Pendulum drop angle: 90°-120; Pendulum effective Wt: 20-25 kg; Striking velocity of pendulum: 3-4 m/sec; Pendulum impact energy: 168 j; Min scale graduation: 2 J; Distance of axis of pendulum rotation from center of specimen to specimen hit by pendulum : 815 mm	**7**
7	**Compression Testing Machine:** Digital display manual control compression testing; machine; Max. Capacity (KN): 2000; Measuring range: 4%-100% of FS; Relative error of reading: ≤ ±1%; Max. distance between two platen (mm): 330; Compression platen size (mm): 220×220; Max. piston stroke (mm): 0-20; Max. piston speed (mm/min): Approx. 30; Column clearance (mm): 300×200; Oil pump motor power (KW): 1.5; Whole dimensions (mm): 855*380*1435	**4**
9	Freeware for SF and BM diagrams	**9**
10	Freeware for Principal planes, Principal stresses and Mohr's circle method	**10**

54. THEORY COMPONENTS

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

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
UNIT 1. SIMPLE STRESSES AND STRAINS (Weightage-12 , Hrs- 12)	
1a. Define various engineering properties of metals 1b. Define stress and strain with their units. 1c. Calculate axial strain, axial stress and Modulus of Elasticity using Hooke's law. 1d. Determine nature and magnitude of thermal stress. 1e. Draw stress-strain curve for ductile and brittle material in tension. 1f. Calculate shear stresses for single/double/punching shear condition.	1.1 Recap of concepts of force and equilibrium. 1.2 Elastic, plastic & rigid bodies 1.3 Mechanical properties of materials – ductility, malleability, brittleness, hardness, strength and toughness. 1.4 Stress & Strain – concept & Definitions, types of stresses and related deformations- Axial, Flexure, torsion, shear. 1.5 Hooke's Law, Young's Modulus, Axial deformation in a body and bodies in series. 1.6 Behavior of ductile and brittle materials subjected to axial tension, stress-strain or Load-deformation curve, Limit of proportionality, yielding, permanent set, yield stress, ultimate stress. 1.7 Shear stress and shear strain, Modulus of rigidity, punching shear, single and double shear. 1.8 Temperature stress and strain – concept and numerical problems on thermal stress in bodies having uniform cross-section, deformation fully prevented.
UNIT 2. GENERALIZED HOOKE'S LAW (Weightage-12 , Hrs- 08)	
2a. Define lateral and longitudinal strain, Poisson's ratio, volumetric strain and Bulk modulus 2b. Calculate strain and deformation along all three axes, under bi and tri axial stresses 2c. Compute volumetric strain and change in volume under given biaxial or triaxial stresses 2d. Calculate instantaneous stresses, strains and deformations under given gradual, sudden or impact loads 2e. Estimate Resilience, Modulus of resilience, Proof Resilience.	2.1 Linear and lateral strain, Poisson's ratio, changes in lateral dimensions. 2.2 Uni axial- Bi axial and Tri axial stress systems, strain in each direction, generalized Hooke's law 2.3 Change in the dimensions and volume, volumetric strain, volumetric stress, Bulk modulus 2.4 Relation between three moduli. 2.5 Strain Energy, Resilience, Proof Resilience and Modulus of resilience. 2.6 Stress due to Gradual, Sudden and Impact load and corresponding deformations.
UNIT 3. SHEAR FORCE & BENDING MOMENT (Weightage-12 , Hrs- 10)	

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
3a. Define Shear force and Bending moment with their units and sign convention. 3b. Calculate SF and BM for given load and beam. 3c. Draw SFD and BMD. 3d. Locate point of maximum BM and point of contra-flexure.	3.1 Types of Beams (Simply supported with or without overhang, Cantilever) , Types of loads (Point load, Uniformly Distributed load), Bending of beam, deflected shape, 3.2 Meaning of SF and BM, Relation between them, Sign convention, 3.3 Drawing SFD and BMD, Location of point of maximum BM, Location of Point of Contra-flexure.
UNIT 4. MOMENT OF INERTIA (Weightage-08 , Hrs- 06)	
4a. Define MI and explain Parallel and Perpendicular axes theorems 4b. Calculate MI of standard shapes. 4c. Calculate MI of composite plane figures such as I and T sections. 4d. Calculate Polar MI and radius of gyration of a given section.	4.1 Concept of Moment of Inertia (MI) 4.2 Parallel and Perpendicular axes theorems, Polar MI, radius of gyration 4.3 MI of standard basic shapes, 4.4 Determination of MI of Composite plane figures such as I and T sections.
UNIT 5. BENDING STRESSES (Weightage-08 , Hrs- 06)	
5a. State the assumptions of theory of bending & explain flexural formula 5b. Use flexural formula to calculate bending stresses for given section at given point in a simply supported and cantilever beam. 5c. Determine maximum bending stress in the given beam. 5d. Determine Section modulus and Moment of resistance for given beam..	5.1 Theory of simple bending, Assumptions in theory of bending, Flexural formula, concept of Neutral axis 5.2 Concept and calculation of Moment of resistance, Section modulus. 5.3 Bending stress variation diagram across depth for cantilever and simply supported beams for symmetrical and unsymmetrical sections such as. Rectangular, circular, T and I sections only.
UNIT 6. DIRECT AND BENDING STRESSES (Weightage-08 , Hrs- 06)	
6a. Define eccentricity, Limiting eccentricity and Core of section 6b. Calculate resultant stress and draw resultant stress variation diagram in a member subjected to eccentric loading. 6c. Mark core of standard sections 6d. Determine size of component for given stress condition	6.1 Axial and eccentric load, effects of eccentricity, Field cases (Hook, clamp, Bench Vice, Frame etc) 6.2 Axial stress and bending stress, resultant stress intensities, resultant stress distribution diagram (Eccentricity about one axis only) 6.3 No tension condition Limiting eccentricity, Core of section.
UNIT 7. PRINCIPAL PLANES AND PRINCIPAL STRESSES (Weightage-12 , Hrs- 08)	
7a. Define principal planes and principal stresses. 7b. Calculate stresses on an inclined plane under a given stress condition. 7c. Locate Principal planes, planes carrying maximum shear stress and calculate principal stresses using standard formulae. 7d. Locate Principal planes and calculate	7.1 Normal stress, Shear stress & resultant stress on oblique planes, angle of obliquity. 7.2 Concept of principal planes and principal stresses, major and minor principal planes and principal stresses. 7.3 Analytical method to locate Principal planes, planes carrying maximum shear stress and to calculate principal stresses,.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
principal stresses using Mohr's circle method..	7.4 Mohr Circle method – concept and application to problems based on stresses on inclined planes and problems on calculating principal planes and principal stresses
UNIT 8. TORSION (Weightage-08 , Hrs- 08)	
8a. State assumptions in theory of torsion 8b. State and explain torsional formula, 8c. Calculate torque and power transmitted by shaft 8d. Determine shear stress and angle of twist in a shaft for given power to be transmitted/ given torque. 8e. Determine diameter of shaft for given shear stress/ angle of twist.	8.1 Torsion: Concept, field applications (Shaft, flange couplings, shear bolts), torsional rigidity, torsional equation and assumptions 8.2 Torsional resistance for hollow and solid circular shafts, 8.3 Power transmitted by shaft, shear stress in the shaft and angle of twist

55. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	Simple Stresses and Strains	12	04	04	04	12
2	Generalized Hooke's Law	08	02	04	06	12
3	Shear Force and Bending Moment	10	02	04	06	12
4	Moment of Inertia	06	02	--	06	08
5	Bending Stresses	06	02	--	06	08
6	Direct and Bending Stresses	06	--	02	06	08
7	Principal Planes and Principal Stresses	08	02	04	06	12
8	Torsion	08	--	02	06	08
Total		64	**14**	**20**	**46**	**80**

56. 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. Prepare journals based on practical performed in laboratory.
b. Prepare charts of maximum bending moment and shear force values in standard beams.
c. Prepare excel program worksheets based on unit number 8.
d. Collect information and present in tabular form, values of different engineering properties of five standard mechanical engineering materials.
e. Present a seminar on different testing methods used in industry
f. Prepare a model of a shaft to demonstrate relation between length and angle of twist.
g. Collect information comprising of different machine components subjected to direct and bending stresses.

57. 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:

n. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
o. 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).
p. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
q. Guide student(s) in undertaking micro-projects.
r. Use proper equivalent analogy to explain different concepts.
s. Use Flash/Animations to explain various components, operation and
t. Teacher should ask the students to go through instruction and Technical manuals

58. SUGGESTED MICRO-PROJECTS

NA

(Only for Class Declaration Courses)

59. SUGGESTED LEARNING RESOURCES

S. No.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
16	Strength of Materials	Punmia B C Laxmi Publications (p) Ltd. New Delhi, 10/e, 2015	ISBN-10: 8131809250 ISBN-13: 978-8131809259
17	Strength of Materials	Ramamurtham S Dhanpat Rai Publishing Company - New Delhi; Eighth edition, 2014	ISBN-10: 9384378267 ISBN-13: 978-9384378264
18	Strength of Materials	Timoshenko Gere CBS,2 edition, 2006	ISBN-10: 8123908946 ISBN-13: 978-8123908946
19	Strength of Materials	Khurmi R S S. Chand Publishing, New Delhi, 2006	ISBN-10: 8121928222 ISBN-13: 978-8121928229
20	Strength of Materials	Kulkarni S. M. PVG Prakashan, Pune 411030	ISBN -10 :8123563521

60. SOFTWARE/LEARNING WEBSITES

3. www.nptel.com
4. nptel.iitm.ac.in/courses/.../IIT.../lecture%2023%20and%2024.htm
5. en.wikipedia.org/wiki/Shear_and_moment_diagram
6. www.freestudy.co.uk/mech%20prin%20h2/stress.pdf
7. www.engineerstudent.co.uk/stress_and_strain.html
8. www.iit.edu/arc/workshops/pdfs/Moment_Inertia.pdf

61. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	-	3	-	2	2
CO2	3	2	2	2	-	-	2
CO3	3	3	2	2	-	1	2

CO4	2	2	1	1	-	1	2
CO5	3	2	2	2	-	1	1

	PSO1	PSO2
CO1	1	3
CO2	-	3
CO3	2	2
CO4	1	-
CO5	1	-

Sign: Name: Smt. S.M. Kulkarni (Course Expert /s)	Sign: Name: Smt. V.P. Ashwathpur (Head of Department)
Sign: Name: Shri. N.G. Kulkarni (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri A.S.Zanpure (CDC)

Government Polytechnic, Pune

'180OB' – **Scheme**

Programme	Diploma in ET/CE/EE//**ME**/MT/CM/IT/DDGM
Programme code	01/02/03/**04**/05/06/07/08/16/17/21/22/23/**24**/26
Name of Course	**Machine Drawing**
Course Code	**ME3101**
Prerequisite course code and name	**ME2102 Mechanical Engineering Drawing.**

62. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	***ESE**	**PA**	
02	00	04	06	**Marks**	80	20	00	25	125
				Exam Duration	4 Hrs	1.30 Hr			

(*):*OE/POE (Oral Examination/Practical&Oral Examination mention whichever is applicable)*

Legends: L- lecture,T-Tutorial/teacher guided theory practice,P-practical,ESE-End semester examination,PA- Progressive Assesment.

63. RATIONALE

With the Science & Technology advancing at a rapid pace, the type of man power required by the industry and society is becoming more & more specific. Industry requires among other things a workforce having a technological bent of mind and the much desired temper and competencies to maintain high quality standards & productivity. The quality & productivity depends mainly on the ability of Technician to communicate through drawing. Mechanical Technicians are able to read the drawing correctly. The drawing prepared must be clear and it should not have any scope for different interpretations. Machine drawing is more of a performance based rather than knowledge based. The course aims to develop ability to visualize and draw assembly and detail drawings.

64. COMPETENCY

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

- Interpret and prepare mechanical working drawing /production

drawing of given component or assembly.

65. 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**:**

6. Develop a lateral surface of given object.
7. Draw intersection curves of different solids.
8. Draw an auxiliary view of a given object.
9. Use various drawing codes, conventions and symbols as per IS SP-46.
10. Draw assembly and detailed drawings of products.

66. 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**.** Each student will draw 7 half imperial size drawing sheets as given below and will submit at the end of term. A sketch book containing home assignments on each topic is also to be submitted by each student at the end of term.

Sr.No	Unit No	Sheet No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevent CO	Approx. Hours
1	1	01	Development of solids – two problems.	1	08
2	2	02	Intersection of solids – two problems.	2	12
3	3	03	Auxiliary views -- two problems.	3	12
4	4	04	Conventional representations, tolerance and fits symbols, surface roughness symbol , welding symbols etc.	4	08
5	4	05	Production drawing- Production drawing of minimum two components showing tolerances , surface roughness etc.	4	08
6	5	06	Details to Assembly – one problem.	5	08
7	6	07	Assembly to Details– one problem.	5	08
		Total			**64**

S.No.	Performance Indicators	Weightage in %
r.	Draw sheet using different drafting instrument	20
s.	Follow line work for neat and accurate drafting	20
t.	Answers to sheet related questions	20

S.No.	Performance Indicators	Weightage in %
u.	Submit the assigned sheet on time	20
v.	Attendance and punctuality	20
Total		**100**

67. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

S. No.	Equipment Name with Broad Specifications	PrO. No.
18	Drawing Table with Drawing Board of Full Imperial/ A1 size.	All
19	Models/ Charts or actual parts of objects and assemblies.	All
20	Set of various industrial drawings being used by industries.	05
21	Drawing equipment's and instruments for class room teaching-large size: i. T-square or drafter (Drafting Machine) j. Set squares (45^0 and 30^0- 60^0) k. Protractor l. Drawing instrument box (containing set of compasses and dividers)	All
22	Interactive board with LCD overhead projector	All

68. THEORY COMPONENTS

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

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
UNIT 1. DEVELOPMENT OF SURFACES (Weightage12 , Hrs- 06)	
1a.Draw development of lateral surfaces of the given solid. 1b.Identify parts where concept of development of the given surfaces is required. 1c.Draw development of given sheet metal/non sheet metal parts.	1.1 Developments of Lateral surfaces of cube, prisms, cylinder, pyramids, cone. 1.2 Applications of development of surfaces such as tray, funnel, Chimney, Pipe Bends etc.
UNIT 2 INTERSECTION OF SOLIDS(Weightage- 12 , Hrs- 06)	

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
2a. Identify parts where concept of intersection of the given solids is required. 2b. Draw curves of intersection of the given solid combinations.	Curves of intersection of surfaces of the regular solids in the following cases: 2.1 Prism with prism (Tri-angular and square), Cylinder with cylinder, Square Prism with Cylinder . When (i) The axes are at 90° and bisecting (ii) The axes are at 90° and Offset 2.2 Cylinder with Cone. when axis of cylinder is parallel to both the reference planes and cone resting on base on HP with axis intersecting OR offset from axis of cylinder.
UNIT 3 AUXILIARY VIEWS (Weightage- 08 , Hrs- 06)	
3a.Draw an auxiliary view of given object. 3b.Complete an incomplete principle view from the given auxiliary view.	3.1 Study of auxiliary planes, projection of objects on auxiliary planes. 3.2 Completing the principle view with the help of given auxiliary views.
UNIT 4 CONVENTIONAL REPRESENTATIONS AND PRODUCTION DRAWING (Weightage- 16 , Hrs- 06)	
3a. Use IS SP-46 (1988) codes. 3b. Interpret standard conventions used in given mechanical working drawing. 3c. Use standard conventions in practice. 3d. Represent tolerances on the given machine components. 3e. Identify fit required between mating parts of machine components based on the given tolerance values. 3f. Interpret welding symbols in the given working drawing. 3g. Interpret surface roughness characteristics from the values given on component drawing.	3.1 Conventional breaks in pipe, rod and shaft. 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 and external thread. 3.3 Conventional representation of standard parts like ball and roller bearing, gears, springs. 3.4 Counter sunk and Counter bored holes. 3.5 Tapers. 3.6 Limits, Fits and Tolerances: a) Definitions, introductions to ISO system of Tolerance. b) Dimensional tolerances:- Terminology, selection and representation of dimensional tolerance-number and grade method. Definitions concerning Tolerancing and Limits system, unilateral and bilateral tolerance, Hole and shaft base systems, Types of fits- Clearance, transition and Interference, Calculation of limit sizes and identification of type of fit from the given sizes like 50 H7/s6, 30 H7/d9 etc.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
3h. Draw above conventional representations for the given situation.	3.7 Geometrical Tolerances:Types of geometrical tolerances, representation of geometrical tolerance on drawing. 3.8 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. 3.9 Machining symbol and surface texture: Indication of machining symbol showing direction of lay, sampling length, roughness grades, machining allowances, manufacturing methods. 3.10 Draw a production drawing of a component/ part using above conventions and methods.
UNIT 5 DETAILS TO ASSEMBLY (Weightage- 16 , Hrs-04)	
5.a Explain the general procedure for assembly of components. 5b. Draw the assembly drawing from the given detail drawing.	a. Introduction . Sequence of preparing assembly drawing. Bill of materials. Any assembly consisting of 6 to 10 parts . for example- b. i)Cotter Joint,Knuckle Joint,Turnbuckle. ii)Universal Coupling , Oldhams Coupling, Flange coupling iii)Journal Bearing.Pedestal Bearing,Footstep bearing, ball bearing,roller bearing. iv)Piston and connecting rod of IC engine. v)Lathe tool post. vi)Lathe tail stock. vii)Screw Jack. viii)Drill Jig. ix)Gland and stuffing Box. x)Stop valve, Non return valve.
UNIT 6 ASSEMBLY TO DETAILS (Weightage -16 , Hrs- 04)	
6.a Identify various components in the assembly. 6.b Draw detailed drawings from the given assembly drawing.	6.1 Introduction. Process of drawing detail drawings from the assembly drawing. 6.2 Details of all assemblies mentioned in Unit V.

69. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Development of Surfaces	06	-	-	12	12
II	Intersection of solids.	06	-	-	12	12
III	Auxiliary Views	06	-	-	08	08
IV	Conventional Representation and Production Drawing.	06	08	04	04	16
V	Details to Assembly.	04		-	16	16
VI	Assembly to Details.	04			16	16
Total		32	**08**	**04**	**68**	**80**

70. 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:

Student should maintain a separate A3 size sketch book which will be the part of term work and submit it along with drawing sheets.

Students should collect Production drawings, Layouts from nearby workshops/industries and study the drawings.

Students should visit workshop, other laboratories and industries to study various assemblies.

Prepare paper models of development of lateral surfaces of solids.

Visit Institute's Power engineering Lab, TMM Lab, Hydraulics Lab or Workshop and prepare detailed drawings and assembly drawing of any one available assembly . The dimensions are to be measured by using proper measuring instruments.

71. 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:

u. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
v. Show video/animation films to explain orthographic and sectional orthographic projection.
w. Demonstrate/ explain the problems using models. Actual working assemblies eg. Bench vice, pipe vice, screw jack, tool post, tail stock piston, cylinder connecting rod, crank and models of keys, cotter joints knuckle joints can be used.
x. Use charts and industrial drawing to teach standard symbols Teacher should ask the students to go through instruction and Technical manuals
y. Encourage students to refer different websites to have deeper understanding of the subject.

72. SUGGESTED MICRO-PROJECTS

NA

(Only for Class Declaration Courses)

73. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication/ ISBN No
21	Elementary Engg. Drawing (Including plane and solid geometry)	N.D. Bhatt	Charotar Publication, Anand. ISBN:9789380358178
22	A Workbook in Engineering Drawing	Curriculum Development Centre, TTTI, Bhopal	Somaiyya Publication Pvt. Ltd., Mumbai
23	Geometrical and Machine Drawing	N.D. Bhatt	Charotar Publishing house Pvt. Ltd., Anand, Gujarat, 2013, ISBN 9789380358635
24	Machine Drawing	Sidheshwar	McGraw I-Iill, New Delhi, 2009 ISBN: 9780074603376
25	Machine Drawing	Kannaiah, Narayan & K. vekanta Reddy	New Age International Publishers. New Delhi, 2009 ISBN:
26	S.P. 46 – 1988 Code of Engg. Drawing for Schools & Colleges	Bureau of Indian Standards	Bureau of Indian Standards, New Delhi Third reprint, October 1998 ISBN 8170610912
27	I.S. 813 – 1988 Code of welding symbols	Bureau of Indian Standards	Bureau of Indian Standards, New Delhi

74. SOFTWARE/LEARNING WEBSITES

9. www.nptel.com
10. https://en.wikipedia.org/
11. http://www.technologystudent.com/
12. Engineering graphics and Drawing v 1.0 from cognifront
13. www.slideshare.net/
14. https://www.youtube.com/watch?v=2sM04tkgD2Y&list=PLIhUrsYr8yHwAbiCATZUbzd_CpF0EHF3v&index=7
15. https://www.youtube.com/watch?v=u0VQ3xYHpCk&list=PLIhUrsYr8yHwAbiCATZUbzd_CpF0EHF3v&index=8
16. https://www.youtube.com/watch?v=V4AAU9tXCYU&list=PLIhUrsYr8yHwAbiCATZUbzd_CpF0EHF3v&index=9
17. https://www.youtube.com/watch?v=YSzIUzLLPOY&list=PLIhUrsYr8yHwAbiCATZUbzd_CpF0EHF3v&index=10
18. https://www.youtube.com/watch?v=DMtZxp8eFWk&list=PLIhUrsYr8yHwAbiCATZUbzd_CpF0EHF3v&index=1
19. https://www.youtube.com/watch?v=Tkz-OevEddM&list=PLIhUrsYr8yHwAbiCATZUbzd_CpF0EHF3v&index=4
20. https://www.youtube.com/watch?v=9hD7q2CqAOA&list=PLIhUrsYr8yHwAbiCATZUbzd_CpF0EHF3v&index=6
21. http://www.youtube.com/watch?v=_M SeYB60S6M J.

22. http://www.youtube.com/watch?v=UyROI-bAMu4 k.
23. http://www.youtube.com/watch?v=eix8xbqb93
24. http://www.youtube.com/watch?v=kWOI6ttDTBc
25. http://www.yolltube.com/watch?v=g.Jbr02jtoa8&feature=related
26. http://www.youtube.com/watch?v=PXgkBadGHEE

75. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	-	-	1	-
CO2	2	3	2	-	-	1	-
CO3	2	3	2	-	-	1	-
CO4	3	3	3	-	-	1	1
CO5	2	3	3	-	-	1	1

	PSO1	PSO2
CO1	-	1
CO2	-	1
CO3	-	1
CO4	-	1
CO5	-	2

Sign: Name: 1) M.W.Giridhar. 2) M.V.Munde. (Course Expert /s)	Sign: Name: Dr.N.G.Kulkarni. (Head of Department)

Sign: Name: Dr.N.G.Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri A.S.Zanpure. (CDC I/c)

Government Polytechnic, Pune

'180OB'– Scheme

Programme	Diploma in ME
Programme code	04
Name of Course	**THERMAL ENGINEERING**
Course Code	**ME3102**
Prerequisite course code and name	

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	***ESE(OE)**	**PA**	
03	00	02	05	**Marks**	80	20	25	25	150
				Exam Duration	3 Hrs	1 Hr	2 Hr		

(*):*OE/POE (Oral Examination/Practical&Oral Examination mention whichever is applicable)*

Legends: L- lecture,T-Tutorial/teacher guided theory practice,P-practical,ESE-End semester examination,PA- Progressive Assesment.

2. RATIONALE

Thermal engineering incorporating basic principles of the thermodynamics and heat transfer forms an essential element of any mechanical engineering course these days. In this core area, students will be able to solve many problems related to this and inter areas, because the principles involved have universal applications. Keeping this in mind, the present course lays more emphasis on understanding the basic principles of thermodynamics and heat transfer and applying these to practical thermodynamics practical problems. The understanding of fundamentals will also be of direct relevance later when power engineering is studied.

Steam power plants are being established in the country in a big way to cater for the spurt in power demand. It is expected that a large number of mechanical technicians will be associated with planning erecting, running and maintain steam power plant. The present course includes the study of important components of such plants so that these technicians do not find themselves stranger if called upon to perform these jobs

.

3. COMPETENCY

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

- **Use principles of thermal engineering to maintain thermal related equipment.**

4. 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. Apply laws of thermodynamics to devices based on thermodynamics.
b. Calculate thermodynamic properties of Ideal gases and Steam
c. Differentiate various types of heat exchangers on various aspects.
d. Illustrate the working of various components of steam power plant.

5. 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**:**

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1.	3	Trace the path of Flue Gases and Water Steam circuit of the boiler.	4	02
2	3	Assembly and dismantling of boiler mountings.	4	04
3	3	Assembly and dismantling of boiler accessories.	4	04
4	3	Perform simulation of Thermal Power Plant and write specifications of boilers, turbines, condensers and electrical generators.	4	02
5	2	Plot steam properties on Mollier chart for a given sample of wet steam.	2	02
6	4	Assembly and dismantling of impulse and reaction turbines (working Model).	4	02
7	5	Assembly and dismantling of cooling tower (working Model).	4	02
8	5	Dismantle given model of surface condenser, draw sketches of various parts and assemble it.	4	02
9	6	Calculate the thermal conductivity of Metallic Rod.	3	02
10	6	Identify different equipment in power engineering lab having heat exchangers and classify heat exchangers. Write construction and working any 03 of above heat exchangers.	3	02
11	6	Calculate mass flow rate of one fluid using energy balance equation in heat exchanger.	**3**	02
12	6	Calculate convective heat transfer coefficient for the given fluid.	**3**	02
13	3-6	Extended work- Searching and collecting latest information on any of the above experiments from internet.	**1,4**	04
		Total		**32**

Note-Any minimum twelve laboratory experiments from above needs to be performed in the laboratory.

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

S.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test rig or model	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
Total		**100**

5. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	PrO.No.
23	Models of water tube and fire tube boilers (cut section models).	2,3
24	Various mountings and accessories of boilers for assembly and dismantling purpose.	2,3
25	Relevant simulation software.	4
26	Cut section models of impulse turbine and reaction turbine.	6
27	Experimental setup with convergent and divergent nozzle.	6
28	Model of surface steam condenser with assembly and dismantling purpose.	8
29	Experimental setup of shell and tube steam condenser. (Minimum shell diameter 45cm).	8
30	Experimental set up for determination of thermal conductivity.	9
31	Models of different heat exchangers.	10
32	Models of different cooling towers	7
33	Experimental set up to determine convective heat transfer coefficient.	12

6. THEORY COMPONENTS

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

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
UNIT 1- Thermodynamic Principles (**Weightage**-14 **, Hrs**-08**)**	
1a. Determine the properties of the given substance using thermodynamic property tables. 1b. Explain the phenomena when thermodynamic principles is applied to the given condition of gas. 1c. Explain the phenomena when first law of thermodynamics is applied in the given thermodynamic system. 1d. Explain the phenomena when second law of thermodynamics is applied in the given thermodynamic system 1e. Determine the rate of work done and thermal energy transfer during thermodynamic process in the given type of open system.	**1.1** Definition and units-- of Force, Pressure, Volume, Temperature,Work, Torque, Power (Linear & Rotary). (S.I. units). 1.2 Basic concepts – Thermodynamic system, boundary, surroundings. Types of system- closed and open, point function and path function. Definition of property, intensive and extensive property, properties like specific volume, density, pressure, temperature. Process, work-thermodynamic definition, work done at the moving boundary, heat- thermodynamic definition, difference between heat and work. 1.3 First law of thermodynamics: -First law for closed system, internal energy, Types of energy- potential energy, kinetic energy, flow energy. First law for open system - steady flow energy equation, enthalpy. Application of first law to the close system, and to open system like boiler, turbine, engine, nozzle, condenser, pump, compressor, throttling. Definition of specific heat Cp and Cv. 1.4 Second law of thermodynamics : Concept of Heat engine, heat pump and refrigerator ,thermal efficiency, COP, Second law of thermodynamics, Kelvin -Plank and Clausius statement, equivalence of two statements, reversible process, factors making process irreversible, Entropy, entropy change in reversible process..
UNIT 2 - Ideal gas processes and steam properties (Weightage- 14 **,** Hrs- 12**)**	
1a. Evaluate the work done and thermal energy transfer according to Boyles law and Charles' law for the given situation. 1b. Calculate the mass of a gas and its final condition parameters after undergoing a particular process for the given situation.. 1c. Determine characteristic gas constant of commonly used gases for the given data. 1d. Calculate different energy changes during ideal gas processes for the given situation. 1e. Determine dryness fraction for the given steam sample	2.1 Definition of an ideal gas, ideal gas laws ,equation of state , characteristic of gas equation, specific and universal gas constant, specific heat, internal energy and enthalpy analysis of ideal gas processes assuming constant specific heats. 2.2 Process like constant volume (isochoric), constant pressure (isobaric), adiabatic (isentropic), irreversible adiabatic, polytropic, throttling etc. In each case change in internal energy, enthalpy, entropy and determination of heat and work may be considered, and processes plotted on Pressure-Volume (P-V) and Temperature- Entropy (T-S) diagrams 2.3 Two phase system:- Generation of steam at constant pressure with representation on various charts such as P-V, T-S and H-S. Properties of steam and use of steam table, dryness fraction, degree of superheat, sensible and latent heat ,Mollier or (H-S) diagram.Numericals using steam table to determine dryness fraction and enthalpy of wet,dry saturated and superheated steam..

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics

UNIT 3 Heat Transfer Principles (Weightage- 12 , Hrs- 08)	
5a. Calculate heat transfer by conduction through composite slabs and pipes for the given data. 5b. Use Stefan Boltzman's law of radiation in the given situation. 5c. Solve thermal engineering problems with the given data using principles of energy mechanisms. 5d. Explain construction and working of a given type of heat exchangers with sketches. 5e. Select heat exchangers for the given situation with justification	3.1 Modes of heat transfer - Conduction, convection and radiation. 3.2 Conduction - Fourier's law, thermal conductivity, conduction through cylinder, thermal resistance, composite walls,list of conducting and insulating materials.Simple numericals 3.3 Convection - Newton's law of cooling, natural and force convection. 3.4 Radiation- Thermal Radiation, absorptivity, transmissivity, reflectivity, emissivity, black and gray bodies, Stefan-Boltzman law. 3.5 Heat Exchangers - Classification, construction and working of shell and tube, shell and coil, pipe in pipe typ and plate type heat exchanger, automotive heat exchange and its applications, importance of equation for LMTD(n derivation) simple numerical problems(Understand level)

UNIT 4- Steam generators and boiler draught (Weightage- 14 , Hrs- 08**)**	
2a. Calculate the efficiency of given type of boiler for the given conditions. 2b. Calculate the rates of thermal energy transfer in the given type of boiler and superheater for the given conditions. 2c. Describe different types of high pressure boilers. 2d. Name and describe different types of boiler draught	4.1 Rankine cycle, Steam boilers : Classification(sub critical and super critical boilers), description and working of common boiler (this may be included in laboratory work only and should be as a demonstration in laboratory with available models, charts and virtual laboratory) 4.2 Maintenance and inspection of boilers. 4.3 High pressure boilers - **(1)** Lamont **(2)** Loeffler **(3)** Velox **(4)** Benson boiler. Application of boilers in process engineering. 4.4 Boiler mountings and accessories, study of various boiler mountings such as safety valve, water level indicators, pressure gauge, feed check valve, blow off cock, fusible plug (this should be done in laboratory with available models and charts). Study of various boiler accessories such as feed water injector, economiser, super heater, air preheater, (this should be done in laboratory with available models and charts) 4.5 Boiler draught – natural and artificial draught, relative merits and demerits (No analytical treatment).

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
UNIT 5 -Steam nozzles and steam turbines (Weightage- 14 , Hrs- 06)	
3a. Select the nozzles for the given situation. 3b. Determine thermal efficiency for the specified type of steam turbine for given conditions. 3c. Interpret the given types of steam cycles to estimate efficiencies in a steam power plant 5d Compare the performance for the given steam turbine .	5.1 Steam nozzles-Function, types,steady flow energy equation for nozzle. 5.2 Steam turbine - Classification of turbines, Construction and working of impulse and reaction turbine. 5.3 Compounding of steam turbines and various methods of compounding, their relative comparison, Regenerative feed heating, bleeding of steam turbines.
UNIT 6 Condensers and cooling tower (Weightage- 12 , Hrs- 06)	
Identify the elements and processes of the given type of steam condensers. 6a. Identify the elements and processes of the given cooling towers. 6b. Calculate condenser efficiency and vacuum efficiency for the given parameters. 6c. Evaluate the thermal performance for the given data of the steam condenser 6d. Interpret the thermal design of the given type of cooling tower. 6e. Select condensers for the given situation with justification 6f. Select cooling tower for the given situation with justification .	6.1 Functions of condenser,location of condenser in thermal power plant, classification of condensers,Dalton's law of partial pressure, 6.2 Construction and working of Jet and Surface condensers 6.3 Sources of air leakage into condenser, effects of air leakage, definitions of vacuum efficiency, condenser efficiency (simple numericals) 6.4 Cooling Towers-Construction and working of natural ,forced and induced draught cooling tower.

7. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamentals of thermodynamics	08	04	04	06	14
II	Ideal gases and ideal gas processes	12	04	04	06	14
III	**Heat Transfer Principles**	08	04	04	04	12
IV	**Steam generators and boiler draught**	08	02	04	08	14
V	Steam nozzles and steam turbines	06	02	04	08	14
VI	**Condensers and cooling tower**	06	02	04	06	12
Total		48	18	**2**4	**3**8	**80**

8. 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. Prepare journals based on practical performed in laboratory.
b. Prepare and present a seminar on boiler instrumentation using appropriate sources of information.
c. Prepare charts on compounding, regenerative feed heating processes.
d. Prepare P-V & T-S charts of different ideal gas processes.
e. Prepare P-H, H-S, T-S diagrams for different steam processes.
f. Draw manually enthalpy-entropy (Mollier) chart and represent different vapor processes on the same using different color combinations.
g. Prepare a report on visit to Sugar Factory / Steam Power Plant / Dairy industry with specification of boiler and list of mountings and accessories along with their functions.
h. List insulating and conducting materials used in various applications.

9. 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. 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).
c. With respect to item No.9 teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Use proper equivalent analogy to explain different concepts.
f. Use Flash/Animations to explain various components, operation and

g. Teacher should ask the students to go through instruction and Technical manuals

10. SUGGESTED MICRO-PROJECTS

NA

(Only for Class Declaration Courses)

Only one micro-project *is planned to be undertaken by a student that needs to be assigned to him/her.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 is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare charts on fundamentals concepts of thermodynamics. E.g. First/Second law applications, heat and work transfer.
b. Investigate energy transfer in thermodynamic system.
c. Prepare at least one model explaining ideal gas processes.
d. Prepare at least one model of boiler mountings and accessories.
e. Collect and analyze technical specifications of steam turbines, boilers from manufacturers' websites and other sources.
f. Prepare a report on steam traps used in steam piping.
g. Carry out comparative study of conventional cooling towers, cooling towers used in power plants and upcoming cooling towers. .
h. Make power point presentation including videos on heat exchangers commonly used.
i. Make models of Shell and Tube, Plate, tube in tube heat exchangers in workshop.
j. Organize a group discussion session on relative merits and demerits of different types of turbines, condensers, boilers.
k. Make a model of steam condenser and show how vacuum is created after steam condensation.
l. Undertake a 03 days training at Thermal Power Plant.

11. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
28	Thermal Engineering	Rathore, Mahesh M.	Tata McGraw-Hill Education, New Delhi 2010, ISBN: 9780070681132
29	Basic Thermodynamics	Nag, P. K.	McGraw-Hill Education, New Delhi
30	Thermal Engineering	Rajput, R. K.	Firewall Media, New Delhi 2005, ISBN: 978-8170088349

31	A Textbook of Thermal Engineering	Gupta, J. K.; Khurmi R. S.	S. Chand Limited, New Delhi 1997, ISBN: 9788121925730
32	A course in Thermal Engineering	Domkundwar, S; Kothandaraman, C. P;Domkundwar, A. V.	Dhanpat Rai and company, New Delhi, 2004, ISBN:9788177000214
33	Elements of heat engines Vol I, II and III	Patel and Karamchandani	Acharya Publication, Vadodara
34	Engineering thermodynamics	P.B. Joshi, V.S.Tumane	Pune VidyarthiGrihaPrakashan,Pune30
35	Thermal Engineering	A.S.Sarao	Satya prakashan ,New Delhi
36	Heat Engineering	Kumar,Vasandani	Metropolitan book company (p) Ltd. Delhi-6
37	Lewitt	Thermodynamics applied to Heat Engines	Sir Isaac Pitman and sons Publication Ltd.

13 SOFTWARE/LEARNING WEBSITES

1 http://www.sfu.ca/~mbahrami/ENSC%20388/Notes/Intro%20and%20Basic%20Concepts.pdf
2 http://web.mit.edu/16.unified/www/FALL/thermodynamics/notes/node12.html
3 https://www.youtube.com/watch?v=9GMBpZZtjXM
4 https://www.youtube.com/watch?v=3dyxjBwqF-8
5 https://www.youtube.com/watch?v=02p5AKP6W0Q
6 http://www.learnengineering.org/2013/02/working-of-steam-turbine.html
7 https://www.youtube.com/watch?v=MulWTBx3szc
8 http://nptel.ac.in/courses/103106101/Module%20-%208/Lecture%20-%202.pdf
9 https://www.youtube.com/watch?v=Jv5p7o-7Pms
10http://www.cdeep.iitb.ac.in/webpage_data/nptel/Mechanical/Heat%20and%20Mass%20Transfer/Course_home_1.html
11 http://www.rinfra.com/energy_generation.html
12 https://www.youtube.com/watch?G2z9gAfREt0
13 https://www.youtube.com/watch?FPaKjYyUea8
14 https://www.youtube.com/watch?IFWpDzzq0CE
15 https://www.youtube.com/watch? JCYI-ZjHPGg

12. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	-	1	2	1	2	1
CO2	2	2	1	-	1	2	2
CO3	2	1	1	2	2	1	1

CO4	3	1	2	2	2	1	1

	PSO1	PSO2
CO1	-	2
CO2	1	1
CO3	-	2
CO4	1	2

Sign: Name: Shri A.S.Zanpure Shri.V.J.Deshpande (Course Expert /s)	Sign: Name: Dr. N.G..Kulkarni (Head of Department)
Sign: Name: Dr..N.G.Kulkarni (Program Head) (Head of Department)	Sign: Name: Shri A.S.Zanpure (CDC)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diploma in MECHANICAL ENGINEERING
Programme code	04/24
Name of Course	**FLUID MECHANICS AND FLUID MACHINERY**
Course Code	**ME3103**
Prerequisite course code and name	**----**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	***ESE/ POE**	**PA**	150
04	00	02	06	**Marks**	80	20	25	25	
				Exam Duration	3 Hrs	1 Hr	2 Hr		

(*): *OE/POE (Oral Examination/Practical Oral Examination mention whichever is applicable)*
Legends: L- lecture,T-Tutorial/teacher guided theory practice, P-practical, ESE-End semester examination, PA- Progressive Assessment.

2. RATIONALE

Knowledge of fluid pressure, fluid flow and related machinery is essential in all fields of engineering.Hydraulic machines and hydraulic devices have important role in power generation, power transmission, water supply, irrigation and other engineering segments. This subject requires the knowledge of basic engineering science, applied mechanics and mathematics etc. The fundamentals of this subject are essential for the subject Industrial Hydraulics to be taught in higher semesters.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences

- **Maintain Hydraulic machinery using knowledge of Fluid Mechanics.**

4. 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**:**

After studying this course, the student will be able to

1. Define different characteristics of fluids.

2. Identify the patterns of fluid flow.
3. Determination of different losses in flow through pipes.
4. Calculate efficiency of different turbines and pumps.
5. Select Suitable Turbines and pumps based on given parameters.

5. 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**:**

Sr. No.	Unit No.	Practical Exercises(Pro's) (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1	1	Determination of coefficient of discharge of rectangular Notch/Orifice.	01	04
2	2	Measure the Total Energy available at different sections of a pipe layout	02	04
3		Determination of coefficient of discharge of Venturimeter.	03	04
4	3	Estimate Darcy's friction factor 'f' in pipes of three different diameters for four different discharges	03	04
5		Determination of loss of head due to sudden enlargement and sudden contraction in pipes.	03	04
6	4	Determine the force exerted by a jet on flat plate	04	04
7		Observe construction, working and find power and efficiency of Pelton wheel or Francis turbine.	04	04
8	5	Observe construction working & find power & efficiency of centrifugal /Reciprocating pump	05	04
		Total Hrs		**32**

S.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test rig or model	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
Total		**100**

6.MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	PrO. No.
1	Hydraulic Bench	1,2

2	Venturimeter Testing Apparatus	1 ,2,3
3	Impact of jet test rig	4
4	Centrifugal pump Test rig	6
5	reciprocating Pump Test Rig	6
6	Pelton Wheel test rig	4
7	Francis Turbine test rig	4
8	Different sizes pipes	1,3,4
9	Manometers with Mercury, Stop watch , Bourdon Pressure Gauge	All

6. THEORY COMPONENTS

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

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
UNIT 1. Fluids, Fluid Pressure & Measurement of Pressure (Weightage-14 , Hrs- 10)	
1.1a)Compare the given two fluids based on the given physical properties. 1.2a) Calculate fluid pressure, total pressure and centre of pressure on the given immersed body in the specified liquid and the given position. 1.3a)Choose the relevant pressure measuring device for the given situation with justification. 1.3b)Calculate pressure using different Types of Manometers and Bourdon pressure gauge measuring devices for the given application .	**1.1** Fluid, types of fluids, properties of fluids::mass density, weight density, specific volume, specific gravity, viscosity, kinematic viscosity, Newton's law of viscosity and units. Compressibility bulk Modulus, surface tension, Capillary action, vapour pressure, cavitation. Types of fluids: Ideal, Real, Newtonian, Non- Newtonian, Plastic. **1.2** Pascal's Law, concept of static pressure, pressure head, centre of pressure and total pressure for rectangular, circular and triangular plane surfaces. **1.3**Concept of atmospheric pressure, Gauge pressure and vacuum pressure. Pressure head measurement by Piezometer, U-tube manometer, inverted U-tube manometer, micro manometer and Bourdon's pressure gauge.
UNIT 2 Flow of Fluids (Weightage- 12 , Hrs- 10)	

2.1a)Compare the types of fluid flow based on the given characteristic properties. 2.2a)Determine energies possessed by flowing fluids. 2.3b)Apply Bernoulli's theorem and Continuity equation to the given discharge measuring device and data. 2.5a)Determine Hydraulic coefficients. 2.6b)Describe with sketches the procedure to calculate discharge using the given flow meter. 2.6c)Choose the relevant discharge measuring device for the given situation with	2.1 Types of flows: Steady-unsteady, uniform-non uniform, Laminar-turbulent, compressible-incompressible, rotational-irrotational, 1,2,3 Dimensional. Rate of flow (discharge).law of continuity, Reynolds's number. 2.2 Energies possessed by flowing liquids like pressure, kinetic and potential energy, total energy equation 2.3 Bernoulli's theorem and its application to venturimeter and Pitot tube 2.4 Derivation for discharge through Venturimeter 2.5 Hydraulic coefficients, determination of coefficient of velocity by trajectory method 2.6 Flow through small circular orifice, rectangular and V-notches.
UNIT 3 Flow through Pipes (Weightage - 12 , Hrs- 10)	
3.1a)Use laws of fluid friction for the given Laminar and turbulent flow. 3.1b)Use Darcy's equation and Chezy's equation for the given frictional losses. 3.1c)Estimate losses in flow for the given pipe layout. 3.3a)Calculate power transmitted and transmission efficiency for the given pipe layout and data.	**3.**1 Laws of fluid friction for laminar and turbulent flow. Darcy's and Chezy's equation for frictional loss. Different types of head losses in pipes. Minor losses: sudden expansion, sudden contraction, bend, pipe fittings, entry, exit. Equivalent pipe. 3.2 Hydraulic gradient line, total energy line. 3.3 Power transmitted through pipes, transmission efficiency, water hammer and its effects (numerical based of connected reservoirs are not expected)
UNIT 4 Impact of Jet and Water turbines (Weightage- 16 , Hrs- 14)	
4.1a)Apply impulse momentum equation to the given geometry of vanes and find equations for force and work done. 4.2a)Calculate force exerted by a jet, work done and efficiency for the given vane and data. 4.2b)Draw velocity diagram for the given curved vane with special reference to turbines. 4.2c)Draw velocity diagram for the given curved vane with special reference centrifugal pumps.	4.1 Impact of jet and generation of force on stationary and moving flat plate, stationary and moving curved vanes. 4.2 Tangential entry on the moving vanes mounted on the wheel, calculation of work done and efficiency. 4.3Simple layout of hydro-electric power plant showing dam, reservoir pen stock, surge tank pressure relief valves turbine penstock and tail race.Simple layout of hydro-electric power plant showing dam, reservoir pen stock, surge tank pressure relief valves turbine penstock and tail race. 4.4Classification of turbines, principles of working and construction of Pelton, Francis, and Kaplan Turbines.

4.3a)Select the hydraulic turbine for the given application with justification. 4.4a)Calculate work done, power, specific speed and efficiency of the given turbine and data. 4.5a)Describe with sketches the functioning of the given types of Draft tubes. 4.6a)Draw characteristic curves of the given turbine. 4.6a)Describe the procedure to troubleshoot the given type of hydraulic turbine with sketches.	4.5Construction and working of Pelton wheel and Francis turbine, Draft tubes – types and construction, calculation of work done, power developed, losses and different efficiencies including velocity diagram. 4.6Methods of governing, performance characteristics, 4.7 Concept of cavitation in Turbines. Turbine selection critria
UNIT 5 Centrifugal Pumps (Weightage- 16 , Hrs- 12)	
5.1a)Select the relevant hydraulic pumps for the given application with justification. 5.1b)Calculate work required and efficiency of the given centrifugal pump data. 5.1c)Draw characteristic curves of the given pump. 5.2a)Describe the procedure to troubleshoot the given type of hydraulic pump with sketches.	5.1 Classification and applications of pumps, main components, construction, and working. Priming, different heads, velocity diagrams, calculation of power required to drive the pump, manometric efficiency and overall efficiency. NPSH and performance characteristic curves. (numerical based on velocity diagrams are expected) 5.2 Multistage pumps, submersible pumps, jet pumps, maintenance and fault finding, their remedies. Installation and testing of centrifugal pumps and pump selection.
UNIT 6 Reciprocating pumps and Hydraulic devices (Weightage- 10 , Hrs- 8)	
6.1a). Calculate slip, efficiency, and power required to drive the given reciprocating pump and data. 6.2a). Define working principle of different hydraulic devices with sketch and applications.	6.1 Construction and working of single acting and double acting pumps, indicator diagram. Positive and negative slip, calculation of power required. Air vessels, functions and advantages. 6.2 Working principle, construction & applications of hydraulic intensifier, hydraulic press and hydraulic lift.

7. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fluid, Fluid Pressure and Measurement of pressure	10	06	04	06	16
II	Flow of Fluids	10	08	02	02	12
III	Flow through Pipes	10	06	02	04	12
IV	Impact of Jet and Water turbines	14	04	04	08	16

V	Centrifugal Pumps	12	04	04	06	14
VI	Reciprocating pumps and hydraulic devices	08	04	04	02	10
Total		64	**32**	**20**	**28**	**80**

8. 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. Prepare journals based on practical performance in the laboratory.
b. Follow the safety precautions.
c. Use various mechanical measuring instruments and equipment related to fluid mechanics and machinery.
d. Read and use specifications of the hydraulic machines and equipment.
e. Library / Internet survey of hydraulics and hydraulic machines
f. Prepare powerpoint presentation or animation for understanding constructional details and working of different hydraulic machines.
g. Visit nearby shops to identify different PVC and GI pipe fittings. Collect manufacturing catalogs related to the same.
h. Visit nearby shops to identify different pumps. Collect manufacturing catalogue related to the same and compare their salient features.
i. Prepare a list of commercially available software related to computational Fluid dynamics (CFD).
J. Visit any hydraulic power plant and write reports.

9. 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/subtopics.
b. About ***15-20% of the topics/sub-topics*** which are 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).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant systems and equipment.
f. Use the proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. Teacher should ask the students to go through instruction and Technical manuals

10. SUGGESTED MICRO-PROJECTS

(Only for Class Declaration Courses)

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 is group-based. However, in the fifth and sixth semesters, it should preferably be ***individually*** undertaken to build up the skill and confidence in every student to become a 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 a 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. Prepare a pipe layout water supply of your lab from the supply reservoir and calculate the loss of head.
B. Prepare a chart showing all the pressure and flow measuring devices.
C. Prepare a demonstration model of a hydroelectric power plant/ any hydraulic device.
D. Calculate running cost of your house,/hostel pump and verify the electricity bill.
E. Gather information of hydroelectric power plants in Maharashtra, India and world.
F. Visit a hydroelectric power plant and write a report.
G. Make a video to explain the Hydraulic power generation which could be understood by the common man.
H. Select a pump for a coolant recirculation in the lathe machine, Bore well pumps, pump at service station, pump used in water coolers, pump in purified water filter system with justification.
I. Download catalogue of pump manufacturers like kirloskar, CRI Texmo,etc and compare their parameters.
J. Disassemble and assemble centrifugal pump for fault finding, troubleshooting and to identify worn out parts.
K. Prepare a display chart of types of pipes on the basis of material, size and applications.
L. Study pressure gauges used by roadside tyre works, blood pressure measurement by doctors, pressure gauges mounted on turbine test rig.
M. Visit to nearby pump manufacturing unit
N.Conduct market survey of pump suppliers and prepare reports on technical specifications, area of applications, cost, material of different parts and maintenance procedure.

11. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	Hydraulics and Fluid Mechanics including Hydraulic Machines .	Modi P.N. Seth S M Standard Book House New Delhi, 2013	ISBN 978818940126
2	Fluid Mechanics and Hydraulic m/c	Bansal R. K. Laxmi Publication Pvt. Ltd. New Delhi, 2013,	ISBN 9788131808153
3	A textbook of Fluid Mechanics and	Rajput R. K. S. Chand and Company Pvt. Ltd. New Delhi, 2000,	ISBN 9789385401374

	Hydraulic Machines		
4	Fluid Mechanics and Hydraulic Machines: problems and solution	Subramanya K. Tata McGraw-Hill Co. Ltd. New Delhi 2011,	ISBN 9780070699809
5	Fluid Mechanics and Machinery	Ojha, Berndtsson, Chandramouli Oxford University Press, New Delhi 2000,	ISBN 9780195699630
6	Introduction to Fluid Mechanics and Fluid Machines	Som S. K. , Biswas G. Tata McGraw-Hill Co. Ltd. New Delhi 2005,	ISBN 9780070667624
7	A Textbook of Hydraulics, Fluid Mechanics and Hydraulic Mechanics	Khurmi R. S. S. Chand and Co. Ltd. New Delhi 2015,	ISBN-13: 9788121901628
8	Hydraulic, fluid mechanics and fluid machines	Ramamrutham S. Dhanpat Rai and Sons New Delhi 2011,	ASIN: 8187433809
9	Fluid Mechanics	Streeter Victor, Benjamin Wylie E. Bedford K.W. McGraw Hill Education; New Delhi, 2017,	ISBN 978-0070701403
10	Hydraulic Machines	Jagdish lal Metropolitan; 2008,	ISBN-13: 9788120004221

SOFTWARE/LEARNING WEBSITES

www.nptel.ac.in/courses
www.learnerstv.com www.ni.com/multisim
https://www.youtube.com/watch?v=e6a2q9k2JCA
https://www.youtube.com/watch?v=5TTnFccqJEE
https://www.youtube.com/watch?v=3Gq3tR3fkM0
https://www.youtube.com/watch?v=UNBWI6MV_lY
https://www.youtube.com/watch?v=ljMVt7T4HQM
https://www.youtube.com/watch?v=wnOQMk7pKak
https://www.youtube.com/watch?v=IcJOkRZPNMI
https://www.youtube.com/watch?v=w7n0srAzm8g

https://www.youtube.com/watch?v=f9LY0-WP9Go
https://www.youtube.com/watch?v=tXLI-IeAynI
https://www.youtube.com/watch?v=qbyL--6q7_4
https://www.youtube.com/watch?v=3BCiFeykRzo
https://www.youtube.com/watch?v=0p03UTgpnDU
https://www.youtube.com/watch?v=BaEHVpKc-1Q
https://www.youtube.com/watch?v=oQqMrtc6kJQ

12. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	-	-	-	-	2
CO2	3	2	*1*	*1*	-	*1*	2
CO3	3	*2*	-	*1*	-	*1*	2
CO4	*3*	-	-	-	-	-	2
CO5	*2*	-	-	*1*	*3*	*1*	3
Avg	*2.7*	*1*	*0.2*	*0.6*	*0.6*	*0.6*	2.2

	PSO1	PSO2
CO1	-	-
CO2	-	*1*
CO3	-	*1*
CO4	-	*1*
CO5	-	*2*
Avg	-	*1*

Sign: Name: Smt.V.S.Jadhav (Course Expert /s)	Sign: Name: Dr.N.G.Kulkarni (Head of Department)
Sign: Name: Dr.N.G.Kulkarni (Program Head) (Mech.Engg.Dept.)	Sign: Name: Shri A.S.Zanpure (CDC)

Government Polytechnic, Pune
180 OB -Scheme

Programme	Diplôma in ME
Programme code	01/02/03/**04**/05/06/07/08/16/17/21/22/23/24/26
Name of Course	**Metrology and Measurements (C.D.)**
Course Code	**ME 3104**
Prerequisite course code and name	---

1. TEACHING AND EXAMINATION SCHEME:

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	**ESE**	**PA**	
04	00	02	06	**Marks**	80	20	25	25	150
				Exam Duration	3 Hrs	1 Hr	2 Hr		

***(*):** Under the theory PA, Out of 20 marks, 10 marks are for micro-project assessment*
Legends: L- lecture-Tutorial/teacher guided theory practice, P-practical, ESE-End semester examination, PA- Progressive Assessment.

2. RATIONAL:

The course has been included in the curriculum as inspection and quality control activities are given prime importance in industry. A diploma technician working in the industry has to identify the variables to be measured, decide the accuracy required, Select the instrument, investigate reasons for defects and give suggestions, decide whether to accept or reject the jobs.

Methods and techniques of measurements are becoming increasingly important in engineering in recent years. Laboratory programs have been modernized, sophisticated electronic instrumentation has been incorporated into the program and newer techniques have been developed. The course aims at making a Mechanical Engineering student familiar with the principles of instrumentation, transducers & measurement of parameters like temperature, pressure, flow, speed, force and stress.

3. COMPETENCY:

Use relevant analog and digital instruments to measure various parameters of machine components and Mechanical Engineering related applications.

4. COURSE OUTCOMES (COs):

1. Select the relevant instrument for measurement of length and angle.
2. Select gauges, fits and tolerances for machine components.
3. Use relevant instruments for thread, gear and surface measurement.

4. Identify different components of a control system.

5. Select relevant instruments for measurement of speed, temperature, flow and miscellaneous quantities.

5. SUGGESTED PRACTICALS/EXERCISES: - Any TWELVE

Sr. No.	Name of Practical / Experiment / Assignment	Hrs
1	Study & use of various basic measuring instruments.	04
2	To find unknown angle of component using Sine-Bar, slip gauge and dial indicator	02
3	Use of dial indicator for run out measurement.	02
4	Study & use of pneumatic comparator	02
5	Measurement of different Parameters of screw thread by optical profile projector/ Tool maker microscope.	02
6	Study and use of Autocollimator/ Angle Dekker.	02
7	Measurement of gear tooth elements by using gear tooth Vernier caliper	02
8	Measurement of surface finish – Ra, Rz values.	02
9	Study of generalized measurement & identification of components	02
10	Study & detection of different types of errors in any one measurement system	02
11	Calibration of pressure gauge using Dead weight Tester	02
12	Temperature Measurement using thermocouples, pyrometers.	02
13	Displacement measurement using Linear variable differential transducer.	02
14	Force measurement on load cell demonstrator.	02
15	Speed measurement with Magnetic pickup transducer/ Stroboscope	02
	Total	**32**

S.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test rig or model	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED:

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	Pr. No.
1	Vernier, micrometers of various types, vee block, spirit level, combination set, gauges	1
2	Dial indicator, Pneumatic comparator, sine bar	2,3,4
3	Optical profile projector, tool maker's microscope	5
4	Autocollimator, Angle Dekker	6
5	Gear tooth Vernier	7
6	Surface roughness tester	8
7	Various transducers	9,10,11,12,13,14,15

7. THEORY COMPONENTS:

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub topics
SECTION I	
	UNIT 1. INTRODUCTION TO METROLOGY (Weightage - 12 , Hrs - 10)
1a. Explain the testing parameters used for the given instrument. 1b. Select relevant measuring instrument for the given job with justification. 1c. Calculate the least count of all basic instruments. 1d. Identify the errors in given instrument. 1e. Select slip gauges to be used along with sine bar for given job. 1f. Select angular measuring instrument for the given job.	1.1 Selection of Definition of metrology, objective of metrology, Need of inspection. 1.2 Static characteristics of instruments – Least count (resolution), range and span, accuracy and precision, reliability, calibration, hysteresis, dead zone, drift, sensitivity, threshold, repeatability, reproducibility, linearity, Amplification, Magnification. Dynamic characteristics of instruments - speed of response, fidelity, overshoot. n1.3 Errors- Sources of errors, Types of errors, factors affecting accuracy. 1.4 Selection of instrument, general precautions of instruments. 1.5 Standards in measurement: Definition and introduction to Line standard & end standard. 1.6 Study of sine bar, slip gauges (With Numerical on setting of slip gauges) 1.7 Angular measurement: Bevel protractor, spirit level, Sine Bar, Angle Gauges (With Numerical on Setting of Angle Gauges).
	UNIT 2. LIMITS, FITS, GAUGES AND COMPARATORS (weightage -12, Hrs - 10)
2a. Apply limits, fits and tolerances on the given job.	2.1 Limits Fits and tolerances: Concept of Limits, terminology, Selective Assembly, Interchangeability.

2b. Select the gauges for the given job with justification. 2c. Select slip gauges for adjusting Adjustable snap gauge. 2d. Explain construction and working of given comparator.	2.2 Indian standard (IS 919-1993), types of fits, Hole and Shaft Basis System, (Numericals on finding the limit and tolerances of hole and shaft assembly) 2.3 Gauges: Limit gauges. Taylor's principle of gauge design, Plug, Ring Gauges, snap gauges, adjustable snap gauges. 2.4 Comparators: Definition, Requirement of good comparator, Classification, use of comparators, Working principle of comparators, Dial indicator, Pneumatic comparator.
	UNIT 3. SCREW THREAD, GEAR AND OTHER MEASUREMENTS **(weightage - 16 , Hrs - 12)**
3a. Calculate screw thread parameters using given method. 3b. Explain the procedure of measuring the given gear parameters. 3c. Measure surface finish of the given component. 3d. Explain the procedure to check surface pattern by optical flat. 3e. Explain the procedure for measurement by CMM.	3.1 Screw thread Measurements: Screw thread terminology, Errors in threads, Measurement of different elements such as major diameter, minor diameter, effective diameter, pitch, thread angle. Best size wire, two wire method, Thread gauge micrometer, Working principle of floating carriage dial micrometer. 3.2 Gear Measurement: Gear terminology, Analytical and functional inspection, Parkinson Gear tester, gear tooth Vernier, Profile projector, Errors in gears. 3.3 Meanings of surface texture and definitions, terminology as per Indian standard, methods of surface measurement. 3.4 Flatness checking by optical flat. 3.5 Introduction to Co-ordinate measurement machine (CMM).
SECTION II	
	UNIT 4. GENERALIZED MEASURING SYSTEM **(weightage -12 , Hrs - 10)**
4a. Identify different characteristics of given instrument. 4b. Classify the transducers for the given application. 4c. Identify the given contact and non-contact transducer with justification. 4d. Identify components in the control systems for boilers and ACs.	4.1 Generalized measuring system and its components. 4.2 Transducers: Classification of transducers- active and passive, contact, non-contact, Mechanical, Electrical, analog, digital. Applications of transducers. 4.3 Block diagram of automatic control system, closed loop system, open loop system, feedback control system, feed forward control system, servomotor mechanism. 4.4 Applications of control systems for boiler and air conditioners .
	UNIT 5. DISPLACEMENT, SPEED AND TEMPERATURE MEASUREMENT **(weightage - 14 , Hrs -12)**

5a. Select displacement measuring sensor in the given system with justification. 5b. Describe with sketches the use of speed measuring instrument for given system. 5c. Choose relevant instruments to measure temperature of given system. 5d. Describe with sketches the procedure of temperature measurement by given device.	5.1 Specification, selection and application of displacement transducer, Potentiometer. 5.2 Speed measurement – Tachometers: Eddy current generation type, incremental and absolute type. Classification: Mechanical Tachometers, Slipping Clutch Tachometer, Electrical Tachometers, Eddy current Drag Cup Tachometer, Contact less Electrical tachometer, Inductive Pick Up, Capacitive Pick Up, Stroboscope. 5.3 Non-electrical methods- bimetal and liquid in glass thermometer, pressure thermometer. 5.4 Electrical methods- RTD, platinum resistance thermometer, thermostat. 5.5 Thermoelectric methods-elements of thermocouple, law of intermediate temperature, law of intermediate metals.
	UNIT 6. FLOW AND MISCELLANEOUS MEASUREMENT (weightage - 14 , Hrs - 10)
6a. Identify the flow meter for given situation with justification. 6b. Select relevant flow meter to measure flow in given system with justification. 6c. Identify relevant sound measuring device for the given situation with justification. 6d. Select the relevant humidity measuring device for the given system with justification. 6e. Select relevant dynamometer for measuring the given torque with justification.	6.1 Types of flow meters. Selection criteria for flow meters. Variable area meter - Rota meter, turbine meter. Anemometer - hot wire and hot film. Electromagnetic flow meter, ultrasonic flow meter. 6.2 Acoustics measurement- sound characteristics - intensity, frequency, pressure, power - sound level meter. 6.3 Humidity measurement - hair hygrometer 6.4 Force measurement -Tool Dynamometer (Mechanical Type) 6.5 Shaft Power Measurement - Eddy Current Dynamometer, Load cells

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN:

Unit No.	Unit title		Cognitive Levels			Total
		Teaching hours	Knowledge	Comprehension	Application	
1.	Introduction To Metrology	10	04	04	04	12
2.	Limits Fits and Gauges and Comparators	10	04	04	04	12
3.	Screw thread, gear and other measurements	12	06	04	06	16
4.	Generalized measuring system	10	04	04	04	12

5.	Displacement, speed and temperature measurement	12	04	04	06	14
6.	Flow and miscellaneous measurements	10	04	04	06	14
Total		**64**	**26**	**24**	**30**	**80**

9. 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. Prepare journals based on practical performed in laboratory.
b. Prepare charts showing construction of different instruments.
c. Prepare charts of limits, fits and gauges.
d. Search information about various ISO standards of measurement.
e. Collect information of transducers and prepare charts of the same.

10. 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:

z. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
aa. About ***15-20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations.
bb. Teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
cc. Guide student(s) in undertaking micro-projects.
dd. Use Flash/Animations to explain working of various instruments.
ee. Teacher should ask the students to go through instruction and Technical manuals.

11. 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 first four semesters, the micro-projects 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 and UOs. 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.

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

a. Various charts.
b. Various models

c. Simple transducers.
d. Various PPTs on advanced topics.

12. SUGGESTED LEARNING RESOURCES :-

Sr. No	Author	Title	Publication
1	R.K. Jain	Engineering Metrology	Khanna Publication, New Delhi
2	I.C. Gupta	A text book of Engineering Metrology	Dhanpat Rai and Sons,
3	K.J. Hume	Engineering metrology	Kalyani Publication, Ludhiyana
4	A.K. Sawhney	Mechanical Measurements & Instrumentation	Dhanpat Rai & Sons, New Delhi.
5	D.S. Kumar	Mechanical Measurements & Control	Metropolitan Publications, New Delhi
6	R.K. Jain	Mechanical & Industrial Measurements	Khanna Publications, New Delhi

13. SOFTWARE/LEARNING WEBSITES: Students should refer following videos from internet.

Introduction to metrology :
https://www.youtube.com/watch?v=HpIEeBtJupY&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=1

MQC terminologies:
https://www.youtube.com/watch?v=jpHzjhYyKO4&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=2
Measurement errors:
https://www.youtube.com/watch?v=7VNyyInaVsU&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=3
Angle plate, steel rule, spring calipers: https://www.youtube.com/watch?v= u8UW9O1UHCw&list PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=4
Combination set, Vernier calipers:
https://www.youtube.com/watch?v=SBGacenZ_80&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=5
Height gauge, micrometers:
https://www.youtube.com/watch?v=ioyRjm-dSuI &list=PLbMVogVj5nJSZiwuh_tp50dKry 8mCxzKA&index=6
Micrometer, Bore gauge:
https://www.youtube.com/watch?v=E7KWQTQOV3M&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=7
Dial indicators, thickness gauges, depth gauges:
https://www.youtube.com/watch?v=xPUjQAtre7Q&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=8
Manufacturing tolerances and fits:
https://www.youtube.com/watch?v=-_qz8_sbhwY&list=PLbMVogVj5nJSZiwuh_tp50 dKry8mCxzKA&index=9
Terminology of limits, fits and tolerances:
https://www.youtube.com/watch?v=c8TKftViusQ&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=10
Numerical problems on fit and tolerances:
https://www.youtube.com/watch?v=uAntebtIgCY&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=11
Selection of fits and tolerances:
https://www.youtube.com/watch?v=rbk28swIiHU&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=12
Limit gauging:
https://www.youtube.com/watch?v=OcbkOvjZujU&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=14
Surface finish parameters:

https://www.youtube.com/watch?v=99zzBRKYLwQ&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=20
Screw thread terminology:
https://www.youtube.com/watch?v=O7WvzU3FQ5c&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=23
Screw thread measurement:
https://www.youtube.com/watch?v=xPGi2e-gOo8&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=24
Gears:
https://www.youtube.com/watch?v=n1EzCOnZn3s&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=25
Angle measurement:
https://www.youtube.com/watch?v=U_LMe40gxds&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=27
Comparators:
https://www.youtube.com/watch?v=Hi7NUJdznc0&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=32
Pneumatic comparator:
https://www.youtube.com/watch?v=TyM28gmhJcc&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=34
Universal testing machine:
https://www.youtube.com/watch?v=cjzSXPDBA_Q&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=37
Generalised measuring system:
https://youtu.be/oAdNKL8SgNY
Transducers:
https://youtu.be/bfw_So5cCp4?list=PLVsrfTSlZ_40qYhVeqtLiNhnQ_40IfOyM
Temperature measurement:
https://youtu.be/tg8M3uOJi2M

14. PO - CO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	2	2	-	-	2
CO2	3	1	2	2	-	-	2
CO3	3	1	2	2	-	-	2
CO4	3	2	-	2	-	-	2
CO5	3	2	2	2	1	2	3

	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	1
CO5	-	1

Mrs. V. S. Jadhav Mr. N. B. Hirlekar	Dr. N. G. Kulkarni (Head Of Department)

(Course experts)	
Dr. N. G. Kulkarni (Program Head) (Head Of Department)	Mr. A.S. Zanpure (CDC)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diploma in Mechanical Engineering
Programme code	04/18/24
Name of Course	**Theory of Machines and Mechanisms**
Course Code	**ME 3105**
Prerequisite course code and name	--

- **TEACHING AND EXAMINATION SCHEME**

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	OE	PA	150
4	--	2	6	Marks	80	20	25	25	
				Exam Duration	03	01	--	--	

***(*):** Under the theory PA, Out of 20 marks, 10 marks are for micro-project assessment*
Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, ESE-End semester examination, PA- Progressive Assesment.

- **RATIONALE**

In this machine age , it is necessary to know the mechanism of machine to understand its functioning. Number of links transferring the forces and motion will comprise mechanism.
This course deals with geometry of mechanism, as well as velocity and acceleration of links, inversions of kinematic chain, different power drives
The scope of course is kinematics and dynamics of machines, role of friction, flywheels and governor, power transmission and application of cams.

- **COMPETENCY**

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Use principles of kinematics in Design or maintenance of various equipment**

- **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**:**

1. Illustrate Inversions of various mechanisms using basic definitions
2. Calculate velocities and accelerations of various links of mechanisms using graphical solutions
3. Justify role of Flywheel, Governors,Brakes, Clutches in Mechanical applications
4. Draw cam profiles for various follower motions
5. Calculate power transmitted by belt drives, Velocity ratios of various types of Gear trains.

- **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**:**

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1		Identify the types of kinematic pairs and inversions of mechanisms in the various models available in he laboratory(sketches and explanation is expected) four bar,single slider ,double slider crank chains	1	4
2		Measure the ratio of time of cutting stroke to the return stroke in shaping machine available in institute's workshop by varying the stroke length. (Sketch or photographof the mechanism is expected)	1	4
3		Determine velocity and acceleration of various links of the given mechanism (any two) by relative velocity method for analysis of motion of links (Minimum 2 problems on A3 size drawing sheet).	2	6
4		Determine velocity and acceleration in an I. C. engine's slider crank mechanism by Kleins's construction (Minimum 2 problems on A3 size drawing sheet).	2	2
5		Measure the lift of sleeve of the centrifugal governor for various speeds. Draw the turning moment diagram of four stroke I.C.Engine and define various terms related to flywheel and governor	4	4
6		Identify different types of brakes such as band brake, block brake and observe their working by actually handling the working models. Demonstration of calculation of breaking torque on a dynamometer.	3	4
7		raw the profile of a radial cam for given folloffollower motion um 3 problems on A3 size dsize drawing sheet).	5	4
8		Collect information of belt drives,chain drives and gear drives by surveying different laboratories and workshop (Students will visit PE lab ,App Mech Lab, workshop and take photographs and relevant information about drives and prepare report of it) i.e velocity ratio, types of belts, types of gear drives etc.	6	4
9		Prepare at least one working model,or charts etc in a group of 4 to 5 students (mini project)		
		Total Hrs		**32**

.No.	Performance Indicators	Veightage in %
●	Arrangement of available equipment or model	20
●	Line work and presentation of graphical solutions of problems	20
●	Safety measures	10
●	Observations and Recording	10
●	Mini Project	20
●	Answer to sample questions	10
●	Submission of report in time	10
Total		**100**

- **MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED**

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	PrO. No.
●	Ackerman's steering gear mechanism and foot operated air pump mechanism, slider crank mechanism, elliptical trammel, skotch yoke mechanism, oldham's coupling, hooks joint, inversions of four bar mechanisms.	1-4
●	Working models of locomotive coupler, Beam engine, Pantograph, Pendulum pump, Rotary I.C. engine mechanism, Oscillating cylinder engine, Whitworth quick return Mechanism, Quick return mechanism of shaper, Scotch Yoke mechanism, Elliptical trammel and Oldham's Coupling.	1-4
●	Working models of various cam follower arrangements for demonstration.	12
●	Working and cut section models of various types of brake assemblies.	7
●	Various types of clutch assemblies.	8
●	Working models of various types of governors.	10
●	Working models of ● various belt drives, ● chain and sprocket, ● various gear drives.	13
●	g Models of Gear trains - all types.(Simple, compound, reverted, epicyclical).	13

● **THEORY COMPONENTS**

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

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
UNIT 1. KINEMATICS OF MACHINE (Weightage-12 , Hrs- 08)	
● Identify various constraints of motions in the given mechanism with justification. ● Describe the constructional details of the given mechanism ● Select suitable mechanism for the given application with justification.	● **Kinematics of Machines:** troduction to Statics, Kinematics, Kinetics, Dynamics. nematic links, joints, pairs, chain and its types, Constrained motion and its types, Inversion, Mechanism, Machine and Structure. ● **Inversions of Kinematic Chains:** Four bar chain – Locomotive coupler, Beam engine and Pantograph,ackermann steering mechanism Single slider Crank chain – Pendulum pump, Rotary I.C. engine mechanism, Oscillating cylinder engine, Whitworth quick return Mechanism, crank and slotted lever quick return mechanism Double Slider chain - Scotch Yoke mechanism, Elliptical trammel, Oldham's Coupling.
UNIT 2 VELOCITY AND ACCELERATION IN MECHANISMS **(**Weightage- 12 , Hrs- 12)	
● Draw dimensioned sketch of the given mechanism. ● Draw velocity diagram for a given mechanism using relative velocity method. ● Draw acceleration diagram for the given mechanism. ● Draw velocity and acceleration diagram for the given mechanism using Klein's construction. ● Estimate velocity and acceleration of any link at any instant in the given mechanism.	● Concept of relative velocity and relative acceleration of a point on a link, angular acceleration, inter-relation between linear and angular velocity and acceleration. ● Klein's construction to determine velocity and acceleration of different links in single slider crank mechanism. ● Drawing of velocity and acceleration diagrams for simple mechanisms. Determination of velocity of a point on link by relative velocity method
UNIT 3 FLYWHEEL ,GOVERNER and **BALANCING (**Weightage- 12 , Hrs- 08)	

• Draw turning moment diagram for the given single cylinder 4-Stroke I.C Engine • Explain the method of balancing a rotating mass as per the given conditions. • Estimate the balancing mass and position of plane analytically and graphically in the given problem	• Flywheel-Introduction to flywheel – need, function and application of flywheel with the help of turning moment diagram for single cylinder 4-Stroke I.C Engine. • Coefficient of fluctuation of energy, coefficient of fluctuation of speed and its significance. • Governors- Introduction, types, functions and applications, Terminology of Governors. Comparison of Flywheel and Governor. • Balancing- Need and types of balancing, Balancing of single rotating mass, balancing of several masses revolving in same plane.
UNIT 4 FRICTION (Weightage- 20 , Hrs- 14)	
• Illustrate types of brakes • Explain various parts of the given brakes and Dynamometers with their functions and constructional details. • Describe needs, functions and applications of the given clutches. • Explain various parts of the given clutch with their functions and constructional details.	• Introduction to Brakes – Types, Functions and Applications. No neumericals on brakes and dynamometer. • Construction and principle of working of i) Shoe brake, ii) Band brake iii) Internal expanding shoe brake iv) Disc Brake.v) Hydraulic Brake • Braking force, braking torque and power for shoe and band brake. • Dynamometer- construction and working of Rope Brake, Hydraulic, Belt transmission , epicyclic gear train dynamometer • Clutches-Uniform pressure and Uniform Wear theories. Introduction to Clutch - Types, Functions and Applications, Construction and principle of working of i) Single-plate clutch, ii) Multi-plate clutch, iii) Centrifugal Clutch iv) Cone clutch 4.5 Bearings – Analytical treatment to determine power absorbed in friction for flat collar and pivot bearings (conical pivot excluded)
UNIT 5 CAMS AND FOLLOWERS (Weightage- 12, Hrs- 10)	
• Draw dimensioned sketch of the given cam and follower arrangement. • Identify the type of motion of follower in the given situation with justification. • Draw cam profile for the given motion of knife-edge and roller follower with and without offset application using Graphical method.	• Introduction to Cams and Followers. Cam and follower terminology. Classification of Cams and Followers. Applications of Cams and Followers. • Types of follower motions and their displacement diagrams - Uniform velocity, Simple harmonic motion, uniform acceleration and retardation. • Drawing of profile of a radial cam based on given motion of reciprocating knife-edge and roller follower with and without offset.
UNIT 6 POWER TRANSMISSION (Weightage- 12 , Hrs- 12)	
• Calculate velocity ratio, belt tensions, slip and angle of contact in the given belt drive. • Estimate power transmitted and condition for maximum power transmitted in the given belt drive through simple numerical problem • Calculate Train value & velocity ratio for the given simple, compound, reverted and epicyclic gear trains using spur and helical gears. • Select suitable drives for the given application with justification.	• Belt Drives – Introduction to Flat belt, V-belt & its applications, materials used for flat and V-belts. Angle of lap, length of belt, Slip and creep. Determination of velocity ratio of tight side and slack side tension for flat belt centrifugal tension and initial tension, condition for maximum power transmission. Merits, demerits and selection of belts for given applications. • Chain Drives – Introduction to chain drives, Types of chains and sprockets, Methods of lubrication. Merits, demerits of chain drives. • Gear Drives – Introduction to gear drives, Classification of gears, gear terminology, Types of gear trains, Train value & velocity ratio for simple, compound gear trains using spur gears. Merits, demerits and selection of gear drives for given applications.

- **SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN**

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Kinematics of Machine	08	6	6	-	12
II	Velocity Acceleration in Mechanisms	12	2	4	6	12
III	Flywheel ,Governor and Balancing	08	2	4	6	12
IV	Friction	14	4	8	8	20
V	Cams and Follower	10	2	4	6	12
VI	Power Transmission	12	2	4	6	12
Total		64	**14**	**26**	**40**	**80**

- **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:

- Prepare journals based on practical performed in laboratory.
- Prepare charts of different clutch, Brakes, Dynamometers and chain drive
- Compile information from internet related to various mechanisms/elements like piston, crank, connecting rod, cam, clutch, brake, flywheel, governor, or animation of mechanism etc. along with functions and areas of application of each.
- List the mechanisms which you are using in your day to day life. Sketch any three from these.
- List the different mechanisms used in a typical car.
- Identify and measure the dimensions of Flywheel used in automobile engines, generators, punching and riveting machines.
- Identify the type of clutches used in different automobiles and also the type of brakes in automobile and bicycle.
- Visit the market and collect the data of items which are used in any mechanisms. Data includes specifications, cost, applications, etc. Also name the mechanism/s in which such item/s is/are used.

- **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:

- Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
- 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).
- With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
- Guide student(s) in undertaking micro-projects.
- Correlate subtopics with power plant system and equipment.
- Use proper equivalent analogy to explain different concepts.
- Use Flash/Animations to explain various components, operation and
- Teacher should ask the students to go through instruction and Technical manuals

- **SUGGESTED MICRO-PROJECTS**

NA

(Only for Class Declaration Courses)

Only one micro-project *is planned to be undertaken by a student that needs to be assigned to him/her.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 is given here. Similar micro-projects could be added by the concerned faculty:

- **SUGGESTED LEARNING RESOURCES**

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	Theory of Machines	Rattan S. S.	Tata McGraw-Hill Education, 1986 ISBN 9780070591202
2	Theory of Machines	Khurmi R. S., Gupta J. K.	S. Chand Publications, New Delhi, 2015 ISBN 9788121925242
3	Theory of Machines	Bevan Thomas	Pearson Education India, 1986, 3/e ISBN 9788131729656
4	Theory Of Machines and Mechanisms	Ballaney P.L.	Publisher Khanna, 2003, Edition 23, ISBN 9788174091222
5	A Text Book of Theory of Machines	Bansal R.K., Brar J. S.	Laxmi Publication, New Delhi, 2004, ISBN 9788170084181
6	Theory of Machines and Mechanisms	Joseph E. Shigley	OXFORD UNIVERSITY PRESS, Fifth Edition, ISBN 9780190264482
7	Mechanics of machines elementary theory and examples	J. Hannah & R.C. Stephens	Hodde; International student edition edition, ISBN-13: 978-0713132328

- **SOFTWARE/LEARNING WEBSITES**

  - http://nptel.iitm.ac.in/video.php?subjectId=112104121
  - http://www.technologystudent.com/gears1/gears7.htm
  - http://kmoddl.library.cornell.edu/model.php?m=20
  - http://www3.ul.ie/~kirwanp/whatisacamandfollowersyste.htm
  - http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-
  - Delhi/Kinematics%20of%20Machine/index.htm
  - http://elearning.vtu.ac.in/12/enotes/Des_Mac-Ele2/Unit6-RK.pdf
  - en.wikipedia.org/.../Canadian_Committee_for_the_Theory_of_Machines...
  - global.oup.com/.../theory-of-machines-and-mechanisms-978019537123...
  - www.tecquipment.com/Theory_of_Machines.aspx
  - www.researchgate.net/.../0094-114X_Mechanism_and_Machine_Theory
  - www.journals.elsevier.com/mechanism-and-machine-theory/
  - journalseek.net/cgi-bin/journalseek/journalsearch.cgi?field=issn...
  - site.iugaza.edu.ps/wp-content/.../IUGAZA%20TOM2012_CH1-2.pdf
  - www.iftomm.org/
  - www.wiziq.com/online-tests/44047-mechanical-theory-of-machine
  - www.cs.ubc.ca/~murphyk/Teaching/CS340-Fall07/infoTheory.pdf

- **PO - COMPETENCY- CO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	1	-	-	-	2
CO2	3	2	2	-	-	1	1
CO3	-	1	1	2	-	1	2
CO4	2	3	3	-	-	-	1
CO5	1	2	3	-	-	1	1

	PSO1	PSO2
CO1	-	2
CO2	2	-
CO3	1	2
CO4	2	2
CO5	1	2

Sign: Name Mr. R.R.Godbole (Course Expert /s)	Sign: Name: Dr. N. G. Kulkarni (Head of Department)
.Sign: Name: Mrs. M.S. Deshmukh (Course Expert /s)	Sign: Name: Shri A.S.Zanpure (CDC)

Government Polytechnic, Pune

'180OB'– Scheme

Programme	Diplôma in ME
Programme code	01/02/03/**04**/05/06/07/08/16/17/21/22/23/24/26
Name of Course	**Fundamental of Mechatronics**
Course Code	**ME 3106**
Prerequisite course code and name	**NA**

2. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	***ESE (POE)**	**PA**	100
1	0	2	3	**Marks**	-	-	25	25	
				Exam Duration	-	-			

(*): *POE (Practical & Oral Examination)*

Legends: L- lecture,T-Tutorial/teacher guided theory practice,P-practical,ESE-End semester examination,PA- Progressive Assessment.

3. RATIONALE

Rapid development in Technology and competitive economy has led to development of new trends in manufacturing Industry such as CNC Machines, Automation, FMS etc. which consists of combination of mechanical, electrical and electronic systems which is referred as Mechatronics. Diploma engineer in professional life has to operate and maintain systems being developed in the area of Mechatronics. In view of this, it is important for him to understand fundamental facts, concepts, principles and application of Mechatronics systems which enables him to work as technician to adopt an interdisciplinary approach of engineering while working on shop floor/industry.

4. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Use mechatronics systems for relevant Application.**

5. 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**:**

1) Identify various instruments, sensor, actuators, microprocessor, software and mechanical components in mechatronics based systems.
2) Prepare block diagrams for basic applications.
3) Use sensor and actuator for different mechatronics applications.
4) Programme PLC for simple applications.
5) Use microprocessor and microcontroller for simple mechatronics based applications

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**:**

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1	1	Conduct a survey of manufacturers of various building blocks of mechatronic system	CO1	04
2	1	Identify various types of sensors and actuators used in mechatronics systems in lab	CO1	02
3	2	Use open and closed loop controls for interfacing servomotors.	CO2	02
4	3	Select sensors and actuators for given application with justification.	CO3	02
5	3	Prepare small circuits using different sensors Proximity Sensor –NPN.NO.PNP, Limit Switch, Opto sensors, Pressure sensors, Motor-24V DC, interfacing facility with PLC used in Mechatronics systems.	CO2	02
6	3	Prepare small circuits using different transducers like linear and rotary transducers with PLC	CO3	04
7	4,5	Identify various types of PLC and microprocessors used in mechatronics systems in lab	CO4	02
8	3,4	Prepare small circuits for i) Door open and close application, ii) Stamping iii) Raw material rejection system (any one) using different actuators with PLC and its use in Mechatronics Systems	CO3, CO4	02
9	4	Develop ladder diagram for simple light ON OFF switch	CO4	04
10	4	Develop ladder diagram for pedestrian traffic controller (Yellow, Red, Green)	CO4	02
11	4	Develop ladder diagram for simple applications of PLC such as Soft drink vending machine, bottle filling plant. (any one)	CO4	02
12	4,5	Select PLC and microprocessors for given application with justification.	CO4, CO5	02
13	5	Write simple program for microprocessor (8085) based application.	CO5	02
		Total Hrs		**32**

S.No.	Performance Indicators	Weightage in %
h.	Arrangement of availableequipment or model	20
i.	Setting and operation	20
j.	Safety measures	10
k.	Observations and Recording	20
l.	Interpretation of result and Conclusion	10
m.	Answer to sample questions	10
n.	Submission of report in time	10
Total		**100**

7. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	PrO.No.
34	PLC Trainer Kit with 12 DI,12 DO,2AI and 2AO with ladder and scada software	1 to 12
35	Basic Pneumatic Trainer Kit with manual and electrical controls/ PLC Control	1 to 12
36	Electro-pneumatic Trainer kit	1 to 12
37	Basic Hydraulic Trainer Kit	1 to 12
38	Hydraulics and Pneumatics Systems Simulation Software /Automation studio	1 to 12
39	BLDC, stepper motor and drive circuit sets.	1 to 12
40	AC servo and VFD trainer kit	1 to 12
41	Real Time Temperature Controller	1 to 12
42	DC Motor Speed controller	1 to 12
43	Servo controller using Open/Closed loop control system	1 to 12
44	Pneumatic Power circuit system	1 to 12
45	Real Time Temperature Controller	1 to 12
46	SCADA software (2000 points) with Siemens TIA portal educational bundle or equivalent Free Software	1 to 12
47	Pneumatic Power circuit system for Door close and open application, stamping application and raw material rejection system	1 to 12

8. THEORY COMPONENTS

The following topics/subtopicsshould betaught and assessed in order to develop UOs for achieving the COs to attain the identified competency**.**

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
UNIT 1. Introduction to Mechatronics(Hrs-02)	
1f. Compare with block diagram the features of the traditional and Mechatronics system for the given example 1g. Identify sensor, actuators, microprocessor techniques, software and mechanical components in the given diagram of the mechatronics based system with justification.	1.1 Introduction, Need, Scope, objectives and importance 1.2 Traditional V/s Mechatronics Approach, 1.3 Block diagram representation of General Mechatronics system (key elements of mechatronics system) showing various components with suitable example.
UNIT 2 Block Diagram Representation(Hrs- 02)	
2a. Describe basic elements of the given closed loop system. 2b. Build Blocks of Mechatronics 2c. List applications of Mechatronics system	2.1 Control System - Open and Closed Loop Systems, Basic Elements of closed loop system, Concept of Transfer Function, Block Diagram & Reduction principles 2.2 Building Blocks of Mechatronics - Electronics, Instrumentation, Sensor, Actuators, Microprocessor techniques, Software, Mechanical Components. 2.3 Applications of Mechatronic systems such as washing machine, microwave oven, Flexible Manufacturing System.
UNIT 3 Sensors & Actuators(Hrs- 04)	
3a. Explain working of the given sensor with sketch and block diagrams. 3b. Write specifications and features of the given sensor. 3c. Select relevant sensor for the given situation with justification. 3d. Select the relevant actuator for the given situation with justification. 3e.	3.1 Introduction to Sensors,Transducersand Actuators 3.2 Need, Classification of Sensors and Actuators. 3.3 Working and Application of- Potentiometer Sensors, Strain Gauge Elements, Capacitive Elements, Eddy Current, Proximity Sensors, Inductive Proximity Sensors, Light Sensors, Pressure Sensors, Pneumatic Sensors, Pyroelectrical Sensors, Piezoelectric Sensors. 3.4 Electrical Actuation Systems - Electrical Systems Viz. Switching Devices, solenoid type Devices, Drive Systems, Mechanical Switches Viz. Debouncing, Keypads, Electro-Mechanical and Solid State Relays, Stepper Motors. 3.5 Selection of Sensor & Actuator.
UNIT 4 PROGRAMMABLE LOGIC CONTROLLER (Hrs- 04)	
4a. Explain with sketches the working of the given PLC. 4b. Write specifications and features of the given PLC and power supply.	4.1 Introduction, definition, Basic PLC functions, PLC block diagram, Difference between relay panel and PLC, 4.2 Power supply, input/output modules (analog, digital) concepts of sink/source, set/reset, latch/unlatch, 4.3 Advantages and disadvantages. 4.4 Installation, troubleshooting and maintenance.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
4c. Select the relevant PLC and power supply for the given situation with justification. 4d. Describe the procedure for installation, troubleshooting and maintenance of the given PLC.	4.5 Selection of a PLC, Programming equipment, 4.6 Introduction to Programming Formats, Ladder diagrams and sequence listing, PLC auxiliary commands and functions, Online, offline, stop/run modes of operations, uploading/ downloading between PLC and PC.
UNIT 5 MICROPROCESSOR AND MECHATRONICS SYSTEM (Hrs- 04)	
5f. Explain the working of the microprocessor with sketches and block diagrams. 5g. Justify the use of D/A converters and A/D converters in the given application. 5h. Explain with sketches the working of the mechatronics devices in the given appliance.	5.1 Introduction, Architecture-Pin Configuration, Instruction set, 5.2 Interfacing input and output devices, Interfacing D/A converters and A/D converters, 5.3 Applications-Temperature control-Stepper motor control-Traffic light controller, 5.4 Introduction to ICs used for interfacing Comparison of microprocessor and microcontroller 5.5 Application of Mechatronics systems in Washing Machines, Desk Jet Printer, CNC Trainers, Pick and Place Robot, Automatic camera. 5.6 Introduction to IoT, general applications, role of mechanical engineer in IoT.

9. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

NA

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:

h. Prepare journals based on practical performed inlaboratory.
i. Study of datasheet of electronic components.
j. Prepare charts of different sensors, actuators used in Mechatronics
k. Collect information of passive transducers and prepare charts of the same.
l. Collect information of different PLC's

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:

ff. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
gg. 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).
hh. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
ii. Guide student(s) in undertaking micro-projects.

jj. Correlate subtopics with power plant system and equipment.
kk. Use proper equivalent analogy to explain different concepts.
ll. Use Flash/Animations to explain various components, operation and
mm. Teacher should ask the students to go through instruction and Technical manuals

12. SUGGESTED MICRO-PROJECTS

NA

(Only for Class Declaration Courses)

Only one micro-project *is planned to be undertaken by a student that needs to be assigned to him/her.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 is given here. Similar micro-projects could be added by the concerned faculty:

13. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	Mechatronics Integrated Mechanical electronic system	K.P. Ramchandran G.K. Vijayraghavan M.S. Balsundaram	Jhon Wiley & sons, 2013
2	Mechatronics	Bolton W.	Addison Wesley Longman Ltd., U.S.A. 1999, ISBN 9780582357051
3	Mechatronics	H.M.T.	McGraw-Hill Education, New Delhi, 2000, ISBN: 0074636435
4	Mechatronics Electronics in Production and Process	Dawson D.A., Burd N.C., Loader A.J.	Chapman-Hall, 1993, Taylor & Francis, ISBN 9780748757428
5	Introduction to mechatronics and Measuring Systems	Histand Michael B. Alciatore David G.	McGraw-Hill, New Delhi, 2003 ISBN 9780072402414
6	Mechanical Measurements and Instrumentation	SawhneyPuneet, Sawhney A.K.	DhanpatRai and Sons, 2013, New Delhi

14. SOFTWARE/LEARNING WEBSITES

27. www.cesim.com/simulations
28. www.scilab.org/scilab
29. www.ni.com/multisim
30. www.youtube.com /electric circuits
31. www.dreamtechpress.com /ebooks
32. www.nptelvideos.in/electrical engineering/ circuit theory
33. www.learnerstv.com/free-engineering
34. www.orcad.com/resources/orcad-downloads

15. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	-	-	1	-	-	2
CO2	2	-	1	1	-	-	2
CO3	3	-	-	2	-	-	3
CO4	3	2	2	3	-	2	3
CO5	2	-	-	2	-	-	2

	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	3	-
CO5	-	2

Sign: Name Dr. A AGadhikar Mr. S.S.Harip (Course Expert /s)	Sign: Name:
.Sign: Name: Dr. N.G.Kulkarni (Head of Department)	Sign: Name:ShriA.S.Zanpure (CDC)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in Mechanical Engineering**
Programme code	**04/18/24**
Name of Course	**Computer Aided Drafting**
Course Code	**ME3107**
Prerequisite course code and name	--

16. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	***ESE**	**PA**	
00	00	04	4	**Marks**	--	--	50	50	100
				Exam Duration			2 Hr		

(*): *OE/POE (Oral Examination/Practical & Oral Examination mention whichever is applicable)*

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, ESE-End semester examination,PA- Progressive Assesment.

17. RATIONALE

As per the latest requirements in the Industry demands sequent changes in product design to suits the customer needs .With the introduction of computers the task of incorporating frequent changes as per requirement is becoming simpler .Moreover , the technology driven competitive environment in today's market is compelling design .the main aim of this course is to provide the students hand on experience in drafting and editing of an industrial production drawing using one of the commercial computer Aided Drafting software with particular emphasis on the application of CAD software.

18. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Prepare digital drawing by using CAD software**

19. 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**:**

After completing this course students will be able to–

1. Draw CAD drawing files in drafting set-up
2. Modify 2D and isometric drawing
3. Integrate layers and blocks in drawing
4. Develop customized drawing template
5. Print drawing.

3. 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**:**

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1.	CAD Basics	Identify and locate components of CAD classic screen by creating new drawing.	1	4
2.	Drawing in 2D	Draw a line diagram using absolute coordinate method. Use LIMITS, UNITS, LINE, ARC Commands	1	6
		Draw a line diagram using relative coordinate and relative polar coordinate method.		6
3	Drawing in Two Dimensions and Modifying the Drawing	Draw a 2D figure using Draw and Modify commands. Use LINE, CIRCLE, OFFSET, TRIM, FILLET commands.	2	6
		Draw a 2D figure using Draw and Modify commands. Use LINE, ARC, POLYGON, ELLIPSE, COPY, MIRROR, TRIM, ROTATE, CHAMFER commands.		6
		Draw 2D drawing of mechanical component using required commands. (any one component like gear, pulley, bearing etc. may be selected)		6
4	Dimensioning, Layout and Printing	Dimension the object. Open the previously saved file and dimension the lines, arc, circle, polygon etc.	5	8
		Plot the drawing from model space and print it.		6

5	Isometric Drawing	Draw isometric drawing of mechanical component. Use LIMITS, UNITS, ZOOM, GRID, SNAP, LINE, COPY, ISOPLANE, ELLIPSE, TRIM, ERASE, PROPERTIES, SAVE Commands	2	8
6	Drawing Organization and information	Create the customized template, draw title block using LAYER, RECTANGLE, EXPLODE, TEXT, AND COPY Commands.	3,4	8
		Total Hrs		**64**

Sr. No.	Performance Indicators	Weightage in %
o.	Using drafting set up /aids	10
p.	Drawing diagrams of 2D or isometric given figure	15
q.	Dimensioning figure	10
r.	Answer the question	5
s.	Submission of drawing in time	10
Total		**50**

20. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	PrO. No.
1	CAD workstation with latest configuration for each student	1,2,3,4,5, and 6
2	LCD projector	1,2,3,4,5, and 6
3	Licensed latest version of computer aided software	1,2,3,4,5, and 6
4	Windows 7 operating system or latest operating system	1,2,3,4,5, and 6
5	Laser printer	1,2,3,4,5, and 6

21. THEORY COMPONENTS

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

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
UNIT 1. CAD Basics	

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
1. Identify components of CAD screen. 2. Describe the procedure to Create new drawing 3.Describe toolbar and commands 4. Describe the procedure to Edit drawing	1.1 Getting acquainted with CAD, Starting CAD, CAD screen layout, drawing area, menu and toolbars, status bar 1.2 Creating a new drawing, working with toolbar and commands, changing drawing limits, creating rectangle etc. saving drawing for first time 1.3 Opening and existing drawing file, CAD Cartesian workspace, working with drawing editor, closing a drawing and exiting from CAD
UNIT 2 Drawing in Two Dimensions	
1. State drafting set-up 2. Describe the procedure to Create 2D drawing with Draw commands 3. Identify and select draw commands for particular drawing 4. Describe the procedure to Use view options for Drawing	2.1 **Drafting set-up:** units, angle, area, coordinate system, limits, grid, object snap, line type and line weight 2.2 **Draw commands:** Drawing line, polyline, spline, rectangles, polygons creating construction lines, creating rays 2.3 Drawing circles, arcs, ellipses, Donuts, placing points, changing points style, text 2.4 Creating two dimensional drawings using draw commands, Viewing your drawing- zoom, pan, window, aerial view, viewport, undoing and redoing action, save and exit
UNIT 3 Modifying the Drawing	
1. Modify the 2D drawing with edit commands 2. Identify and select proper edit command for particular editing 3. Describe the procedure to Use edit commands 4. Interpret draw and modify commands 5. Describe the procedure to Change properties of drawing entities by Modify commands	3.1 Editing object, understanding object selection basic, erasing object, moving object, coping object, rotating object, scaling object, using change command 3.2 Copying and moving object using MIRROR command, ARRAY command, Offsetting object, resizing command, extending object, stretching object 3.3 Modify the created object using copy, mirror, hatch, divide, explode, join, pedit, offset, array,
UNIT 4 Dimensioning, Layout and Printing	
1. Identify dimensioning techniques 2. Describe the procedure to Use annotate menu for dimensioning drawing	4.1 Dimensioning/annotating your drawing-Working with annotation, adding text in drawing, modifying and formatting multiline text 4.2 Hatching 4.3 Adding dimensions- dimensioning concept, adding linear, radial, angular dimensions, adding notes to your dimensions

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
3. Describe the procedure to Create hatching 4. Describe the procedure to Set up layout for printing 5. Describe the procedure to Carry out printing of Drawing	4.4 Setting up layout- printing concept, creating view ports, setting up layouts, guideline for layouts 4.5 Printing your drawing: Preparing drawing for plotting or printing, creating layout in paper space, working with plot style, plotting a drawing- choosing a plotter/printer, preview/creating the plot
UNIT 5 Isometric Drawing	
1. Create isometric environment. 2. Identify isometric setup 3. Classify circle and iso-circle 4.Select proper plane for isometric drawing 5. Describe the procedure to Draw isometric drawing	5.1 Isometric mode- grid, snap, standard/isometric 5.2 Isoplane-orientation of crosshairs, isotop, isoright and isoleft 5.3 Drawing isometric circles- set isoplane, use ellipse-isocircle 5.4 Isometric text- oblique angle, rotation angle, style, dynamic text 5.5 Creating isometric drawing
UNIT 6 Drawing Organization and information	
1.Describe the procedure to Create customized template 2. Interpret components in different layers. 3. Describe the procedure to Collect information from drawing 4. Describe the procedure to Insert proper block 5. Describe layers and block design center	6.1 Creating new drawing with template 6.2 Working in layers 6.3 Getting information from your drawing- measuring objects, working with properties 6.4 Inserting blocks- inserting blocks from tool pallets, inserting block using insert, inserting block with design center

22. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

NA

23. SUGGESTED STUDENT ACTIVITIES

NA

24. 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:

nn. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
oo. 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).
pp. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
qq. Guide student(s) in undertaking micro-projects.
rr. Correlate subtopics with power plant system and equipment's.
ss. Use proper equivalent analogy to explain different concepts.
tt. Use Flash/Animations to explain various components, operation and
uu. Teacher should ask the students to go through instruction and Technical manuals

25. SUGGESTED MICRO-PROJECTS

NA (Only for Class Declaration Courses)

26. SUGGESTED LEARNING RESOURCES

NA

27. SOFTWARE/LEARNING WEBSITES

35. www.nptel.com
36. http://www.mycadsite.com/tutorials/level_3/isometric-drawing-in-autocad-3-2.htm
37. http://www.cadlearning.com/courses/autocad-mechanical-training-tutorials/,
38. http://www.staff.city.ac.uk/~ra600/ME1105/Tutorials/CAD-1/Tutorial%20CAD-1a.pdf

28. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	2	1	2	2
CO2	3	3	2	2	1	2	2
CO3	3	3	2	2	1	2	2
CO4	3	3	3	2	1	2	2
CO5	2	2	2	1	1	1	1

	PSO1	PSO2
CO1	3	1

CO2	3	1
CO3	3	1
CO4	3	1
CO5	3	1

Sign: Name: Smt.V.G.Talkit (Course Expert /s)	Sign: Name:Dr.N.G.KULKARNI (Head of Department)
Sign: Name: Smt.P.S.Sarode (Course Expert)	Sign: Name: Shri A.S.Zanpure (CDC)

Government Polytechnic Pune

'180OB' – Scheme

Programme	Diplôma in Mechanical Engineering
Programme code	**04/18/24**
Name of Course	**Mechanical Engineering Materials**
Course Code	**MT 3108**
Prerequisite course code and name	**SC1106 Applied Chemistry**

29. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	***ESE**	**PA**	
02	00	02	04	**Marks**	80	20	--	25	125
				Exam Duration	3 Hrs	1 Hr			

(*):*OE/POE (Oral Examination/Practical & Oral Examination mention whichever is applicable)*

Legends: L- lecture-Tutorial/teacher guided theory practice-practical, ESE-End semester examination, PA- Progressive Assessment.

30. RATIONALE

This course in engineering materials is a part of acquiring basic and essential knowledge about materials being used in engineering products and industry.

The course is useful for mechanical engineering to understand metallurgical aspects of materials, processes and related problems encounter in industry. Course deals with classification, properties and application of materials with processes carried on them as well as testing of materials

This course aims to

- Make the student capable to handle metallurgical needs in general mechanical industry.
- Create consciousness about problems related to materials and suggest substitute materials
- Create awareness about Heat treatment, properties and structure relationship.
- Create awareness about mechanical testing on different materials.

31. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Select appropriate materials to relevant Mechanical applications.**

32. 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**:**

1	Identify properties of different materials.
2	Select proper Ferrous alloy materials, Nonferrous alloys material or Nonmetallic Materials for various mechanical components.
3	Select relevant heat treatment processes to obtain desired structure and properties.
4	Perform destructive and non-destructive testing for the given material

33. 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**:**

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1.	1	Measurement of mechanical properties such as strength of any one ferrous alloy and non-ferrous alloy using UTM.	1,4	04
2	2	Study of Iron carbon diagram of steel and cast iron	2,3	02
3	2	Assignment on Special Cutting Tool Materials – Diamond, Stelites & Tungsten Carbide tool steel of	2,3	02
4	3	Preparation and Examine the microstructure of steels and cast iron	2,3	06
5	3	Basic Heat treatment of steel and cast iron	2,3	06
6	4	Preparation and Examine the microstructure copper, aluminum alloys, bearing materials.	2	04
7	5	Assignment on other materials such as polymers, composites, Insulating, Ceramics etc.	2	02
8	6	Perform any one Non-Destructive Testing of given sample	5	04
9	6	Use relevant hardness tester to determine the hardness of given sample	5	02
		Total Hrs		**32**

S.No.	Performance Indicators	Weightage in %
t.	Arrangement of available equipment / test rig or model, Performing task, Following safety measures	50
u.	Observations, Interpretation and conclusion	30
v.	Answer to sample questions and submission in time	20
Total		**100**

34. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specifications mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	Pr. No.
1	Fe-fe3c Phase diagram chart, Metallurgical Microscope and sample	2

2	Muffle Furnace. Sample, hardness tester and Metallurgical microscope, sample	3,4
3	Metallurgical microscope, microstructure set of nonferrous metals	5
4	NDT Setup level 1; UTM, Hardness tester	6

35. THEORY COMPONENTS

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

Unit Outcomes (UOs) (in cognitive domain	**Topics and Sub-topics**
UNIT 1 CLASSIFICATION & PROPERTIES OF MATERIALS **(Weightage**- 10 **Hours**- 04)	
Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
1a. Compare /Classify the materials 1b. Understand Mechanical and Electrical properties 1c. Explain Metallic crystal structure 1d. Explain allotropy and advantages to be allotropic. 1e. Explain solid solution as strengthening mechanism.	1.1 **Classification of material:** Metals, non-metals, ceramics and glasses, polymers, composites and semiconductors (example and application) 1.2 **Mechanical properties:** Strength, elasticity, ductility, malleability, plasticity, toughness, hardness, hardenability, brittleness, fatigue, thermal conductivity, electrical conductivity, thermal coefficient of linear expansion 1.3 **Bonding in metals:** Metallic bond crystal structures (BCC, FCC and HCP) and allotropy of metals 1.4 **Solid solution:** types and their condition
UNITT 2 FERROUS METAL **(Weightage**- 24 **Hours**- 10)	
2a. Draw, explain and compare Fe-Fe3c Phase diagram of steel and cast iron 2b. Explain and compare Alloy steel. 2c. Explain effect of alloying element 2d. Explain properties and composition of tool steels 2e. Classify various cast iron 2f. Explain properties of various grades of cast iron.	2.1 Characteristics and application of ferrous metals Phase equilibrium diagram for Iron and Iron Carbide 2.2 **Alloy Steels:** - Low alloy steel, high alloy steel, tools steel & stainless steel. Effect of various alloying elements such as – Chromium, nickel, manganese, molybdenum, tungsten, vanadium. 2.3 **Tool Steels:** - High speed Steels (HSS), Hot & cold Working dies etc., properties & applications. 2.4 **Cast iron types:** White GCI, FG, SG, Malleable Alloy CI, Concept of castability & suitable production methods.
UNIT 3 HEAT TREATMENT PROCESS **(Weightage**- 12 **Hours**- 04)	
. 3a. Explain the basic Heat treatments with advantages.	3.1 **Heat treatment-**Introduction to Heat treatment processes such as Annealing, subcritical annealing, Normalizing, Hardening, Tempering (Austempering & Martempering) - Principle, Advantages, limitations and applications.

3b. Explain advantages of tempering 3c. Explain surface hardening treatment with advantages. 3d. Compare nitriding with carburizing	3.2 **Surface Hardening** - Methods of surface hardening, i) case hardening ii) Flame Hardening, iii) Induction Hardening, iv) Nitriding, v) Carburizing - Principle, advantages, limitations and applications, of Heat Treatments
UNIT 4 NON-FERROUS METALS AND ALLOYS **(Weightage**- 12 **Hours**- 04)	
4a. Differentiate between properties, application and composition of various nonferrous alloys. 4b. Explain heat treatment of aluminum alloys	4.1 **Properties, applications & chemical compositions** Properties, applications & chemical compositions of Copper alloys (naval brass, muntz metal, Gun metal & bronzes), Aluminum alloys (Y-alloy & duralumin) & bearing materials like white metals, leaded bronzes & copper lead alloys. **4.2 Heat treatment of Aluminum alloys**
UNIT 5 OTHER ENGINEERING MATERIALS **(Weightage**- 12 **Hours**- 06)	
5a. Explain properties, advantages and uses of various polymeric materials, 5b. Explain types and properties of ceramic materials, 5c. Explain insulating materials. 5d. Explain composites	5.1 **Polymeric Materials** – Introduction to Polymers- types of polymer, Introduction, characteristics, properties and application of Thermoplastic, Thermosetting plastic, Rubber. 5.2 **Properties and applications of following Engineering Materials** – Ceramics, Abrasive, Adhesive and Insulating materials such as Cork, Asbestos, Thermocole and Glass Wool 5.3 **Composites:** Fiber reinforced plastics, Metal-Metrix composites, Nano materials
UNIT 6 TESTING, INSPECTION AND EXAMINATION OF MATERIALS **(Weightage**- 10 **Hours**- 04)	
6a. Compare NDT and DT 6b. Explain Dye Penetrant test principle, working and applications 6c. Explain any one DT	6.1 **NDT**: Advantages of NDT, Dye penetrant test (DPT), Magnetic particle test (MPT), eddy current test, Ultrasonic, X-ray. Inspection: Visual, optical . 6.2 **Destructive Testing:** On UTM, Hardness

36. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	**Classification & properties of materials**	04	2	4	4	10
II	**Ferrous Metal**	10	4	8	12	24
III	**Heat Treatment Process**	04	2	4	6	12

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
IV	**Non Ferrous Metals and Alloys**	04	2	4	6	12
V	**Other Engineering Materials**	06	2	4	6	12
VI	**Testing, Inspection and Examination of materials**	04	2	4	4	10
Total		32	14	**28**	**38**	**80**

37. 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:

m. Prepare a comparative chart overall specifications of materials of same class
n. Survey of materials used in automobiles/ mechanical machines .
o. Search information about ASTM specifications of NDT or DT test, .
p. Prepare posters to illustrate microstructure of steels or nonferrous alloys.

38. 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:

vv. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
ww. 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).
xx. With respect to item No.3&6, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
yy. Guide student(s) in undertaking micro-projects.
zz. Use Flash/Animations to explain various components, operation and
aaa. Teacher should ask the students to go through instruction and Technical manuals

39. SUGGESTED MICRO-PROJECTS

NA

40. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
2	Material Science And Metallurgy	O.P. Khanna Dhanpat Rai & Sons, Delhi	ISBN-13:9789383182459 ISBN-10:9383182458
3	Material Science And Metallurgy	Dr. Kodgire Everest Publishing House	ISBN-13:9788186314008

4	Material Science And Engineering	R.K. Rajput S.K. Kataria and Sons	ISBN-13:9788185749686 ISBN-10:818574968X
5	Engineering Materials Properties And Selection	Kenneth G. Budinski And Micheal K. Budinski Printice Hall of India Pvt. Ltd.	ISBN-13:9780137128426 ISBN-10:0137128428
6	Material Science And Processes	S.K. Hazra Chaudhary Indian Book Distribution Company	
7	Engineering Materials	C.P. Sharma Printice Hall of India Pvt. Ltd.	

41. SOFTWARE/LEARNING WEBSITES

39. www.nptel.com
40. http://www.capabiltydevelopment.org

42. PO - COMPETENCY- CO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
1	3	2	1	-	1	1	2
2	3	2	3	-	2	2	2
3	3	3	3	1	-	2	2
4	3	3	1	3	2	2	3

CO	PSO1	PSO2
1	1	-
2	1	1
3	-	2
4	1	3

Sign: Name: Mr. P.B. Kamble Name : Mrs V G Talkit (Course Expert /s)	Sign: Name: Prof. Namita S. Kadam (Head of Metallurgy Department)
Sign: Name: Dr. Nitin G. Kulkarni (Head of Mechanical Department)	Sign: Name: Shri A.S. Zanpure (CDC)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diploma in ME
Programme code	04
Name of Course	**Manufacturing Processes**
Course Code	**WS 3101**
Prerequisite course code and name	

43. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	**P**	**T/W**	
02	00	04	06	**Marks**	80	20	25	25	150
				Exam Duration	3 Hrs	1 Hr	2 Hr		

(*): *OE/POE (Oral Examination/Practical&Oral Examination mention whichever is applicable)*

Legends: L- lecture,T-Tutorial/teacher guided theory practice, P-practical, ESE-End semester examination, PA- Progressive Assesment.

44. RATIONALE

Diploma engineers require the knowledge of core principles of manufacturing processes to design and manufacture industrial equipment, machine parts, transport systems, and others. This subject help the students in performing various operations on Lathe, Shaper, Planner, Slotting machine and Press. Also performing Metal cutting, Mechanical working of metal, Foundry technology and welding and related processes.

45. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Produce components using manufacturing processes.**

46. 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**:**

11. Interpret various manufacturing process, pattern making and molding principles for a given job.

12. Use lathe and shaping machine for given Job.
13. Select different press operations and dies for a given job.
14. Select Hot and cold working operations for a given job.
15. Use different welding machines for a given Job.

47. SUGGESTED PRACTICALS/ EXERCISES

The practical 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**:**

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1.	2	One job involving plain turning , step turning, taper turning and threading (v).	2	18
2.	3	Demonstration of simple job involving various operations on shaping machine	2	08
3.	6	One job of thermacol pattern or wooden pattern in group.	5	10
4.	6	Demonstration of simple job of casting / molding	5	8
5.	6	Demonstration of simple job of forging / smithy	5	8
6.	7	One job in welding involving different operations/- spot welding, TIG and MIG welding	6	12
		Total Hrs		**64**

S.No.	Performance Indicators	Weightage in %
w.	Arrangement of available equipment / test rig or model	20
x.	Setting and operation	20
y.	Safety measures	10
z.	Observations and Recording	10
aa.	Interpretation of result and Conclusion	20
bb.	Answer to sample questions	10
cc.	Submission of report in time	10
Total		**100**

48. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	PrO. No.
1	Centre Lathe machine (Length between centers:2000)	1
2	Shaping machine (Maximum stroke length :upto 150mm)	2
3	TIG /MIG Welding set up with suitable specification	6

4	Pattern making, moulding and casting shop with necessary equipment	3,4,5

49. THEORY COMPONENTS

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

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
UNIT 1. BASIC MANUFACTURING PROCESSES (Weightage-06 , Hrs- 04)	
1a. Classify of manufacturing processes. 1b. Identify different types manufacturing processes.	1.1 Manufacturing processes, Definition , Classification 1.2 Shaping processes, Metal forming Processes 1.3 Joining processes, Surface finishing processes
UNIT 2 LATHE AND LATHE WORK (Weightage- 14, Hrs- 06)	
2a. Explain procedure of performing the given lathe machine operation on a job with sketches. 2b. Explain cutting speed, feed and depth of cut for the given job in different operations with sketches.	2.1 Introduction, classification, working principles, specifications of center lathe , basic parts and their functions, lathe accessories, attachments, operations 2.2 Cutting parameters: speed, feed, depth of cut and estimation of machining time
UNIT 3 SHAPER, PLANER AND SLOTTING MACHINE (Weightage- 14 , Hrs- 06)	
3a. Explain working of shaper, planer and slotting machine with sketches. 3b. Explain procedure of performing the given operation on a job with sketches.	3.1 Introduction, classification of shaper, planer and slotting machine 3.2 Construction, basic parts and their functions, working principle of Standard shaper, Standard double housing planer, Slotting machine (Puncher slotter and precision slotter). 3.3 Shaper operations:- Machining horizontal surface, Machining vertical surface, Machining angular surface 3.4 Planer operations:- Planing flat horizontal surface, Planing vertical surface, Planing at an angular surface 3.5 Slotter operations:- Machining flat surface, Machining circular surface, Machining irregular surface or cams
UNIT 4 PRESS AND PRESS WORK (Weightage- 10 , Hrs- 03)	

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
4a. Explain different types of presses 4b. Explain functions of parts of press with sketches. 4b. Explain types of dies in detail.	4.1 Introduction, types of presses 4.2 Construction, basic parts of Fly press and Power press, Press Tools, Press operations 4.3 Classification of dies, Die accessories:-Stop, Pilots, Strippers, Knockout, Press pad
UNIT 5 MECHANICAL WORKING OF METAL (Weightage- 08 , Hrs- 03)	
5a. Differentiate between hot working and cold working. 5b. Explain with sketches hot working and cold working processes.	5.1 Introduction, Hot Working, Hot Rolling, Piercing or seamless tubing, Drawing, Deep Drawing, Hot Spinning, Extrusion. 5.2 Cold working, Cold rolling, Cold Drawing, Cold bending, Cold spinning, Cold Extrusion, Squeezing, Peening, Sizing, Coining, hobbing, Electro-hydraulic forming, Metallurgical aspects.
UNIT 6 FOUNDRY TECHNOLOGY (Weightage- 14 , Hrs- 04)	
6a. Explain a pattern and mold for the given job. 6b. Explain casting process with sketches. 6c. Select a relevant furnace for the given raw material for with justification.	6.1 Introduction, Pattern-Materials, Tools, Types, Allowances, Core Prints, Core boxes, Colour Code 6.2 Moulding – Processes – Green Sand moulding, moulding machines. Casting – Die casting. 6.3 Furnaces- Classification of furnaces
UNIT 7 WELDING AND RELATED PROCESSES (Weightage- 14 , Hrs- 06)	
7a. Explain joining processes with sketches. 7b. Select the relevant joining process for the given job with justification. 7c. Select the relevant soldering / brazing process for the given job with justification.	7.1 Introduction, Weldability, Types of welding, Metallurgy of welding ,Gas Welding, Carbon arc welding, Oxy-acetylene welding, TIG welding, MIG welding, plasma arc welding, Oxy-hydrogen welding, Resistance welding, Solid state welding. 7.2 Related processes, Oxygen cutting, Hard facing, Bronze welding, Soldering, Brazing, Inspection and testing of welds, Welding joints and edge preparation, Welding of pipes, Representation of welds(Indian Standard),Safety in welding.

50. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Basic manufacturing processes	04	02	02	02	06

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
II	Lathe and lathe work	06	04	04	06	14
III	Shaper, planner and slotting machine	06	04	04	06	14
IV	Press and press work	03	02	02	06	10
V	Mechanical working of metal	03	02	02	04	08
VI	Foundry technology	04	04	04	06	14
VII	Welding and related processes	06	04	04	06	14
Total		32	**22**	**22**	**36**	**80**

51. 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:

q. Visit a Foundry shop and observed the Centrifugal / Die casting process and identify the different defect on the surface of component.

r. Visit plastic molding industry and collect information on types of molding machines, its specification and observe various activities performed in a molding process.

s. Visit and industry where the operations like drop forging, rolling and extrusion are carried out. Collect information on types these machines, their specifications and observe various activities performed and characteristics of output product.

t. Visit a industry /workshop to observe the process like seam, spot, TIG and MIG welding . Collect information on these machines, their specifications and observe these processes critically to get information regarding various accessories (electrodes, current rating etc.) used in these processes.

u. Collect information of recent advancement regarding manufacturing processes, machines /tools /equipment and their specifications/manufacturers and application in the industries.

v. Collect information of various forming processes used in industries. Observe shape of input and output products and suggest suitable operation for various jobs.

52. 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:

bbb. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.

ccc. 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).

ddd. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.

eee. Guide student(s) in undertaking micro-projects.

fff. Use proper equivalent analogy to explain different concepts.

ggg. Use Flash/Animations to explain various components, operation and

hhh. Teacher should ask the students to go through instruction and Technical manuals

53. SUGGESTED MICRO-PROJECTS (Only for Class Declaration Courses)

NA

54. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	Manufacturing Engineering Hand book	Hwaiyu Geng, McGraw Hill, New York, 2000	ISBN: 9780071398251
2	Workshop Technology, Volume- I and II	Raghuvanshi B.S., Dhanpat Rai Publications, New Delhi, 2009	ISBN: 100470534915
3	Production Technology (Manufacturing Processes)	Sharma P.C., S.Chand and Company, New Delhi, 2013	ISBN: 9788721911146
4	Text book of Production Technology	Khanna O.P., Dhanpat Rai Publications, New Delhi, 2010	ISBN: 9788189928322
5	Text book of Foundry Technology	Khanna O.P., Dhanpat Rai Publications, New Delhi, 2010	ISBN: 9788189928346
6	Elements of Work shop Technology- Volume- I and II	Choudhary Hajara S.K., Media Promoters and Publishers Limited, Mumbai, 2005	ISBN: 9788185099156
7	Workshop Technology, Volume- I and II	Bawa H.S., McGraw Hill, New York, 2011	ISBN: 13EBK0009651
8	Workshop Technology, Volume- I and II	Chapman W., Taylor and Francis, New Delhi, 1995	ISBN: 139780415503020
9	Material and Processing in Manufacturing	Black J.T., Kosher Ronald A., Wiley India Pvt. Ltd., New Delhi, 1999	ISBN: 9788126540464

55. SOFTWARE/LEARNING WEBSITES

41. http://nptel.ac.in
42. www.basicmechanicalengineering.com/lathe-machine-operations-basic-turning
43. www.makeengg.net/2016/operation-performed-on-shaping-machine.html
44. www.protolabs.com/injection-molding/plastic-injection-molding.html
45. www.thelibraryofmanufacturing.com/forming-basics.html
46. www.themetalcasting.com/casting-process.html

56. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	-	2	1	2	2
CO2	3	-	-	2	1	2	2
CO3	3	1	1	1	-	-	2
CO4	2	1	1	1	-	1	2
CO5	2	1	-	2	2	2	2
Average	2.6	0.6	0.4	1.6	0.8	1.4	2

	PSO1	PSO2
CO1	-	-
CO2	-	3
CO3	-	2
CO4	-	-
CO5	-	2
Average	-	1.4

Sign: Name: Shri.M.R.Munde Smt.S.S.Panpatil (Course Expert /s)	Sign: Name: Shri.N.G.Kulkarni (Head of Department)
Sign: Name: Shri.N.G.Kulkarni (Program Head) (Head of Department)	Sign: Name: Shri A.S.Zanpure (CDC)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	Diploma in /CE/EE/ ET /ME/MT/CM/IT/DDGM
Programme code	01/02/**03**/04/05/06/07/08/16/17/21/22/23/24/26
Name of Course	**Environmental science**
Course Code	**AU4101**
Prerequisite course code and name	

57. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	*ESE	PA	
-	-	02	02	Marks	-	-	-	50	50
				Exam Duration	-	-	-		

***(*):**OE/POE (Oral Examination/Practical&Oral Examination mention whichever is applicable)*

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, ESE-End semester examination, PA- Progressive Assessment.

58. RATIONALE

This is an interdisciplinary course, introduced with an aim to create awareness about environmental issues among the diploma students. The rate Industrialization and Urbanization is very fast, and the country/world is facing the issues like draught, flood, deforestation, increase in earth temperature, pollution and depletion of resources. In view of this the management of resources' and dilution of pollutants is of prime need to keep the environment safe and clean.

59. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **To create environmental awareness for sustainable development".**

60. 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**:**

1. Create awareness for conservation of natural resources and preserving the environment.
2. Perform/Contribute in sustainable development.
3. Undertake preventive measures to control different pollutions.
4. Differentiate between Conventional and Non-conventional energy sources.
5. Identify the role of SPCB/CPCB and EPA in Environment protection

61. 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**:**

Sr. No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1.	Visit to "Kachara Depot,(dumping yard) and write a report.*	CO1,3,,5	6*****
2.	Identify the Environmental issues and group discussion on the efforts made to increase public awareness and prepare a report. *	CO1,2,3	4*****
3.	Assignment/Report on ecosystem and its components.	CO2	2
4.	Expert lecture on Role of NGOs and Government in Conserving Environment and write a report on it.*	CO2,3,5	**4***
5.	Visit to a local area -Environmental assets such as river /forest / grassland / hill / mountain and writing report on it.	CO1,3	8
6.	Activity based on – "Best out of Waste" (use of waste paper, plastic, glass bottles, clothe, scrap.)*	CO3	2*****
7.	Video Demonstration /Expert Lecture Report on Climate Change and Global warming.	CO1,2,3, 4,5	2
8.	Write a report on E-waste - * 1. Describing E-waste and it's type. 2. State its impact/hazards on environment. 3. State importance of E-waste disposal and disposal methods. 4. Comments on how E-waste is handled globally. (Role play can be enacted by each group representing different countries) 5. Description of how India handles e-waste. (Role play can be enacted by a group)	CO1,2,3	**4***
9.	Visit to nearby site ,using nonconventional energy source (e.g solar/wind)	CO4	8
10.	Visit to nearby Poly house and write a report. (product, financial assistance, ,limitations ,difficulties in operating, any other related information),.	CO2	8
11.	Individual Presentation on Environmental issues and his/her contribution towards Environment.*	CO12,3, 4,5	4*****
12.	Write an assignment on Green House effect, carbon footprint, carbon trading.	CO2,3,4	2

13.	Assignment on disposal of medical waste.(To study Incineration.)	CO3	2
14.	Identify the issues related to the programmes in the institute and write the report. * (here disciplinary or interdisciplinary activity can be carried out)	CO2,3	4*
15.	Write an assignment on role of Ministry of Environment and Forest Organizational Structure (MOEF) and Central Pollution Control Board(CPCB), State Pollution Control Board(SPCB), Environment Protection Act.*	CO5	4****
	Total Hrs		**32**

Practical marked with* are compulsory.

S.No.	Performance Indicators	Weightage in %
dd.	Observation , collection ,and analysis of data	40
ee.	Preparation of report	30
ff.	Interpretation of result/ observation and conclusion	10
gg.	Answer to questions	10
hh.	Submission of report in time	10
Total		**100**

62. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

NA

63. THEORY COMPONENTS

The curriculum is activity based. It is expected from teacher to explain to students the scientific theory behind each assignment.

For eg.- The assignment stating best out of waste..... Does not mean to make only decorative items from waste....

In this case it is expected to explain the concept of 4R I.e. reduce, reuse, recycle, reproduce**...**

64. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

NA

65. SUGGESTED STUDENT ACTIVITIES

NA

66. 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:

iii. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
jjj. 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).

67. SUGGESTED MICRO-PROJECTS

NA

(Only for Class Declaration Courses)

68. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1.	Basic Civil and Environmental Engineering	S.P. Nisture, D. A. Joshi, G.S.Chhawsaria, Pearson	978-1282531819
2.	Basics of Environmental Studies	Anindita Basak, D.L. Manjunath, Pearson	978-8131756072
3.	Global Warming The Hard Science	L.D.DannyHarvey Pearson	978-8131733318
4.	Environmental Studies	BennyJoseph TataMcGraw Hill	978-9352605170
5.	Renewable Energy	Godfrey Boyle, Oxford Publications	0199261784, 9780199261789
6.	Environmental studies	R. Rajagopalan, Oxford University Press	9780199459759

69. SOFTWARE/LEARNING WEBSITES

47. **www.nptel.com**
48. **http://www.mpcb.gov.in/**
49. **http://www.cpcb.nic.in/**
50. **http://www.envfor.nic.in/**
51. **http://www.neeri.res.in/**

70. PO - COMPETENCY- CO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	1	2	1	3	1	3
CO2	1	**1**	2	1	3	1	3
CO3	1	**1**	2	2	2	1	3
CO4	1	**1**	2	1	2	1	3
CO5	1	**1**	2	1	2	1	3

CO	PSO1	PSO2	PSO3

CO1	--	1	1
CO2	1	1	1
CO3	1	1	1
CO4	1	1	1
CO5	2	--	1

List of Experts & Faculties Who Contributed For This Curriculum:

S.N.	Name	Designation	Institute / Industry
1.	DR. SMS Shashidhara.	Chairman PBOS	Head Civil Engg. Dept. GOVT. POLYTECHNIC,PUNE
2	Shri .Sanjay Deshpande.	Director, Sanjivani Development	Industry person
3.	Mrs.M.U.Kokate	Faculty from Institute	Head IT. Dept. GOVT. POLYTECHNIC,PUNE
4	Mrs.Seema V.Kolhe	Faculty from Institute	Lecturer in Civil Engg. GOVT. POLYTECHNIC,PUNE
5	Shri .M.K.Panchawate	Faculty from Institute	Lecturer in Civil Engg. GOVT. POLYTECHNIC,PUNE
6	Mrs. P.M.Zilpe	Faculty from Institute	Lecturer in Electronics Engg. GOVT. POLYTECHNIC,PUNE
7	Mrs. S.S.Chhatwani .	Faculty from Institute	Lecturer in Electronics Engg. GOVT. POLYTECHNIC,PUNE
8	Mrs. M. H. Bilgi	Faculty from Institute	Lecturer in Electrical Engg. GOVT. POLYTECHNIC,Pune

Sign: Name:Mrs.S.V.KOLHE / M.K.Panchawate (Course Expert /s)	Sign: Name: DR.SMS SHASHIDHARA (Program Head) (Civil Engg Dept.)
Sign: Name: Shri A.S.Zanpure (CDC)	

Government Polytechnic, Pune

'180OB' – Scheme

Programme	Diploma in ET/CE/EE//ME/MT/CM/IT/DDGM
Programme code	**01/02/03/04/05/06/07/08**/16/17/21/22/23/24/26
Name of Course	**Engineering Economics**
Course Code	**AU4103**
Prerequisite course code and name	**NA**

1.TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	***ESE**	**PA**	
02	00	00	02	**Marks**	40	10			50
				Exam Duration	2 Hrs	30Mins	-	-	

(*):*OE/POE (Oral Examination/Practical & Oral Examination mention whichever is applicable)*

Legends: L- lecture-Tutorial/teacher guided theory practice, P-practical, ESE-End semester examination, A- Progressive Assessment.

2. COMPETENCY

The aim of this course is to address following industry identified competency through various teaching learning experiences:

Ability to analyze and decide acceptance or rejection of offers / project proposals based on economic criteria.

3. RATIONALE

This course aims at equipping the students with fundamental knowledge of economics and cost analysis to make them capable of taking economically sound decisions.

5. 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**:**

CO1: Interpret various principles, concepts and applications of Economics in the field of Engineering and technology.
CO2: Analyze Market Demand.
CO3: Apply the principles of economics and cost analysis to proposals in engineering and Technology.
CO4: Read and interpret financial statements and indicators.

6. THEORY COMPONENTS

The following topics/subtopicsshould betaught and assessed in order to develop UOs for achieving the COs to attain the identified competency**.**

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
UNIT 1. Introduction to Economics(Weightage-08 , Hrs- 06)	
1a.Define the term Economics. 1b.State the objectives and importance's of engineering Economics. 1c.Differiate between Micro and macro economics. 1d.Describe the functions of Market economy and Command economy. 1e.List the elements of mixed economy.	**1.1** Definitions of economics **1.1.2**Objectives and Importance of engineering economics. 1.1.3Concept of engineering economics. **1.2**General concepts on micro and macro economics **1.2.1**Market economy, **1.2.2**Command economy **1.2.3** Mixed economy.
UNIT 2 Demand Analysis (Weightage- 08 ,Hrs- 06)	
2a.List the utility related demand. 2b.State the importance of total and marginal utility. 2c.Explain Law of demand. 2d.Analyasis elasticity of demand. 2e.State factors governing the elasticity of demand. 2f.Enlist the techniques and methods for forecasting of demand.	**2.1**Utility related demand **2.1.1**Total and marginal utility **2.1.2** Law of diminishing marginal utility **2.1.3** Cardinal and ordinal utility. **2.2**Law of demand **2.2.1** Determinants of demand **2.2.2** Elasticity of demand **2.2.3** Factors governing the elasticity of demand. **2.3**Techniques and methods for forecasting of demand
UNIT 3Elements of Business/Managerial Economics(Weightage- 12 ,Hrs- 12)	
3a.Define the term cost and cost control. 3b.Enlist the types of costs.	**3.1** Cost and Cost Control –Techniques **3.1.1** Types of Costs **3.1.2**Lifecycle costs

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
3c.Interpret the lifecycle costs. 3d.Define the term Budgets. 3e.Determine Break even analysis. 3f.Explain in brief application of Linear Programming. 3h.Importance of Time value of money. 3j.Ellabrorate the methods of cash flow. 3k.Evaluate the Causes of depreciation.	3**.1.3**Budgets **3.1.4**Break even Analysis **3.2**Capital Budgeting **3.2.1**Application of Linear Programming. **3.3** Time value of money **3.4.1**Simple and compoundinterest. **3.4.2**Principle of economic equivalence. **3.5** Evaluation of engineering projects and Cost-benefit **3.6.** Cash flow- Methods of comparison of alternatives – present worth and future worth method (Revenue dominated cash flow diagram) **3.7** Depreciation-Causes of depreciation **3.8.1**Depreciation straight line method and declining balance method
UNIT 4National Income, Finance and Banking (Weightage-12 , Hrs- 08)	
4a.Expain Balance sheet, Book Keeping and Financial reporting. 4b.Mentionmeasurement parameters ofnational income. 4c.Differiate between Gross domestic and national production (GNP, GDP). 4d.State the functions of commercial banks and Reserve Bank of India.	**4.1**.Concept of profit and loss account 4.1.1 opening stock, closing stock, sales, purchases,wages, creditors, debtors, gross profit, net profit **4.2**. Concept of Balance sheet, &book keeping 4.2.1. Fixed asset, Current assets, share capital, current liabilities,goodwill,debt, inventories, bill receivable, overheads and expenses. **4.3.**Concepts and measurement of national income **4.4.** Gross domestic and national production (GNP, GDP). **4.5**Banking- Meaning and functions of commercial banks and Reserve Bank of India.

7.SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to Economics	06	02	02	04	08
II	Demand Analysis	06	02	02	04	08
III	Elements of Business/Managerial Economics	12	04	04	04	12
IV	National Income, Finance and Banking	08	02	02	08	12
Total		**32**	**10**	**10**	**20**	**40**

8.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. Study of datasheet of Cash flow of a firm.
b. Prepare charts of depreciation by taking different examples.
c. Case Study-Prepare a comparative statement of of two Engineering projects in respect of investment and profit.(Consider Capital Investment, over head expenses, wages, net profit)
d.Case study- Prepare a cost sheet for a small scale unit.
(In Cost sheet consider production, selling, overhead cost and profit analysis)

9.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:

kkk. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
lll. Guide student(s) in undertaking micro-projects.
mmm. Use proper equivalent analogy to explain different concepts.
nnn. Use Flash/Animations to explain various components, operation.
ooo. Teacher should ask the students to go through instruction and Technical manuals

10.SUGGESTED MICRO-PROJECTS

NA

11.SUGGESTED LEARNING RESOURCES

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	"Contemporary Engineering Economics",	**Author**-Chan S.Park, **Publisher**-Prentice Hall of India, 2011.	ISBN- 9780134105598
2	"Engineering Economics and analysis"	**Author**-Donald.G. Newman, **Publisher**-Jerome.P.LavelleEngg. Press, Texas, 2010	ISBN- 0824709535
3	"Engineering Economy"	**Author**-Degarmo, E.P., Sullivan, W.G and Canada, J.R **Publisher**- Macmillan, New York, 2011	ISBN-9780029461396
4	"Engineering Economy"	**Author**-Zahid A khan: Engineering Economy **Publisher**-Dorling Kindersley, 2012	ISBN-10- 8131763870 ISBN-13-978-8131763872

12.SOFTWARE/LEARNING WEBSITES-

13.PO - COMPETENCY- CO MAPPING

***NOTE:-**THE DEPARTMENT WHO WILL RUN THIS COURSE PLEASE DO THE PO - COMPETENCY- CO MAPPING ACCORDING TO YOUR POS,AS THIS MAPPING IS DONE ACCORDING TO DDGM POS

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	-	3	3	3
CO2	3	3	3	-	3	3	3
CO3	3	2	2	-	2	3	3
CO4	3	2	2	-	2	2	3

	PSO1	**PSO2**
CO1	-	-
CO2	2	2
CO3	-	-
CO4	-	-

Sign: Name: Smt.C.M.Ambikar (Course-Expert)	Sign: Name: N.V.Gondane (Course-Expert)
Sign: Name: Smt.P.V.Toshniwal(Kalantri) (Program Head of Department)	Sign: Name: ShriA.S.Zanpure (CDC)

Government Polytechnic, Pune

'180 OB'– Scheme

Programme	Diplôma in ET/CE/EE//ME/MT/CM/IT/DDGM
Programme code	01/02/03/04/05/06/07/08/16/17/21/22/23/24/26
Name of Course	**Ethical Sourcing and Sustainability**
Course Code	**AU4104**
Prerequisite course code and name	**--**

71. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	***ESE**	**PA**	
02	00	00	02	**Marks**	40	10	-	-	50
				Exam Duration	2Hrs	1 Hr	-	-	

(*): *OE/POE (Oral Examination/Practical&Oral Examination mention whichever is applicable)*

Legends: L- lecture-Tutorial/teacher guided theory practice, P-practical, ESE-End semester examination, PA- Progressive Assessment.

72. RATIONALE

This course is aimed at creating awareness amongst the students about global level commitment towards sustainable development. The course also creates awareness on ethical manner of production, including the supply chain, the environmental and social impacts of the production process and product as well as the safety and fair deal towards the work force involved at all levels.

COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Adopt ethical practices and sustainable processes and products in industry.**

73. 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**:**

CO1: Interprets the concept of ethical sourcing and fundamentals of Sustainability.
CO2:Practice Global Sustainable Development Goals (SDG).

CO3:Follow ethical and sustainable supply chain**.**
CO4:Differentiate traditional and sustainable manufacturing.

74. THEORY COMPONENTS

The following topics/subtopicsshould betaught and assessed in order to develop UOs for achieving the COs to attain the identified competency**.**

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
UNIT 1. ETHICAL SOURCING (Weightage-08Marks , Hrs- 06)	
1.1 Define Ethical Sourcing. 1.2 Explain Basic Eight Principles ofEthical Sourcing. 1.3 State the laws of industrial ethics. 1.4 Explain the policies of industrial ethics.	1.1 **Definition-**1.1.1 Ethical Sourcing **1.2 Basic Eight Principles** **1.3 Policies** **1.4 Benefits-**Importance of Ethics **1.5 Challenges-** Causes of Unethical Behavior **1.5Laws**
UNIT 2 SUSTAINABILITY (Weightage-10Marks , Hrs- 08)	
2.1 Define Sustainability and Ethical Sourcing and Sustainability. 2.2 Explain the principles of sustainability. 2.3 Explain the need and challenges of environmental sustainability. 2.4 Compare Social sustainability and economic sustainability. 2.5 Explain the agenda of 2030 sustainable development goals.	**2.1 Definition-**2.1.1 Sustainability 2.1.2 Ethical Sourcing and Sustainability **2.2 Twelve green engineering principles.** **2.3 Benefits and Challenges** **2.4 Types-** 2.4.1Human Sustainability 2.4.2Social Sustainability 2.4.3Economic Sustainability 2.4.4 Environmental Sustainability **2.5 Introduction of SustainableDevelopment Goals (SDGs)=** (Leaving no one behind- Global agenda for 2030- 17 goals, 169 Targets 231 Indicators) **[17Sustainable Development Goals (SDGs)]-** Goal1:NoPoverty Goal2:ZeroHunger Goal3:GoodHealthAnd Well-Being Goal4:QualityEducation Goal5:Genderequality Goal6:Cleanwaterandsanitation Goal7:Affordableandcleanenergy Goal8:Decent workandeconomicgrowth

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	Goal9:Industry,Innovationandinfrastructure Goal10:Reducedinequality Goal11:SustainablecitiesandcommunitiesGoal12:Responsible consumptionandproduction Goal13:Climateaction goal14:Lifebelowwater Goal15:Lifeonland Goal16: Peaceandjusticestronginstitutions Goal17: Partnershipstoachievethegoal.
UNIT 3 ETHICAL AND SUSTAINABLE SUPPLY CHAIN **(**Weightage-12Marks , Hrs- 10)	
3.1 State the use of three P's and E's of sustainability. 3.2 Explain the ways to r**educe waste by simplifying supply chain processes with appropriate example.** **3.3 Comment on existing environmental risks caused by tradition non sustainable manufacturing process.** **3.4 Explain the ways decrease fossil fuel consumption by optimizing routes with appropriate example.**	**3.1 Three P's-**3.1.1 Profit 3.1.2 Planet 3.1.3 People **3.2 Three E's-** 3.2.1 Environment 3.2.2 Equity 3.3.3 Economics **3.3 Study of SixSteps for supply-** **3.3.1 Reduce waste by simplifying supply chain processes** **3.3.2 Ensure ethical sourcing and introduce transparency** **3.3.3 Minimize overproduction through efficient supply and demand planning** **3.3.4 Decrease fossil fuel consumption by optimizing routes.** **3.3.5 Fully utilize containers and transportation to consolidate shipments.** **3.3.6 Monitor for existing environmental risks.**
UNIT 4 MATERIALS FOR SUSTAINABILITY (Weightage-10Marks, Hrs- 08)	
4.1 Explain the impact of material selection over environment. 4.2 Explain the factors to be considered for material selection to optimize performance. 4.3 Explain Life cycle assessment **with appropriate example.** **4.4 Give a note on "**Production of green manufacturing materials" with **appropriate example.** **4.5 Explain the role of 5R's in sustainable development.**	**4.1 Environmental impact of materials** **4.2 life-cycle assessment** **4.3 Material selection to optimize performance** **4.4 Design** **4.5Evaluation** **4.6 Production of green manufacturing materials.** **4.7 Role of 5R's for Sustainable Development-** 4.7.1 Refuse / Reject 4.7.2 Reduce 4.7.3 Reuse / Repurpose / Rethink 4.7.4 Repair 4.7.5 Recycle

75. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	**Ethical Sourcing**	06	4	2	2	08
II	**Sustainability**	08	4	2	4	10
III	**Ethical And Sustainable Supply Chain**	10	4	4	4	12
IV	**Materials For Sustainability**	08	2	4	4	10
Total		**32**	**14**	**12**	**14**	**40**

ppp. 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:

Activity 1-Select any topic and prepare a Power Point Presentation in a group of three to four students covering economic, social and environmental sustainability aspects and give presentation to other students and teacher.
(Example- a)Green Construction Techniques, b)Sustainable Energy solutions for manufacturing, c) Recycling, d)Waste Management e)Rainwater conservation)

OR

Activity 1-Prepare a write up in a group of three to four students and present it to other students considering Global agenda for 2030-Leaving no one behind i.e. **SustainableDevelopment Goals (SDGs)** and its169 Targets 231 Indicators.

Activity 2- Case Study-Prepare a comparative statement of two Engineering projects in respect to traditional and sustainable manufacturing process considering benefits and challenges.

qqq. 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. 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).

rrr. Guide student(s) in undertaking activities or micro-projects.

sss. Use proper equivalent analogy to explain different concepts.
ttt. Use Flash/Animations to explain various components, operation.
uuu. Teacher should ask the students to go through instruction and Technical manuals

vvv. SUGGESTED MICRO-PROJECTS

NA

76. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	Sustainable Construction Processes	Wiley-Blackwell; 1 edition (13 April 2016)	140518759X
2	Sourcing ethically from India: An Introductory Guide for micro-enterprises and start ups	Texture; 1 edition (15 February 2011)	B00EHC7XPM
3	Sustainable Supply Chain Management	Balkan Cetinkaya Richard Cuthbertson Graham Ewer Thorsten Klaas-Wissing WojciechPiotrowicz ChristophTyssen	978-3-642-12023-7
4	Global Value Chains, Flexibility and Sustainability	Julia Connell RenuAgarwal Sushil Sanjay Dhir	978-981-10-8929-9
	The Keys to Responsible Sourcing	Rod Robinson WG95 February 2, 2018 Leadership Management	----------

77. SOFTWARE/LEARNING WEBSITES

https://www.ncbi.nlm.nih.gov/books/NBK64933/

http://www2.econ.iastate.edu/classes/tsc220/hallam/TypesOfSustainability.pdf

https://www.woolworthsgroup.com.au/content/Document/Ethical%20Sourcing%20Policy.pdf

https://www.supplychainbrain.com/blogs/1-think-tank/post/29477-how-to-create-a-more-ethical-and-sustainable-supply-chain

https://h2mgroup.wordpress.com/2013/06/14/the-three-es-of-sustainability/

https://www.cce.ufl.edu/wp-content/uploads/2012/08/Ethics%20of%20Sustainability%20Textbook.pdf

A global indicator framework for the Sustainable Development Goals and targets of the 2030 Agenda for Sustainable Development:- *https://unstats.un.org/sdgs/indicators/Global%20Indicator%20Framework%20after%202020%20review_Eng.pdf*

Transforming our World: The 2030 Agenda for Sustainable Development United Nations,2015- *https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf*

78. **PO - COMPETENCY- CO MAPPING**

***NOTE:-**THE DEPARTMENT WHO WILL RUN THIS COURSE PLEASE DO THE PO - COMPETENCY- CO MAPPING ACCORDING TO YOUR POS,AS THIS MAPPING IS DONE ACCORDING TO DDGM POS

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	-	3	3	3
CO2	3	3	3	-	3	3	3
CO3	3	2	2	-	2	3	3
CO4	3	2	2	-	2	2	3

	PSO1	**PSO2**
CO1	-	-
CO2	2	2
CO3	2	2
CO4	-	-

Sign: Name: Smt.S.M.Waghchaure (Course-Expert)	Sign: Name: P.V.Toshniwal (Program Head of Department)
Sign: Name: ShriA.S.Zanpure (CDC)	

Government Polytechnic, Pune

'180OB' – Scheme

Programme	Diplôma in CE/EE /CM/ME/MT/ET/IT
Programme code	01/02/**03**/04/05/06/07/08/16/17/21/22/23/24/26
Name of Course	**Entrepreneurship and Startup**
Course Code	**MA 4101**
Prerequisite course code and name	--

79. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	**ESE**	**PA**	50
2	-	-	2	**Marks**	40	10	-	-	
				Exam Duration	02Hrs	30min.	-	-	

***(*):** Under the theory PA, Out of 20 marks, 10 marks are for micro-project assessment*

Legends: L- lecture-Tutorial/teacher guided theory practice-practical ,ESE-End semester examination, PA- Progressive Assessment.

80. RATIONALE

Globalization, liberalization and privatization along with revolution in information technology have opened up new opportunities transforming lives of masses. In this context, there is immense opportunity of establishing manufacturing, service, trading, marketing and consultancy enterprises bydiploma engineer**.**Our fast growing economy provides ample scope for diploma engineers to succeed as an entrepreneur. Entrepreneurship requires distinct skill sets which are attempted to be developed through this course. To begin with, this course aims to develop the competency and the related outcomes in order to start small enterprises. Government of India also motivates the young engineers to come up with new idea to promote Start ups.

81. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Develop project proposals for launching small scale enterprises and starts up.**

82. 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**:**

1 Identify entrepreneurial traits.
2 Collect information from stakeholder for starting starts up
3 Identify support systems available for Starts up
4 Execute plans for managing enterprise effectively.

83. 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**:**

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1		NA		

S.No.	Performance Indicators	Weightage in %
ii.	NA	
jj.	NA	
Total		**100**

84. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	PrO. No.
48	NA	

85. THEORY COMPONENTS

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

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
UNIT 1. INTRODUCTION TO ENTREPRENEURSHIP DEVELOPMENT (Weightage-10 , Hrs-08)	
1a. Describe procedure to evaluate entrepreneurial traits as a career option for given product 1b. Explain given terms related to Entrepreneurship 1c. Describe salient features of the resources required for starting the specified enterprise. 1d. Identify characteristics for a given type of enterprise.	1.1 Entrepreneurship as a career 1.2 Traits of successful entrepreneur: consistency, creativity, initiative, independent decision making, assertiveness, persuasion, persistence, information seeking, handling business communication, commitment to work contract, calculated risk taking. 1.3 Entrepreneurship: scope in local and global market. 1.4 Types of enterprises and their features : manufacturing, service and trading.
UNIT 2 STARTUP SELECTION PROCESS(Weightage- 14 , Hrs- 10)	

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
2a. Describe scheme(s) offered by the government for starting the specified enterprise. 2b. Suggest suitable place for setting up the specified enterprise on the basis of given data/circumstances with justification. 2c. Suggest steps for the selection process of an enterprise for the specified product or service with justification. 2d. Describe market study procedure of the specified enterprise.	2.1 Product/Service selection: Process, core competence, product/service life cycle, new product/ service development process, mortality curve, creativity and innovation in product/ service modification / development. 2.2 Process selection: Technology life cycle, forms and cost of transformation, factors affecting process selection, location for an industry, material handling. 2.3 Market study procedures: questionnaire design, sampling, market survey, data analysis 2.4 Getting information from concerned stakeholders such as Maharashtra Centre for Entrepreneurship Development[MCED], National Institute for Micro, Small and Medium Enterprises [NI-MSME], Prime Minister Employment Generation Program [PMEGP], Directorate of Industries[DI], Khadi Village Instries Commission[KVIC]
UNIT 3 SUPPORT STSTEMFOR STARTUP (Weightage- 10 , Hrs- 08)	
3a. Describe support system required for the specified enterprise. 3b. Describe help provided by the government agencies for the specified product/service. 3c. Describe help provided by the non-governmental agencies for the specified product/service. 3d. Compute breakeven point for the specified business enterprise, stating the assumptions made.	3.1 Categorization of MSME, ancillary industries 3.2 Support systems- government agencies: MCED, NI-MSME, PMEGP,DI, KVIC 3.3 Support agencies for entrepreneurship guidance, training, registration, technical consultation, technology transfer and quality control, marketing and finance. 3.4 Breakeven point, return on investment and return on sales.
UNIT 4 MANAGING ENTERPRISE (Weightage- 06 , Hrs- 06)	
4a. Explain key elements for the given business plan with respect to their purpose/size 4b. Justify USP of the given product/ service from marketing point of view. 4c. Formulate business policy for the given product/service. 4d. Choose relevant negotiation techniques	4.1 Sources of Product for Business : Feasibility study 4.2 Ownership, Capital, Budgeting, Matching entrepreneur with the project , feasibility report preparation and evaluation criteria 4.3 Unique Selling Proposition [U.S.P.]: Identification, developing a marketing plan. 4.4 Preparing strategies of handling business: policy making, negotiation and bargaining techniques. 4.5 Risk Management: Planning for calculated risk taking, initiation with low cost projects, integrated futuristic planning, angel investors, venture capitalist. 4.6 Incubation centers: Role and procedure.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
for the given product/ service with justification. 4e. Identify risks that you may encounter for the given type of business/enterprise with justification. 4f. Describe role of the incubation centre for the given product/service.	

86. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to EDP	08	2	2	6	10
II	Entrepreneurial Opportunities and selection Process	10	2	4	8	14
III	Support System	08	2	4	4	10
IV	Managing Enterprise	06	2	2	2	06
Total		32	**8**	**12**	**20**	**40**

87. 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:

ii. Download product development and innovative films from internet.
iii. Invite entrepreneurs, industry officials, bankers for interaction.
iv. Identify your hobbies and interests and convert them into business idea.
v. Convert you project work into business.
vi. Choose a product and design a unique selling preposition, brand name, logo, advertisement (print, radio, television), jingle, packing, packaging, label for it.

88. 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:

www. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
xxx. 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).
yyy. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
zzz. Guide student(s) in undertaking micro-projects.
aaaa. Correlate subtopics with power plant system and equipment.

bbbb. Use proper equivalent analogy to explain different concepts.
cccc. Use Flash/Animations to explain various components, operation and
dddd. Teacher should ask the students to go through instruction and Technical manuals

89. SUGGESTED MICRO-PROJECTS

NA

(Only for Class Declaration Courses)

Only one micro-project *is planned to be undertaken by a student that needs to be assigned to him/her.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 is given here. Similar micro-projects could be added by the concerned faculty:

90. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	*Reading Material of Entrepreneurship Awareness Camp*	*Gujral, Raman*	*Entrepreneurship* Development Institute of India (EDI), GOI, 2016 Ahmedabad,
2	*Product Design and Manufacturing*	Chitale, A K	PHI Learning, New Delhi, 2014; ISBN: 9788120348738
3	Entrepreneurship Development Small Business Entrepreneurship	Charantimath, Poornima	Pearson Education India,New Delhi;*ISBN*: 9788131762264
4	*Entrepreneurship Development: Special edition for MSBTE*	CPSC, Manila	Tata Mc-Graw Hill, New Delhi,
5	Entrepreneurship and Small Business Management	Khanka, S.S.	S.Chand and Sons, New Delhi, *ISBN:* 978-93-5161-094-6

91. SOFTWARE/LEARNING WEBSITES

1	MCED Books links	http://www.mced.nic.in/UdyojakSpecial.aspx?linktype=Udyojak
2	MCED Product and Plan Details	http://www.mced.nic.in/allproduct.aspx
3	The National Institute for Entrepreneurship and Small Business Development Publications	http://niesbud.nic.in/Publication.html
4	Courses : The National Institute for Entrepreneurship and Small Business Development	http://niesbud.nic.in/docs/1standardized.pdf
5	Entrepreneur.com	https://www.entrepreneur.com/lists
6	GOVT. SPONSORED SCHEMES	https://www.nabard.org/content1.aspx?id=23andcatid=23andmid=530
7	NABARD - Information Centre	https://www.nabard.org/Tenders.aspx?cid=501andid=24
8	NABARD – What we Do	http://www.nabard.org/content1.aspx?id=8andcatid=8andmid=488
9	Market Review	http://www.businesstoday.in/markets
10	Start Up India	http://www.startupindia.gov.in/pdffile.php?title=Startup%20India%20Action%20Planandtype=Actionandq=Action%20Plan.pdfandcontent_type=Actionandsubmenupoint=action
11	About - Entrepreneurship Development Institute of India (EDII)	http://www.ediindia.org/institute.html
12	NSTEDB - Training	http://www.nstedb.com/training/training.htm
13	Tata Exposures	http://www.tatasocial-in.com/project-exposure
14	Ministry Of Micro, Small And Medium EnterpriseS	http://www.dcmsme.gov.in/schemes/TEQUPDetail.htm
15	List of Business Ideas for Small Scale Industry	https://smallb.sidbi.in/%20/thinking-starting-business/big-list-business-ideas-small-business
16	Thinking of Entrepreneurship	https://smallb.sidbi.in/entrepreneurship-stage/thinking-entrepreneurship
17	List of services for Small Scale Industry	http://www.archive.india.gov.in/business/Industry_services/illustrative.php
18	NSIC Schemes and Services	http://www.nsic.co.in/SCHSERV.ASP

92. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	-	-	-	2	2	2
CO2	1	-	-	-	2	2	2
CO3	-	-	-	-		1	3
CO4	-	-	-	1	-	1	2

	PSO1	PSO2

CO1	-	-
CO2	-	1
CO3	-	1
CO4	-	1

Sign: Name Mr. S.S.Harip (Course Expert /s)	Sign: Name: Dr. R.R.Saraf
Sign: Name: Dr. N.G.Kulkarni (Head of Department)	Sign: Name: Shri A.S.Zanpure (CDC)

Government Polytechnic, Pune.

'180OB' – Scheme

Programme	Diplôma in **ET**/CE/EE//ME/MT/CM/IT/DDGM
Programme code	01/02/**03**/04/05/06/07/08/16/17/21/22/23/24/26
Name of Course	**Industrial Organization and Management**
Course Code	**MA 4102**
Prerequisite course code and name	-------

93. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	***ESE**	**PA**	50
02	00	00	02	**Marks**	40	10			
				Exam Duration	2 Hrs	1/2 Hr			

(*):*OE/POE (Oral Examination/Practical & Oral Examination mention whichever is applicable)*

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, ESE-End semester examination, PA- Progressive Assessment.

94. RATIONALE

The industrial organization is a structured organization which has different levels of management. There are different sections / divisions of industry in which, a diploma engineer is expected to work. There are various roles of diploma engineers at different levels of technical and administration departments in an industry. They must be aware of financing agencies, Market survey, marketing techniques, human relations management and different acts by which the industries are governed.

95. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Ability to work with various levels of management in industry, develop awareness about different departments of industry, acts by which, industries are governed, industrial ethics and leadership qualities.**

96. COURSE OUTCOMES (COs)

The theory experiences and behavioral skills associated with this course are to be taught and implemented, so the student will able to exhibit the following CO'S.

CO .1: Understand different levels of Industry Organization and entrepreneurship.
CO .2: Implement skills for organizing Market Survey and Managements technique.
CO .3: Implement various Financial & Material Management technique.
. CO .4: Use the relevant acts applicable for factories .

97. THEORY COMPONENTS

The following topics/sub-topics should be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency.

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit-I : **Overview of Business and Organizational Management** (Weightage-08 , Hrs-6)	
1.a.Students can describe types of business. 1.b Students can classify types of industries. 1.c Students can describe Organizational Structure of Industry. 1.d Students can describe forms of ownerships.	1.1 Classification of Industries: Engineering, IT, ITeS Banking, Retail. Small Scale, Large Scale, Pvt. Ltd, India Ltd, Multi-National, MSME. 1.2 Role of engineer in Manufacturing, Service-sector, Trade , Consultancy. 1.3 Introduction to Types of business: Manufacturing, service, Trade, Consultancy. 1.4 definition of Organization. Types : Line, Functional, Line and staff, Project. 1.5 Authority and delegation of power at different levels of organization. 1.6 Forms of Ownerships : Proprietorship, Partnership, Joint Stock, Cooperative Society, Government Sector.
Unit-II **Fundamentals of Management (**Weightage-08, Hrs-6)	
2.a Describe concept of Management. 2.b. Describe different levels of Management. 2.c Describe different functions of Management.	2.1 Definition of Management. 2.2 Role of management. 2.3 Levels of Management: Higher, Middle and Lower Level management. 2.4 Scientific management by FW Taylor. 2.5 Function of Management : Planning, Organizing, Directing, Coordinating, Controlling. 2.6.Role of Management with respect to feedback & Corrective actions.
Unit-III **Financial Management, Accounting and Material Management**. (Weightage-12, Hrs-10)	
3.a . Describe different types of capital generation. 3.b Describe different types of budgets. . 3.c Describe advantage of balance sheet to calculate Profit / Loss.	3.1 Overview of : Capital generation and Management, Fixed & Working Capital. 3.2 Sources of raising Capital. 3.3 Budget & Accounts : Types of Budget viz. Production budget, fixed and variable budget (concept level) 3.4 (MRP)-function of MRP, input to MRP, benefit of MRP. 3.5 Basic concepts Enterprise resource planning (ERP)-concepts, advantages and disadvantages of ERP . 3.6 Accounts : Profit & Loss accounts, rules for debits & credits, books of accounts. 3.7 Balance Sheet : definition, sample format, various fields.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
. 3.d Describe concept of Inventory management.	3.8 Material Management : Inventory (Concept, classification, functions.), Necessity of ABC analysis. 3.9 Standard steps in purchasing. Direct Purchase , tender method, E- Tendering. .
Unit-IV **Marketing, Industrial Safety and various Acts.** (Weightage-12, Hrs10)	
4.a Describe the concept of Market Survey and types of survey. 4.b List different techniques of increasing sales of product. 4.c List and Describe various types of accidents in industry. 4.d List and Describe various acts with respect to industry.	4.1 Market Survey: Need, Advantages and Types of market survey. 4.2 Different techniques of increasing sales of product. 4.3 Packaging of goods. 4.4 Industrial Safety: Types of accidents in industry, Causes of accidents, Preventive measures to avoid accidents. 4.5 Industrial legislation : Indian Factory Act, Minimum Wages Act, Workmen Compensation Act. (Main provisions in the acts). 4.6 Penal actions on violation of Acts. (provisions)

98. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	**Overview of Business and Organizational Management.**	06	02	06	00	08
II	**Fundamentals of Management.**	06	02	06	00	08
III	**Financial Management, Accounting and Material Management**.	10	04	06	02	12
IV	**Marketing, Industrial Safety and various Acts.**	10	02	06	04	12
Total		32	10	**24**	**06**	**40**

99. SUGGESTED STUDENT ACTIVITIES:

1) Prepare/download information about different industrial acts.
2) Visit to manufacturing Industry and Prepare Report on...
   i) Structure of Organization/Department
   ii) Safety Measures taken in Organization
   iii) Procedure adopted for quality control
   iv) Any Specific observation you have noticed
3) Prepare the Technical details of 5 (Electronics Product like mobile phone, TV ,Laptop, Home Theatre, Projector etc. of different company including cost and Suggest which is cost effective to buy.
4) Prepare Project report which includes financial Viability of any product of your choice.
5) Prepare a questioner for market survey of electronic product of your choice.
6) Write detailed Processes to start the Partnership firm.

100. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

A}To arrange a Visit to an Industry and observe industrial safety norms followed in the industry. Students should submit a report based on their observations regarding the safety norms to be followed in the industry.

B} To Arrange an Expert Lecture by a Lawyer to update the students regarding Amendments in Different acts (Factory act, Minimum Wages Act, Workmen Compensation Act) and Penal actions on violation of the acts.

101. SUGGESTED MICRO-PROJECTS: NA

102. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	Industrial Engineering and Management.	O.P. Khanna, Dhanpat Rai and Sons.	
2	Project Planning and Entrepreneurship.	Banga and Banga, Khanna Publishers.	
3	Behavioral Process in Organizations.	Uday Parikh, T.V. Rao and D.M. Pestonjee, Tata McGrawhill.	

103. SOFTWARE/LEARNING WEBSITES

52. www.nptel.com
53. www.slideshare.net

104. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	-	-	-	-	2	3	2
CO2	-	-	-	-	2	3	2
CO3	-	-	-	-	1	3	2
CO4	-	-	-	-	2	3	2

	PSO1	PSO2	PSO3
CO1	-	1	-
CO2	-	1	-
CO3	--	1	-
CO4	-	1	-

Sign: Name: G.W. Sonone (Course Expert /s)	Sign: Name: Shri.R.N.Shikari (Program Head) (Electronics &Telecommunication Dept.)
Sign: Name: Shri A.S.Zanpure (CDC)	

Government Polytechnic, Pune

'180OB' – Scheme

Programme	Diploma in **ET/CE/EE//ME/MT/CM/IT/DDGM**
Programme code	**01/02/03/04/05/06/07/08/15/16/17/21/22/23/24/26**
Name of Course	**Disaster Management**
Course Code	**MA 4104**
Prerequisite course code and name	**NIL**

105. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	***ESE**	**PA**	
02	00	00	02	**Marks**	40	10	Nil	NIL	50
				Exam Duration	2Hrs	30 min	NA	NA	

(*):*OE/POE (Oral Examination/Practical&Oral Examination mention whichever is applicable)*

Legends: L- lecture,T-Tutorial/teacher guided theory practice,P-practical,ESE-End se2mester examination,PA- Progressive Assesment.

106. RATIONALE

Sensitization of every citizen of the country regarding disaster management is of utmost importance. A diploma holder in any discipline has a greater role in disaster management owing to the technical skill sets possessed by him/her. The course is an attempt to sensitize the students pursuing diploma programme in Engineering / Technology about various aspects of Disaster management.

107. COMPETENCY

The aim of this course is to address following Society / Industry identified competency through various teaching learning experiences:

- **Exhibit capability to contribute in Disaster management related activities through the technical skillsets possessed.**

4. COURSE OUTCOMES (COs)

On completion of the course through theory and relevant soft skills, the student shall demonstrate the following tangible outcomes;

16. Define and emphasize the significance of various terms associated with disaster and disaster management.
17. Classify and distinguish various types of disasters.
18. Interpret and elaborate features of the disaster management setup in India
19. Elaborate on the disaster mitigation, disaster preparedness and relief operations.

5. SUGGESTED PRACTICALS/ EXERCISES

Theteachingand examination scheme for the course does not mandate any practicals for the course.

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

Nil

7. THEORY COMPONENTS

The following topics/subtopicsshall berendered through classroom sessions/supplementing selective MOOC video clips. Assessment shall bethrough two progressive assessment tests and end semester examination in order toensure development of Unit Outcomes for achieving the Course Outcomes to attain the identified competency**.**

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
UNIT 1. DISASTER AND DISASTER MANAGEMENT CONCEPTS (Weightage- 6, Hrs-6)	
1a. Define disaster and disaster management. 1b. Define terms associated with disaster and disaster management. 1c. Corelates the effect of Vulnerability and Coping capacity on disaster management.	**1.1 Disaster and Disaster management:** Definitions of Disaster and disaster management. (CO 1) **1.2 Definition of terms associated with disaster and disaster management:** Definitionof terms Vulnerability to disaster, Hazard, Risk, Risk management, Coping capacity(CO 1) **1.3Correlation of Vulnerability and Coping capacity in Disaster management:** Effect of vulnerability to disaster on the effect of disaster and disaster management. (CO 1) Influence of coping capacity on disaster assessment and mitigation. (CO 1)

UNIT 2. Types of disasters (Weightage- 8 , Hrs- 6)	
2a. Classifies disasters based on source. 2b. Classifies Natural and Manmade disasters in to further categories. 2c. Further classification of disasters based on sequence of occurrence, Pace and scale.	2.1 Classification of disaster based on source as Natural and Manmade.(CO 2) 2.2 Classification of Natural disasters asatmospheric, Terrestrial, Aquatic and Biological. (CO 2) 2.3 Classification of manmade disasters as Industrial, Chemical, Technological, Nuclear, Gas leaks, Oil spills, Dam failures and canal breaches, Wars, Terrorist attacks, Biological, Transportation accidents. (CO 2) 2.4 Primary and secondary, Slow on set and rapid onset, simple and complex disasters. (CO 2)
UNIT 3 Disaster management in India(Weightage- 16 , Hrs- 12)	
3a. Elaborates the provisions of Disaster management Act 2005. 3b. Signifies the role of National Institute of Disaster Management (NIDM) and elaborates on its activities. 3c. Describes the evolution of disaster management set up at national / state / district levels.	3.1 Disaster scenario in India, its vulnerabilities, review of some of the notable disasters in Indian history. (CO 3) 3.2 National disaster management Act 2005, its provisions, authorities at different levels and their roles / responsibilities. (CO 3) 3.3. National Institute of Disaster Management (NIDM) – the need for its establishment, activities, contributions to disaster management in India. (CO 3) 3.4. National disaster management policy 2009, National Disaster management plan 2016 and 2019, Maharashtra state disaster management plan 2016. Provisions, features and role in strengthening national disaster management. (CO3)
UNIT 4. Disaster mitigation and relief (Weightage- 10 , Hrs- 8)	
4a. Describes various stages involved in disaster mitigation. 4b. Elaborates disaster risk reduction strategies. 4.c. Signifies the need for disaster preparedness in disaster management. 4.d.Elaborates Disaster relief and rehabilitation activities.	4.1 Disaster mitigation strategies as per national disaster management plan provisions. (CO 4) 4.2 Disaster risk reduction strategies and study of factors contributing to disaster vulnerability. (CO 4) 4.3 Study of disaster preparedness strategies and early warning systems to anticipate occurrences of disaster to improve preparedness. (CO 4) 4.4 Disaster relief activities as per the provisions of statutes and the action plans and procedures for disaster relief. Stake holders in disaster relief management. (CO 4) 4.5 Capacity building rehabilitation measures and long term reconstruction. (CO 4)

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	DISASTER AND DISASTER MANAGEMENT CONCEPTS	06	02	04	00	06
II	Types of disasters	06	04	04	00	08
III	Disaster management in India	12	04	12	00	16
IV	Disaster mitigation and relief	08	04	06	00	10
Total		32	**14**	**26**	**00**	**40**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom, following student-related ***co-curricular*** activities are suggested which reinforce the cognitive learning and aid in attainment the course outcomes;

a. Individual student shall prepare a report on one natural and one manmade disaster that has occurred in India (Preferably in Maharashtra) in the last 10 years. The report shall highlight classification of the disaster, magnitude, vulnerability of the disaster location/ site, mitigation measures, relief activities undertaken and long-term measures and their effect.
b. Individual student shall prepare a report on a successful disaster preparedness exercise executed in India in the near past. The report shall highlight the risk reduction strategies adopted, early warning systems used and reduction of vulnerability to hazard measures adopted.
c. Each individual student undergoing this course shall complete "Course 1 – Basics of disaster management under the self-study programme of National Institute of Disaster Management (NIDM) and secure certification for the same.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

- All the units of curriculum are supported by selective MOOCS prepared by Educational Multimedia Research Centre (EMRC) Osmania University on Disaster management. The Urls of the earmarked videoclips for the course are listed as reference material in the curriculum. The students can access them.
- The course teacher shall prepare study material to the students based on the MOOCs, reference materials listed.

11. SUGGESTED MICRO-PROJECTS

The scope of the course does not mandate any micro projects. However, suggested student activities suffice as micro projects.

12. SUGGESTED LEARNING RESOURCES

Sr.No.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	The Disaster Management Act, 2005	Government of India	N A (pdf of the bare act is enclosed with curriculum)
2	National Disaster Management Plan (NDMP) 2016	Government of India	N A (pdf of the bare act is enclosed with curriculum)
3	Maharashtra State Disaster Management Plan 2016	Government of Maharashtra	N A (pdf of the bare act is enclosed with curriculum)

4	National Disaster Management Plan 2019	Government of India	N A (pdf of the bare act is enclosed with curriculum)
5	Draft National Disaster Management Plan Part II Disaster mitigation and response function plans	Government of India	N A (pdf of the bare act is enclosed with curriculum)

108. SOFTWARES / ONLINE LEARNING RESOURCES

The students and faculty can visit following earmarked urls for MOOCs of EMRC Osmania University without indulging in any acts violating copyright.

54. https://youtu.be/DExlZTfKZAM?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG(Disaster and Disaster management concepts)
55. https://youtu.be/7ZhS_HrivqA?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Types of Disaster)
56. https://youtu.be/BI38KKij9Nc?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Natural Disasters)
57. https://youtu.be/cijSod44Q2g?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Manmade Disaster)
58. https://youtu.be/zwIQVKqytD4?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Slow onset and Rapid onset Disasters)
59. https://youtu.be/zBqvJkzbk-w?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Simple and Complex Disaster)
7. https://youtu.be/e3MwwrRMfZ8?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Evolution of Disaster in India)
8. https://youtu.be/iFPMSRCswG0?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Disaster and disaster management in India)
9. https://youtu.be/u9ch6eqjG-Y?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Disaster management act 2005)
10. https://youtu.be/e5KV2exJTeE?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (National Institute of Disaster Management)
11. https://youtu.be/6zFOS1VVGLw?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (National Policy on disaster management)
12. https://youtu.be/PHUf3WFtGfc?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (National disaster management plan 2016)
13. https://youtu.be/mgb7bs4Yv1g?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Stake holders in disaster management)
14. https://youtu.be/GtFO-FaUwbM?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Central Government as stake holder in disaster management)
15. https://youtu.be/J4oMdAOuUFQ?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (State Government as stake holder in disaster management)
16. https://youtu.be/7TFTXqOtARo?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (District administration as stake holder in disaster management)
17. https://youtu.be/rUziSTV2l9o?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Armed forces as stake holder in disaster relief management)
18. https://youtu.be/lv80bN26KeE?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Paramilitary forces as stake holder in disaster relief management)
19. https://youtu.be/lDhM8Co1pEs?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Fire services as stake holder in disaster relief management)
20. https://youtu.be/ueqXlFC5bg0?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Disaster risk reduction strategies)
21. https://youtu.be/VQ6tMdBZARM?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Disaster preparedness plan)

22. https://youtu.be/TFLwWMcQll4?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Early warning system in disaster preparedness)
23. https://youtu.be/972scfiEPtw?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Factors contributing to disaster vulnerability)
24. https://youtu.be/9e-iiKwQ3I4?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Disaster risk reduction master plan for the future)
25. https://youtu.be/y0qui7QWTQU?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Components of disaster relief)
26. https://youtu.be/9EWZvwE2548?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Capacity building rehabilitation measures and long term reconstruction)

109. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	-	-	-	-	-	-	1
CO2	-	-	-	-	1	-	1
CO3	-	1	2	1	2	1	2
CO4	1	1	2	1	2	2	2

Sign: Name:Dr. S M S Shashidhara (Course Expert /s)	Sign: Name:Dr. S M S Shashidhara (Head of Department) (Department of Civil Engineering)
Sign: Name: (Program Head) All departments	Sign: Name: Shri A.S.Zanpure (CDC)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diplôma in ME
Programme code	01/02/**03**/04/05/06/07/08/16/17/21/22/23/24/26
Name of Course	**In-Plant training**
Course Code	**ME 4101**
Prerequisite course code and name	**-**

110. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	**ESE**	**PA**	100
-	-	6	6	**Marks**	-	-	50	50	
				Exam Duration	-	-	2Hrs		

***(*):** Under the theory PA, Out of 20 marks, 10 marks are for micro-project assessment*

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, ESE-End semester examination, PA- Progressive Assessment.

111. RATIONALE

In-plant Training is introduced in this curriculum to develop the industrial culture among the students before they enter in to the professional life. By exposing and interacting with real life industrial environment, student will understand the actual working of an industry, practices adopted in industry. The industrial need soft skill, life skills and hands on practices intended to be inculcated in the students through training. This short association with an industry will be instrumental in orienting the students in transforming them to be ready after completion of Diploma in Mechanical Engineering.

112. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Develop soft skills and hands on practices in industrial environment.**

113. 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**:**

1. Communicate effectively for executing work
2. Prepare report of executing work

3. Exercise time management and safety in the work environment.
4. Work in team for executing the given task.

114. 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**:**

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Week No.
1	-	Prepare report by collecting information about Industry.(Nature of Industry, Organizational structure, Turnover, product and services, human work force, Safety systems etc.)	1,2	01
2	-	Prepare report by collecting information about Facilities available in the industry (Manufacturing facilities, Planning and Scheduling activities, Material Handling system, Materials management System, Quality Techniques etc)	1,2,3	03
3	-	Prepare report of assigning work (Nature of work, Area of work etc.)	1,2,3,4	06

S.No.	Performance Indicators	Weightage in %
kk.	NA	
Total		**100**

115. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	PrO. No.
49	NA	

116. THEORY COMPONENTS

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

NA

117. FORMAT FOR TRAINING REPORT

In plant Training report may content

a. Organizational structure of industry
b. Types of product /services , Human Resource management in Industry
c. Available Manufacturing Facilities
d. Production planning and control system.
e. Inventory management
f. Material Handling systems
g. Testing Facilities available for Raw and finished product
h. Safety procedures followed by industry
i. Maintenance procedure
j. Report of Task assigned to the students

118. 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:

119. 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:

NA

120. SUGGESTED MICRO-PROJECTS

NA

(Only for Class Declaration Courses)

Only one micro-project *is planned to be undertaken by a student that needs to be assigned to him/her.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 is given here. Similar micro-projects could be added by the concerned faculty:

121. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	NA		

122. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	-	-	2	2	3	3
CO2	1	-	-	2	2	3	3
CO3	1	-	-	3	3	3	3
CO4	1	-	-	3	2	3	2

	PSO1	PSO2
CO1	2	2
CO2	2	3
CO3	2	3
CO4	2	3

Sign: Name Mr. S.S.Harip (Course Expert /s)	Sign: Name: Mrs. M.S.Deshmukh (Course Expert /s)
.Sign: Name: Dr. N.G.Kulkarni (Head of Department)	Sign: Name: Shri A.S.Zanpure (CDC)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diploma in ET/CE/EE//**ME**/MT/CM/IT/DDGM
Programme code	01/02/03/**04**/05/06/07/08/16/17/21/22/23/24/26
Name of Course	**Seminar on Emerging trends in Mechanical Engineering**
Course Code	**ME4103**
Prerequisite course code and name	**NA**

123. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	*ESE	PA	
00	00	02	02	Marks	00	00	25	25	50
				Exam Duration	--	--	02		

(*): *POE (Oral Examination)*

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, ESE-End semester examination, PA- Progressive Assessment.

124. RATIONALE

Now a day technology, business and everything is getting advanced every second of time. Lots of researches and studies are carried out on various subjects around the world. In order to keep pace with these developments, seminars and workshops are organized where the like-minded intellectuals and professionals assemble to trade ideas, thoughts, and views related to a specific topic. However all these happening in science and technology cannot become part of the curriculum. This is where the seminars are of great importance. Seminars are capable of keeping the students updated with the technologies. Seminars provide an opportunity for students to discuss and analyze a range of new material, ideas and concepts, improve proficiency in verbal communication and acquire knowledge in a particular field. Far from the textbooks and academic syllabuses, students research and learn on their own which boost their confidence, performance, and productivity. Keeping in mind the importance of seminars for students, seminars has become an innovative and welcomed step towards modern education.

125. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Develop ability to obtain information about the latest happenings in science and technology to enhance performance and productivity.**

126. 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**:**

1. Identify the emerging trends in Mechanical Engineering and multidisciplinary fields influencing the society, sustainability and environment.
2. Identify various resources for collecting the information on identified field
3. Develop and practice self- study techniques.
4. Prepare a seminar report
5. Develop technical paper writing and presentation skills

127. SUGGESTED PRACTICALS/ EXERCISES

The practical 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**:**

Sr. No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approx Hours Required.
1.	**Introduction to seminar writing on emerging trends**	**1**	**06**
1.1 Understand the importance of Seminar: Whatever be the field, everything is getting advanced. The students have to always keep their eyes on what new things are arriving day by day. Seminars are capable of keeping the students updated with the latest happenings in following areas. • Recent Trends in the field of Manufacturing/ Production/ Thermal and Heat Power/ Design/ Automobile/ Material Science/ Fluid Power/ Process Engineering/ Mechatronics, Robotics and Automation/ Internet of Things/Artificial Intelligence/ Machine Learning. • Conventional/ Non-Conventional/ Innovative practices/ Case studies. • Management Techniques/ Industrial Safety/ Environmental management systems/ Energy management and audit. 1.2 Plan a schedule for working on the topic at the beginning. This plan should consider a literature survey, designing a document template, reading literature, writing chapters, discussion with the supervisor and so on. 1.3 Do not expect that it is possible to do the seminar work in a few days. Do not run to the supervisor for each small problem (e.g. finding literature, spelling mistakes, …). Do not vanish into space for month and come back only a few days before the deadline as there will be not enough time left for all necessary corrections in such cases.		
2.	**Identification of Resources for learning material**	**2**	**04**
2.1. In order to write a thesis, dissertation, or research paper, it is necessary to conduct a literature review to situate the research within existing knowledge. While writing seminar report also, adequate literature review should be carried out for two purposes,			

first to identify the seminar topics on current developments and then to demonstrate one's familiarity with the selected topic and scholarly context.

2.2. Lot of online and offline resources are available now a day. Unfortunately, Wikipedia is mostly known and used as information source, but this is not an accepted scientific source because there is no guarantee about correctness of entries. Every individual student should refer national and international technical journals and magazines, reference books, Web pages, conference papers etc.

2.3. A literature list should contain mostly journal papers or conference papers, maybe also a smaller number of standard books. Keywords and the questions related to the research topic help in identifying proper resources. Some useful databases to search for journals and articles include:

- University's library catalogue
- Google Scholar
- ResearchGATE
- Shodhganga
- Inspec (physics, engineering and computer science)

2.4. Read the abstract to find out whether an article is relevant. Bibliography of a useful book or article helps to find other relevant sources.

3.	**Selection of seminar topic and Literature survey**	**3**	**6**

3.1 Topic of own interest and of general interest is always a good choice. Selecting a topic that will make a good story is a big first step toward making the seminar a good one.

3.2 Seminar can either be based on a library topic, which should include the information on the history, current status and possible future of research or policy in a particular area or on a particular subject.

3.3 Student should read literature on the assigned topic and afterwards write in own words about it. A graph or single sentences maybe cited from the source but such things have to be marked as copied. The text in general is to be written in own words.

3.4 The first step in working on a seminar topic is to do a literature survey about related works in the topical area. All referenced literature has to be included in the literature list at the end of the paper and in the literature list, only literature has to be included which is referenced somewhere in the paper.

4.	**Structuring of seminar report**	**4, 5**	**6**

4.1 Seminar report should contain following points

a. Cover (Title) page containing Title of seminar, Student name and enrolment number, Guide name, Department and Institute name, Academic year, in the given format
b. Certificate
c. Acknowledgements
d. Abstract and Key words
e. Table of contents
f. Introduction (usually concluding with Aims of the study)
g. Details of the topic divided in appropriate number of chapters with appropriate chapter names
h. Conclusions
i. References

4.2 The first chapter "Introduction" should start with which topic is presented and why is this topic interesting and/or important. The last chapter has to be a concluding chapter. Here, the core statements or findings of the seminar paper have to be shortly summarized. The rest of the chapters between introduction and conclusion should be on literature survey, history, technical details, working principal and Applications, Advantages and Limitations or other details depending on the topic of seminar.

4.3 Usually, it is avoided to use formulations like "I will explain, …" – it usually is written in third person. It is only allowed to use abbreviations (ABB) if they are introduced somewhere in the paper before, like shown here exemplarily for ABB.

5.	**Unit– V Formatting of Seminar report**	**4,5**	**6**

5.1 Format

- Title – Times New Roman, size – 18 (bold)
- Heading - Times New Roman, size- 14 (bold), Sub-heading – Times New Roman , size – 12 (bold), General text - Times New Roman Size – 12,
- Line spacing - 1.5, Space between paragraph, Add space after paragraph – 12 points
- Header – Topic Name (Top of the right hand), Footer – Page No. (Bottom of right hand)
- Margin – Top- 2.54 cm, Bottom – 2.54 cm, Left – 3 cm, Right – 2 cm
- Page Numbers
  i. Page numbers for Certificate, Acknowledgement, Abstract, Index, should be in Roman Numbers.
  ii. Page no. on first page of first chapter will start with 1 but need not be printed.
  iii. Second page onwards page no. should be printed in Arabic numerals at bottom center place.

6.	**Unit– VI Presentation of seminar**	**5**	**4**

6.1 Begin with a title slide and show a brief outline or list of topics to be covered. Introduce the topic well. Give the necessary information but be careful not to include large amounts of extraneous material. The point of the introduction is to catch the audience and get them enthused about the topic, and let them know why the topic is interesting and exciting.

6.2 Don't overwhelm the audience with information. Limit the total amount of data to be presented and limit the amount of information to be shown on any single slide. Don't read the slides verbatim i.e. word by word.

6.3 Cite all sources of information. Use the best graphics available but be careful not to distract the audience by making the artwork more interesting than the information. Focus on content and clarity.

6.4 Display a brief summary of the conclusions on a slide. The conclusions and synthesis must have some original content. It is not sufficient to simply repeat the conclusions that other people have reached.

6.5 Remain relaxed during the question period. When answering questions, take your time, compose yourself, make sure you understand the question clearly and think before you answer. Keep additional slides ready. Make a lot of eye contact with your audience.

	Total		**32**

Note :-

1. Every student will deliver the seminar in the 5th semester. Evaluation of seminar will be carried out by panel of at least three teaching staff including one external examiner. Marks for Practical ESE will be given on the basis of presentation on seminar and oral examination following the seminar.
2. Selection of topic for the seminar should be finalized in consultation with teacher guide allotted for the batch to which student belongs.
3. The topic of seminar may be based on above listed areas or the area given by the faculty
4. The title of the seminar should be specific and clearly defined. Use of broad terms or generalized statements should be avoided (e.g. 'Recent trends in Automobile Engg.' or 'Nanotechnology' should not be the title of the seminar. Instead 'Use of Nanotechnology for the development of stain free cloths' can be a better title.
5. Seminar report should be of min.15 & max. 20 pages and spiral bound. It should be certified by guide teacher and head of the department.
6. Every student will prepare a seminar report in duplicate (typed) one with him and one with the institute.
7. Every student will deliver a seminar for 10-25 minutes in the presence of fellow students so that all of them are exposed to emerging trends in different areas.

S.No.	Performance Indicators	Weightage in %
ll.	Selection of the seminar topic	10
mm.	Literature Survey	20
nn.	Understanding of the topic	20
oo.	Presentation of the topic	20
pp.	Interpretation of result and Conclusion	10
qq.	Answer to sample questions	10
rr.	Submission of report in time	10
Total		**100**

128. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	Experiment Sr. No.
50	LCD Projector/ Smart Board/ Interactive board	
51	Desktop/ Laptop with multimedia	
52	Presenter/ laser pointer	
53	PA System (Optional)	

129. THEORY COMPONENTS

The following topics/subtopics should be learnt and practiced by the students in order to achieve the COs to attain the identified competency**.**

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
NA	

130. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
NA						

131. 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. Read the relevant reference books in the library to get the basic knowledge about the topic.
b. Visit any industry and collect information of recent trends in Industry.

132. 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:

eeee. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
ffff. Guide student(s) in undertaking micro-projects.
gggg. Use proper equivalent analogy to explain different concepts.
hhhh. Use Flash/Animations to explain various components, operation and
iiii. Teacher should ask the students to go through instruction and Technical manuals

133. SUGGESTED MICRO-PROJECTS (Only for Class Declaration Courses)

NA

134. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	Electric and Hybrid vehicles	Tom Denton	IMI(Institute of Motor Industry) ISBN-13: 978-1138842373 ISBN-10: 1138842370
2	The Electric car	M H Westbook	IET. 2001 ISBN-085290131
3	Hybrid Electrical and Fuel cell Vehicles.	Jack Erjavec	Cenage Learnig,2012 ISBN-1285415051
4	Industry 4.0 smart manufacturing for the future.	William MacDougall	Germany trade and Investe, 2014

5	4D printing- The next generation technology.	Dirk Schreder	ISBN-13-978-8963495
6	Automation, Production Systems and Computer Integrated Manufacturing.	Groover, Mikell. P.	PHI, ISBN-13:978-8120334182

SOFTWARE/LEARNING WEBSITES

1. https://www.legit.ng/1118330-steps-write-a-seminar-paper.html
2. https://www.wikihow.com/Write-a-Seminar-Paper
3. https://projectstoc.com/blog/2012/11/how-to-write-a-quality-seminar-paper/
4. https://www.oulu.fi/sites/default/files/content/format_for_seminar_paper.pdf
5. https://tcs.rwth-aachen.de/www-bib/downloads/How%20to%20write%20a%20seminar%20paper.pdf
6. https://libguides.law.ttu.edu/c.php?g=552130&p=3792868
7. http://a4academics.com/be-seminar-topics/19-be-mechanical-seminar-topics

135. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	1	1	--	--	2	3
CO2	2	1	1	--	--	2	3
CO3	2	1	1	--	--	2	3
CO4	1	--	--	--	--	2	3
CO5	2	1	1	--	--	2	3

	PSO1	PSO2
CO1	1	--
CO2	1	--
CO3	1	--
CO4	1	--
CO5	1	--

Sign: Name: Mr. M.W. Giridhar Dr. A. A. Gadhikar (Course Expert /s)	Sign: Name: Dr.N.G.Kulkarni. (Head of Department)
Sign: Name: Dr.N.G.Kulkarni. (Program Head)	Sign: Name: Shri A.S.Zanpure (CDC)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diploma in ME
Programme code	01/02/03/**04**/05/06/07/08/16/17/21/22/23/24/26
Name of Course	**Quality Techniques**
Course Code	**ME4104**
Prerequisite course code and name	-----

1. TEACHING AND EXAMINATION SCHEME:

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	ESE	PA	
03	00	00	03	Marks	80	20			100
				Exam Duration	3 Hrs	1 Hr	--	--	

Legends: L- lecture,T-Tutorial/teacher guided theory practice, P-practical, ESE-End semester examination, PA- Progressive Assesment.

136. RATIONALE:

In today's international market, the quality is another name for universal acceptance for product and services. Hence, the Mechanical Engineers must have consciousness about various quality aspects required for manufacturing /service sector. To fulfill this need, this subject about various factors and philosophies in quality development is introduced. So, the students will have most of the basic inputs before they enter their profession.

137. COMPETENCY:

Apply Quality control techniques for assuring quality of products and services.

138. COURSE OURCOMES:

1) Apply Quality Standards to products as per consumer needs.
2) Interpret data from different processes and quality charts for variable and attribute data.
3) Implement Quality circle and Kaizen for continuous improvement in the work.
4) Apply various statistical tools for data interpretation in graphical format.
5) Use different ISO standards in practice.

139. THEORY COMPONENTS:

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

Unit outcomes (UOs) **(In cognitive domain)**	**Topics and sub topics**
UNIT 1. QUALITY (Weightage - 08 , Hrs - 06)	
1a. Prepare quality characteristics chart to decide fitness of a product. 1b. List parameters for service quality of a product. 1c. Differentiate cost and value of quality. 1d. Select type and stages of inspection for a process for quality control. 1e. Imbibe quality mindedness in supporting staff.	1.1 Meaning of quality of product and services, Various definitions of quality, Quality of design and quality of conformance, cost of quality and value of quality, Service quality Vs product quality. 1.2 Quality policy: definition and objectives 1.3 Quality assurance: - definition, meaning, it's various forms and advantages. 1.4 Quality audit, quality mindedness 1.5 inspection and quality control.
UNIT 2. STATISTICAL PROCESS CONTROL (Weightage -16 , Hrs -12)	
2a. Prepare list of parameters to reduce variation in quality. 2b. Calculate mean, mode, median, range, standard deviation from given data. 2c. Draw and interpret X, R and P, C charts from given data. 2d. Determine Process capability. 2e. Represent the given data through normal distribution curve.	2.1 Meaning and importance of SQC, Variable and attribute Measurement. 2.2 Variation in quality, Reasons of variation, inherent and assignable sources of variation, central tendency, Dispersion, universe, Normal distribution curve. 2.3 Control charts – control charts for variables – X & R charts, defect and defective, control charts for attributes - P & C charts, Trend of control charts, (Numerical on control charts), Process capability. 2.4 Acceptance sampling- Need of sampling, types of sampling plans, operating characteristics (OC) curve).
UNIT 3. TOTAL QUALITY MANAGEMENT (Weightage - 16 , Hrs - 08)	
3a. Apply eight-dimensional model of total quality for the task. 3b. Prepare vision and mission statements for the organization.	3.1 Total Quality: - Concept, definition, objectives, eight-dimensional model of total quality.

3c. Identify key six sigma roles and black belt coaches for the given industrial situation. 3d. Prepare elementary list of parameters of PDCA cycle for a product to be manufactured.	3.2 Strategic quality management (Hoshin Kanri), vision, mission, QCDF (Quality Cost Delivery Flexibility), Juran trilogy. 3.3 Principles of total quantity management. TQM implementation – PDCA cycle. 3.4 Six sigma: Definition and Statistical meaning, advantages, implementation, methodology of system Improvement- DMAIC and DMADV. 3.5 Belts used in six sigma.
UNIT 4. QUALITY MANAGEMENT PROCESS (Weightage - 16 , Hrs -06)	
4a. Prepare list of steps to solve the given problem in the industry using quality circle concept with justification. 4b. Identify wastes in the organization and suggest measures to reduce them. 4c. Decide steps to implement 5S in the organization.	4.1 Quality Circle (QC): - concept, objective, structure, steps in formation of quality Circle, Roles of people involved in quality Circle, advantages of quality Circle. 4.2 Kaizen - concept, meaning and definition, areas for Kaizen, 10 ground rules for change, Traditional methods Vs Kaizen, Kaizen Vs innovation. 4.3 Types of waste and Waste elimination, hidden waste and obvious waste, Identification of wastes. 4.4 5S in housekeeping and their meaning.
UNIT 5. QUALITY IMPROVEMENT TOOLS (Weightage - 12 , Hrs -08)	
5a. Prepare cause and effect diagram/ pareto chart for solving the given problem for root cause analysis. 5b. Conduct brain storming session of a team for generation of new idea. 5c. Prepare flow charts for explaining a process. 5d. Apply '5 Whys' technique to solve a problem.	5.1 Various statistical tools in quality improvement: Cause and effect diagram (Fish bone or Ishikawa diagram), check sheet, histogram, pareto chart, scatter diagram. 5.2 Additional tools of quality improvement: Brains storming, Flow charts, 5W & 1H, 5 Whys technique for problem solving.
UNIT 6. QUALITY MANAGEMENT STANDARDS (Weightage -12 , Hrs - 08)	

6a. Identify suitable ISO standards to be implemented in industry. 6b. Prepare list of steps in implementation of suitable ISO standard in the organization. 6. Prepare documentation for implementation of ISO.	6.1 History of evolution of ISO 9000 standards. European economic community (EEC), need for quality system standards, International organization for standardization (ISO) adopted by Bureau of Indian Standards (BIS) 6.2 ISO 9000: 2000 - Quality system ISO 9000 series standards, ISO 9000 elements understanding requirement, Documentation and implementation, quality manual, structure, internal quality audit, external audit and certification. 6.3 Various Quality Systems Vocabulary and features - ISO 9001:2008 Requirements for a quality management system ISO 9004: 2009 Guidelines for the effectiveness and efficiency of the quality management system IS 14000: Significance ISO 19011: guidance on auditing and environmental management systems. 6.4 Introduction to Toyota way: Toyota production system (TPS), lean production, '4' P model of Toyota way. 6.5 Toyota way: principles and their meaning.

140. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN: -

Unit No.	Unit title	Teaching Hours	Distribution of Theory marks			
			R Level	U Level	A Level	Total marks
1.	Quality	06	08	--	--	08
2.	Statistical Process control	12	08	04	04	16
3.	Total Quality Management	08	08	08	--	16
4.	Quality Management process	06	08	08	--	16
5.	Quality improvement tools	08	08	04	--	12
6.	Quality management standards	08	08	04	--	12
	Total		**48**	**28**	**04**	**80**

141. 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 (students') portfolio which will be useful for their placement interviews.

a. Prepare wall charts of three sigma and six sigma curves.

b. Search information about various ISO standards of quality control.

c. Prepare list of national and international industries working on the principle of six sigma technique.

142. 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. About 15-20% of the topics/sub-topics which are relatively simpler or descriptive in nature to be given to the students for self-directed learning and assess the development of the Cos through classroom presentations.
c. Teachers need to ensure to create opportunities and provisions for co-curricular activities.
d. Use Flash/Animations to explain working of various instruments.
e. Teacher should ask the students to go through instruction and Technical manuals.

143. SUGGESTED LEARNING RESOURCES:

Sr. No	Author	Title	Publication
1	Dr. K.C.Arora	Total Quality Management	S.K. Kataria and sons
2	B. Janakiraman and R.K. Gopal	Total Quality Management Text and cases	Prentice Hall of India pvt. Ltd. New Delhi.
3	Subburaj	Total Quality Management	Tata Mc - Graw Hill Co., New Delhi.
4	Gupta, Srinivas N & B Valarmathi	Total Quality Management	Tata Mc - Graw Hill Co., New Delhi.
5	Paul, Arasu	Total Quality Management	Prentice Hall of India pvt. Ltd. New Delhi.

9. SOFTWARES/ LEARNING WEBSITES: The students should refer following videos from internet.

Quality:
https://youtu.be/ZpFqnefTGA8

Quality control vs quality assurance:
https://youtu.be/zSyICkGZ6iM
TQM:
https://youtu.be/fKvEkOFzhjQ
Six sigma:

https://youtu.be/wEBPVQ7W2wg
Quality improvement tools:
https://youtu.be/7Kc1reo8NU0
http://www.slideshare.net/var93/seven-tools-of-tqm?from_m_app=android

Variable charts:
https://youtu.be/ccReTaolqHo
Attribute charts:
https://youtu.be/66rtASiAnbA
Acceptance sampling:
https://youtu.be/xJ3czkvNxpk
kaizen and 5S:
https://youtu.be/DFsFODnb-Iw
ISO:
http://www.slideshare.net/kumudajayaram/iso-9000-87352949?from_m_app=android

http://www.slideshare.net/parvikasinghal/iso-14000-41162373?from_m_app=android

10. PO - CO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	-	-	-	-	2
CO2	3	2	2	2	-	-	2
CO3	2	2	1	3	-	-	2
CO4	3	3	2	2	2	2	3
CO5	2	-	1	-	-	-	2

	PSO1	PSO2
CO1	-	-
CO2	2	-
CO3	-	-
CO4	2	-
CO5	-	2

Dr. R. R. Saraf Mr. N B Hirlekar (Course Experts)	Dr. N G Kulkarni (Head of Department)
Dr. N G Kulkarni (Program Head) (Head of Department)	Mr. A. S. Zanpure (CDC)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diploma in ET/CE/EE//**ME**/MT/CM/IT/DDGM
Programme code	01/02/03/**04**/05/06/07/08/16/17/21/22/23/24/26
Name of Course	**Industrial Hydraulics and Pneumatics**
Course Code	**ME4106**
Prerequisite course code and name	**NA**

144. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	***ESE**	**PA**	
04	00	02	06	**Marks**	80	20	25	25	150
				Exam Duration	2 Hrs	1 Hr	--		

(*): *POE (Practical & Oral Examination)*

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, ESE-End semester examination, PA- Progressive Assessment.

145. RATIONALE

In any mechanical industry hydraulic and pneumatic control systems are widely used due to its versatility and adaptability to automation, Understanding of fundamental principles, construction and working of elements of hydraulic and pneumatic control systems helps a Diploma technician in operation, maintenance and erection of modern machine tools. Practical circuits and PLC ladder diagrams are also dealt so that that student is familiar with the industrial automation

146. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Use different types of hydraulic and pneumatic systems for engineering applications.**

147. 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**:**

1. Illustrate the working principle of various components used for hydraulic & pneumatic systems.

2. Select appropriate working medium, components and accessories required in the fluid system wherever necessary
3. Connect simple hydraulic and pneumatic circuits as per the drawings
4. Use hydro pneumatic and electro pneumatic system appropriately
5. Develop hydraulic and pneumatic circuits for given applications.

148. 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**:**

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1.	1	Identify the components of hydraulic and pneumatic trainers.	1	02
2.		Draw ISO symbols of all components and their types used in fluid systems.	1	02
3.		Industrial survey of oil used in hydraulic systems (types, desirable properties, selection of oil, manufacturers, cost, sample collection)	2	02
4.		Industrial survey of oil filters (types, filtration material, constructional details, selection of filter, manufacturers, cost, sample collection) and FRL unit	1, 2	02
5.	2	Use of Pumps and compressor mounted on hydraulic and Pneumatic trainer.	1, 2	02
6.	3	Use of actuators mounted on hydraulic and Pneumatic trainer	1, 2	02
7.	4	Construction & demonstration of Hydraulic and Pneumatic Circuits for actuation of linear and rotary actuators by direct and indirect method using suitable DC valves.	1, 2, 3	04
8.		Construction & demonstration of Pneumatic circuits involving use of Quick exhaust valve, logic OR, AND, NOT functions.	1, 2, 3	02
9.	5	Study of pressure control valves	1, 2	02
10.		Construction & demonstration of circuits using pressure relief and sequence valve	1, 2, 3	02
11.	6	Construction & demonstration of speed control circuit for hydraulic and pneumatic actuators (meter in and meter out circuits)	1, 2, 3	02
12.	7	Demonstration of Electro Pneumatic circuits for direct and indirect control of pneumatic actuators	1, 2, 3, 4	02
13.		Development of ladder diagram for simple circuits	4	02
14.	8	Advance Hydraulic & Pneumatic circuit.(To and fro, Time Delay, Two-step speed control of actuator , circuits for Milling machine, Shaper machine and surface grinding machine, Accumulator circuits)	5	04
Total Hrs				**32**

S.No.	Performance Indicators	Weightage in %
ss.	Arrangement of available equipment / test rig or model	20
tt.	Setting and operation	20
uu.	Safety measures	10
vv.	Observations and Recording	10
ww.	Interpretation of result and Conclusion	20
xx.	Answer to sample questions	10
yy.	Submission of report in time	10
Total		**100**

149. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	Experiment Sr. No.
54	Cut sections of pumps, valves, cylinders, motors, accumulators, filters, etc.	1, 2, 3
55	Hydraulic trainer with transparent /actual working components.	1, 4, 7, 8, 9
56	Pneumatic trainer with transparent/ actual working components.	4, 5, 11, 12, 13, 14
57	Working / actual models of pumps, cylinders, valves, other components	1, 2, 3
58	Single /Multistage Reciprocating Compressor (pressure 0-10 bar)	4, 5, 11, 12, 13, 14

150. THEORY COMPONENTS

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

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Section I	
Unit– I Introduction to Hydraulic & Pneumatic Systems (6 hrs, 8 marks)	
1a. List various applications of fluid system 1b. Draw general layout of Hydraulic & Pneumatic Systems. 1c. Identify components from their symbols. 1d. Select hydraulic fluid based on its properties 1e. Draw cross sectional diagrams of accessories.	1.1 Fluid power system: Meaning, Principles and Applications, Future of fluid power in India. 1.2 Oil hydraulic & pneumatic system: basic components and general layout, advantages and disadvantages, comparison between electric, hydraulic & pneumatic systems. 1.3 ISO Symbols used in hydraulic & pneumatic system 1.4 Hydraulic Fluid: Functions, types, properties like viscosity, viscosity index and demulsibility, Selection of fluids, effect of temperature & Pressure on Hydraulic fluid system 1.5 Oil filters: Degree of filtration, filtration material, Types, construction and working of Depth, surface, full flow and proportional filter. Construction and working of FRL unit used in pneumatics.
Unit-II Pumps and Compressors (8 hrs, 8 marks)	
2a. Classify various types of pumps. 2b. Compare various types of pumps on the basis of given factors. 2c. Select pump for the given application. 2d. Classify compressors	2.1 Hydraulic pumps: Classification, Construction and working of Gear pump (external and Internal), Lobe Pumps, Gerotor Pumps, Vane pump (imbalanced and balanced), Screw pump, Piston pump (axial and radial). Comparison, Selection of Pump for Power Transmission, Pump performance. 2.2 Compressors: Types, construction, working principle of Reciprocating & Rotary compressors**.**

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
2e. Draw constructional details of Pneumatic Compressors, Actuators and control valves	
Unit– III Hydraulic & Pneumatic Actuators (8 hrs, 12 marks)	
3a. Classify various types of actuators with justification. 3b. Draw constructional details of hydraulic actuators 3c. Select actuator for the given application with justification. 3d. Draw performance curves of Actuators	3.1 Hydraulic and Pneumatic Actuators: classification, function and applications 3.2 Construction and Working of Linear Actuators: - single acting (spring and gravity return), double acting (single and double piston rod end) Cylinders. 3.3 Construction and Working of Rotary Actuators: Gear, Gerotor, Vane, Piston motors. Motor performance. 3.4 Construction and Working of special designs: Telescopic, Tandem and Rod less cylinder.
Unit –IV Direction Control Valves in Hydraulic & Pneumatic Systems (10 hrs, 12 marks)	
4a. Classify various types of DC valves 4b. Draw constructional details of DC valves 4c. Select appropriate type of DC valves for given application 4d. Select actuation methods of DC valves as per type of application. 4e. Draw Hydraulic and Pneumatic Circuits using DC valve for given application 4f. Compare DC valves on various grounds	4.1 Direction control valves: Classification, construction, working and applications of Poppet valve, spool valve, 2/2, 3/2, 4/2, 4/3, 5/2, 5/3, D.C valves simple and pilot operated check valves (pilot to open, pilot to close) methods of actuation of DCV, Comparison of DC valves, Selection of standard center position in 3 position DCV. 4.2 Construction and working of Rotary spool DC valve, Dual pressure valve, Shuttle valve and Quick exhaust valve. 4.3 Hydraulic and Pneumatic Circuits for actuation of linear and rotary actuators by direct and indirect (with pilot valve) method. Practical circuits involving use of Quick exhaust valve, logic OR, AND, NOT functions.
Section II	
Unit –V Pressure Control valves in Hydraulic & Pneumatic Systems (8 hrs, 8 marks)	
5a. Draw constructional details of pressure control valves 5b. Draw Hydraulic and Pneumatic Circuits using PC valve for given application Illustrate the use of pressure control valves in hydraulic and pneumatic circuits 5c. Compare various pressure control valves	5.1 Pressure Control Valve: Classification, Construction, working and applications of Relief valve (direct and pilot operated), pressure reducing valve (direct and pilot operated), sequence, unloading and counter balance valves. Comparison on various grounds. 5.2 Hydraulic and Pneumatic Circuits using pressure control valve, Single and double sequence circuit, Two pump unloading circuit, Counterbalance

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
5d. Select appropriate type of PC valves for given application	circuit, circuit for reduced pressure in part of the system .
Unit –VI Flow Control valves and Accessories in Hydraulic & Pneumatic Systems (10 hrs, 12 marks)	
6a. Classify various types of FC valves 6b. Draw constructional details of flow control valves 6c. Compare various methods of flow control 6d. Select appropriate flow control valves and method of flow control for the given application 6e. Illustrate the use of various accessories in hydraulic/pneumatic system. 6f. Select appropriate accessories in hydraulic and pneumatic system	6.1 Flow control valves: Classification, Construction, working and applications of non-compensated, Pressure compensated, Pressure & temperature compensated flow control valve. 6.2 Meter in, Meter out and bleed off circuits. Comparison between them. Speed control circuit for pneumatic actuators 6.3 Types, construction and functions of Accessories: Pipes, hoses, fittings, Seals and gaskets, accumulators. 6.4 Hydraulic circuits using Accumulator as an auxiliary power source, leakage compensator, emergency power source, hydraulic shock absorber and thermal expansion compensator
Unit –VII Hydro- Pneumatics and Electro- Pneumatics (6 hrs, 8 marks)	
7a. List and Illustrate the use of, various components of Hydro-Pneumatic and Electro Pneumatic system 7b. Draw and Analyze pneumatic circuits for different applications 7c. Develop ladder diagram for simple hydraulic & pneumatic circuits	7.1 Introduction to Hydro- Pneumatics, need, types, Air-Oil reservoir, Hydraulic check unit and air hydraulic intensifier, comparison with hydraulic and pneumatic system 7.2 Introduction to Electro Pneumatics, important steps, Function of commonly used devices (manually actuated push button switches, Limit switches, Pressure switches, Solenoids, Relays, Timers, Temperature switches, Proximity sensors, Electric counters), Advantages, Electro Pneumatic circuits for direct and indirect control of pneumatic actuators 7.3 PLC programming methods, Development of Ladder Diagram of simple hydraulic & pneumatic circuit s. a. OR, AND, Time delay, sequencing, NOR, NAND. (Basics of PLC are already covered elsewhere)
Unit –VIII Industrial Hydraulic and Pneumatic Circuits (8 hrs, 12 marks)	
8a. Develop hydraulic circuit for specified applications 8b. Develop pneumatic circuit for specified applications	8.1 Position dependent automatic reversal of piston 8.2 Pressure dependent automatic reversal of piston 8.3 Time dependent automatic reversal of piston 8.4 Continuous to and fro motion of D/A cylinder with roller operated valves and solenoid operated valves & limit switches. 8.5 Locked cylinders with pilot check valves 8.6 Regenerative circuit

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	8.7 Two hand safety circuit 8.8 Rapid Feed Return circuit 8.9 Cylinder Synchronizing Circuits (Series and parallel) 8.10 Hydraulic circuits for Milling machine, Shaper machine and surface grinding machine

151. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
Section - I						
I	Introduction to hydraulic & Pneumatic systems	06	04	04	--	08
II	Pumps and Compressors	08	02	04	02	08
III	Hydraulic & Pneumatic Actuators	08	04	04	04	12
IV	Direction Control Valves in Hydraulic & Pneumatic Systems	10	04	04	04	12
Total		32	14	16	10	40
Section - II						
V	Pressure Control valves in Hydraulic & Pneumatic Systems	08	02	04	02	08
VI	Flow Control valves and Accessories in Hydraulic & Pneumatic Systems	10	02	04	06	12
VII	Hydro- Pneumatics and Electro-Pneumatics	06	04	04	--	08
VIII	Industrial Hydraulic and Pneumatic Circuits	08	--	06	06	12
Total		32	08	18	14	40
Total		**48**	**20**	**36**	**24**	**80**

152. 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:

d. Prepare journal based on practical performed in Industrial fluid power laboratory. Journal consists of drawing, observations, required measuring tools, equipment, and date of performance with teacher signature.

e. Power Point Presentation on hydraulic and Pneumatic brakes by group of two/three students. (Duration:10 minutes)
f. Power Point Presentation on accessories used in hydraulics and pneumatics by group of two/three students. (Duration:10 minutes)
g. Prepare report of market survey of suppliers for fluid powered Earth moving equipment like JCB, Mahindra Earth master by group of four students.
h. Prepare chart on full imperial drawing sheet for ISO Symbols used in hydraulic & pneumatic system by group of two students.
i. Prepare chart on full imperial drawing sheet for classification of pumps and actuators by group of two students.
j. Prepare Seminar/presentation on types of oil filters by group of two/three students. (Duration:10 minutes)
k. Prepare display chart on types of seals and gaskets (actual samples) used in hydraulics.
l. Prepare visit report of any automobile service station to observe use of pneumatic hand tools.
m. Prepare visit report of construction sites to observe use of JCB/Other hydraulic /pneumatic equipment for automation.

153. 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:

jjjj. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
kkkk. 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).
llll. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
mmmm. Guide student(s) in undertaking micro-projects.
nnnn. Correlate subtopics with automation.
oooo. Use proper equivalent analogy to explain different concepts.
pppp. Use Flash/Animations to explain various components, operation and
qqqq. Teacher should ask the students to go through instruction and Technical manuals

154. SUGGESTED MICRO-PROJECTS
(Only for Class Declaration Courses)

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. 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 is given here. Similar micro-projects could be added by the concerned faculty:

a. Market survey of oil used in hydraulic system(Manufacturers, specifications, trade names, cost, packing size)
b. Prepare working model of hydraulic crane using waste injections used by Doctors.
c. Prepare report of agriculture equipment working on hydraulic and pneumatics. (field-based)
d. Prepare report of specifications of Hydraulic power pack and Pneumatic service unit(FRL Unit)
e. Collect technical specifications of Gear pumps, Vane pumps/other pumps (Internet based).
f. Prepare visit report to observe use of Pneumatic system used by Dentist.
g. Prepare visit report on automobile vehicle cleaning service station to observe the hydraulic actuator and system used.
h. Prepare display board by collecting sample of pipes and pipe fittings with specifications of different manufactures.(New/Worn out)
i. Prepare a tabulated summary for types of pipes available in market. (Summary includes type, specification, size range, material, rate and applications).
a. Prepare report on specifications, sketches of linear actuators and mounting methods.
b. Prepare report on working of hydraulic jack and its system.
c. Prepare prototype working model of hydraulically operated hospital bed.
d. Prepare demonstration model of telescopic cylinder using PVC pipes.
e. Develop working model of automation of bench vice used in carpentry/fitting shop.
f. Prepare report of various pneumatic hand tools and its attachments.
g. Prepare cut section model of any hydraulic/pneumatic component.
h. Prepare report of hydraulic system used in Universal testing machine available in Strength of material laboratory.
i. Prepare report of construction and working of hydraulic press used in nearby machine/fabrication shop.
j. Prepare visit report of service center for common faults and remedies of hydraulic equipment.

155. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	Oil Hydraulic system- Principles and maintenance	Majumdar S.R	Tata McGraw Hill, *ISBN*: 9780074637487
2	Pneumatics Systems Principles and Maintenance	Majumdar S.R	Tata McGraw Hill,ISBN-978-0-07-460231-7
3	Fluid Power with applications	Anthony Esposito	Pearson Education, Inc 2000,ISBN 81-7758-580-0
4	Hydraulics and Pneumatics	Harry Stewart	Taraporewala Publication, ISBN:978-0672234125

5	Pneumatic Controls	Joji B.	Wiley India Pub. ISBN:978-8126515424
6	Hydraulics & Pneumatics A Technicians & Engineers Guide	Andrew Parr	Butterworth-Heinemann Publisher, *ISBN*: 9780080966755
7	Industrial Hydraulics Manual	-----	Vickers Systems International(Company Manual)
8	Product Catalogue of FESTO	-----	Company catalogue
9	Hydraulic And Pneumatic Power For Production Industrial Hydraulics	D. Stewart	Industrial Press INC. 200, Madison Avenue, New-York 10016.
10	Animation software for hydraulics and pneumatics	Any version available	-----

SOFTWARE/LEARNING WEBSITES

8. **Hydrulic Pumps**:https://en.wikipedia.org/wiki/Hydraulic_pump
9. **Hydrulic Pumps**:www.hydraulicspneumatics.com/.../HydraulicPumpsM/.../TechZone-HydraulicPumps.
10. **Animation of Hydraulic pumps**:https://www.youtube.com/watch?v=Qy1iV6EzNHg
11. **Animation of Hydraulic pumps**:https://www.youtube.com/watch?v=pWuxYnqYDnk
12. **Eaton Pump assembly** :https://www.youtube.com/watch?v=sEVTIRYHoGg
13. **Video lectures of IIT Faculty** :http://nptel.ac.in/courses/112105047/
14. **Lecture series and notes by IIT faculty** :http://nptel.ac.in/courses/112106175/
15. **Pneumatic control valves animation**:https://www.youtube.com/watch?v=XAItnsUcES0
16. **Control valve symbol generation**:https://www.youtube.com/watch?v=yIot4shcOkE
17. **Animation of D.C. Valve**:https://www.youtube.com/watch?v=jsMJbJQkGTs
18. **Animation of 4/2,4/3 D.C Valves:**https://www.youtube.com/watch?v=CQPwvWXbV3w
19. **Animation of Hydraulic cylinder**:https://www.youtube.com/watch?v=bovfDsAYSbc
20. **Telescopic cylinder animation**: https://www.youtube.com/watch?v=icaqvfAtccY

156. **PO - COMPETENCY- CO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	--	1	--	--	--	1
CO2	3	2	3	--	1	--	1
CO3	3	3	2	2	1	1	2
CO4	3	2	2	1	1	--	3
CO5	3	2	3	1	1	--	3

	PSO1	PSO2
CO1	--	--
CO2	--	--
CO3	2	3
CO4	--	1
CO5	2	2

Sign: Name: Mrs. M.S. Deshmukh Dr. A. A. Gadhikar (Course Experts)	Sign: Name: Dr.N.G.Kulkarni. (Head of Department)
Sign: Name: Dr.N.G.Kulkarni. (Program Head) (Mechanical Engg Dept.)	Sign: Name: Shri A.S.Zanpure. (CDC)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**:**	**Diploma in ME**
Programme Code	**:**	**04/18/24**
Name Of Course	**:**	**Design of Machine Elements**
Course Code	**:**	**ME 4107**
Prerequisite Course Code & Name	**:**	**AM 3104 Strength of Materials**

157. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	OE	T/W	
04	00	02	06	Marks	80	20	25	25	150
				Exam Duration	3 Hrs	1 Hr			

(*): *OE/POE (Oral Examination/Practical & Oral Examination mention whichever is applicable)*

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, ESE-End semester examination, PA- Progressive Assessment.

158. RATIONALE

Design office of Industry is one of the major job areas for Diploma Technicians. To enable a student to work there he should know how to design the simple machine elements, applying the knowledge of strength of materials, manufacturing processes, computer aided drawing, etc. He should also be aware of economic considerations and usual design procedures and selection of appropriate material, use of standards.

159. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

Design simple machine elements

160. 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**:**

1	Select suitable materials for designing machine elements.
2	Design joints, levers for various applications.
3	Design power transmission elements like shafts, keys and couplings.

4	Design Fastners, power screws and springs for various applications.
5	Select standard components with their specifications from design data book/ manufacturer's catalogue.

161. SUGGESTED PRACTICALS/ EXERCISES

The practical 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:

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1.	1	1. Identify the material if IS designation is given or designate the material if description is given using Data book. 2. Explain Fatigue failure, Theories of elastic failure. 3. Identify areas of stress concentration in a component and suggest remedy (an assignment of question and answers type may be planned by teacher based on Unit I).	1	02
2.	2	Design C frame/offset link, Levers.	2	02
3.	2	Design and draw joints.		04
4.	3	Design Shaft subjected to bending and twisting.	3	02
5	3	Design and draw couplings.		04
6.	4	Design eccentrically loaded bolts of wall or roof bracket.	4	02
7.	5	*Design and draw Screw clamp.	4	04
8	5	*Design and draw Screw jack.		04
9.	6	Design Helical coiled springs & Sketch of Leaf Spring.		04
10.	7	Sketch various types of Bearings. Select a Ball bearing from Manufacturer's catalogue or Design Data book.	5	04
			Total Hrs	**32**

***Students will draw assembly & details drawing for any one from assignment from number 7 & 8.**

S.No.	Performance Indicators	Weightage in %
zz.	Use of design data handbook for material selection.	10
aaa.	Calculation and result.	30
bbb.	Use of standards and finalizing the dimensions.	10
ccc.	Preparation of production drawing.	30
ddd.	Answer to sample questions.	10

S.No.	Performance Indicators	Weightage in %
eee.	Submission of report in time.	10
	Total	**100**

162. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

Sr.No.	Major Equipment/ Instruments Required	PrO. No.
1	Drawing hall equipped with sufficient number of drawing boards.	all
2	Mini drafter and other drawing instruments.	all
3	Computer lab with CAD software (optional).	all

163. THEORY COMPONENTS

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

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
UNIT 1. DESIGN CONSIDERATIONS (Weightage-12, Hrs- 10)	
1a. Write steps in design 1b. Draw and explain Stress-strain and S-N curves 1c. Explain two theories of elastic failure. 1d.Use design data book	1.1 Machine design philosophy, Steps and procedure followed in design, Aesthetic and Ergonomic consideration in design. Design aspects for Manufacturing, Maintainability, Environment and Cost. 1.2 Types of loads and stresses, eccentric loading, Crushing and bearing stresses, strain, yield point, strength consideration, stress strain diagram, proof stress. 1.3 Reversed bending cycle, endurance limit S-N curve, fluctuating stresses concept and Fatigue failure. 1.4 Use of principle stress equations, maximum principle stress theory, maximum shear stress theory.
1.e Identify areas of stress concentration in a component and suggest remedy.	1.5 Use of design data books, Designation and selection of material, standardization. 1.6 Factors of safety, criteria for selection of F.S. 1.7 Stress concentration meaning, causes and remedies.
UNIT 2 DESIGN OF JOINTS AND OFFSET LINK (Weightage- 10, Hrs-10)	
2a. Design simple components and joints.	2.1 Forces resulting in direct tension, compression and shear.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
2b. Design C-frame/ Offset link. 2c. Design levers.	2.2 Forces resulting in combined, direct and bending. Design of C- frame, offset link. 2.3 Design of simple machine parts such as knuckle joint, turn buckle, cotter joint. 2.4 Forces resulting in bending, designing lever of lever loaded safety valve, bell crank lever.
UNIT 3 DESIGN OF SHAFT AND COUPLINGS (Weightage- 18, Hrs- 12)	
3a. Design shafts under Torsion,Bending and torsion. 3b. Design keys and couplings.	3.1 Design of hollow and solid shaft for combined loading. ASME code equations for shafts. Line shaft supported on two bearing with one or two pulleys (between the bearings) and with overhung. Design of shaft based on rigidity. 3.2 Design of keys. 3.3 Types of couplings, Design of muff coupling, flange coupling, bushed pin type flexible coupling.
SECTION II	
UNIT 4 DESIGN OF FASTENERS (Weightage-08, Hrs- 08)	
4a. Illustrate Bolt of uniform strength. 4b. Design eccentrically loaded bolted joints 4c. Design welded joints	4.1 Bolts of uniform strength. Design of bolted joints, arranged symmetrically and subjected to eccentric loading (about one axis only). 4.2 Design of transverse and parallel fillet welded joints.
UNIT 5 POWER SCREW (Weightage-12, Hrs- 12)	
5a. Sketch thread profiles 5b.Derive equation for torque to overcome thread friction 5c.Design Screw jack, screw clamp.	5.1 Thread profiles used for power screw. 5.2 Torque required for raising and lowering the load, Efficiency, self locking and overhauling conditions. Stresses in power screws. 5.3 Design of screw jack, screw clamp. (Numerical problems limited to square threads only, Exclude check for buckling of screw).
UNIT 6 DESIGN OF SPRINGS (Weightage- 12, Hrs- 08)	
6a.Classify and state functions of springs. 6b.Define Wahl's correction factor and explain its significance 6c.Design helical compression and tension springs. 6d.Sketch a leaf spring.	6.1 Classification, application and functions of springs. 6.2 Material for springs and specifications of spring. 6.3 Wahl's correction factor and its significance. 6.4 Design of helical springs with circular cross section wire only. 6.5 Leaf spring sketch, construction and application. (Numerical problem not expected).
UNIT 7 BEARINGS (Weightage- 08, Hrs- 04)	

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
7a.Sketch various Bearings 7b.Define terms related to Bearings 7c. Select proper bearing for given application with prescribed procedure.	7.1 Types of bearings, common bearings used in practice, Types of ball and roller bearings. 7.2 Static capacity, Dynamic capacity, limiting speed, bearing life. 7.3 Selection of bearings from manufacturer's catalogue causes of bearing failures, Mountings.

164. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
SECTION I						
I	**Design consideration**	10	00	06	06	12
II	**Design of joints and offset link**	10	00	04	06	10
III	**Design of Shaft and couplings**	12	06	00	12	18
SECTION II						
IV	**Design of Fasteners**	08	00	04	04	08
V	**Power screw**	12	04	00	08	12
VI	**Design of springs**	08	04	02	06	12
VII	**Bearings**	04	04	04	00	08
Total		64	**18**	**20**	**42**	**80**

165. 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:

i. Prepare journal for conducted practicals.
j. Undertake micro-projects.
k. Make chart indicating different thread profile and sizes required for different loads in case of screw jack, toggle jack, C-clamps and lead screw of machines.
l. Collect different types of springs and write applications of the same.
m. Collect different types of used bearings and make display model and their application.

166. 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:

rrrr. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.

ssss. 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).

tttt. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.

uuuu. Guide student(s) in undertaking micro-projects.

vvvv. Use proper equivalent analogy to explain different concepts.

wwww. Use Flash/Animations to explain various components, operation.

xxxx. Teacher should ask the students to go through instruction and Technical manuals.

167. SUGGESTED MICRO-PROJECTS (Only for Class Declaration Courses)

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 is given here. Similar micro-projects could be added by the concerned faculty:

m. Take any day to day life component, find load, stresses and also prepare chart/model for the same.

n. Make models of various joints and levers highlight resisting sections of different elements.

o. Make models of various shafts, keys and pulleys highlight resisting sections.

p. Make models of various couplings highlight resisting sections of different elements.

q. Make chart indicating different thread profile and sizes required for different loads in case of screw jack, toggle jack, C-clamps and lead screw of machines.

r. Prepare model of eccentrically loaded bolted and welded joint and highlight the maximum loaded section.

s. Prepare list of different types of bearings used in a bike and write their specifications and basis for selection.

t. Prepare list of different types of levers and springs used in a bike, bicycle, Auto Rickshaw, Moped and write their specifications and basis for selection.

168. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
38	Design of Machine Elements	Bhandari V. B.	McGraw-hilleducation India pvt. limited, New Delhi, 2017, ISBN-13:978-9339221126
39	Machine Design	KhurmiR. S. and Gupta J. K.	S. ChandNew Delhi, 2005, ISBN 10:8121925371 ISBN13:9788121925372
40	Machine Design	Jindal U. C.	Pearson Education India New Delhi, 2010, ISBN13: 9788131716595
41	Machine Design	Pandya and Shah	CharotarPublishing house pvt. Ltd. Anand, Gujarat, 2015, ISBN-13:9789385039102
42	Mechanical EngineeringDesign	Shigley	McGraw-hilleducation India pvt. limited, New Delhi, 2017, ISBN-13:978-9339221638
43	Design Data Book	PSG	PSG College ofTechnology Coimbatore, 2012, ISBN-10: 8192735508
7	Westermann Tables	Hermann Jutz & Eduard Scharkus	New Age International (P) Limited, ISBN:81-224-1730-2
8	IS Codes: IS 4218: 1967 ISO Metric Threads IS 2693: 1964 Cast Iron Flexible Couplings IS 2292: 1963 Taper keys and Keyways IS 2293: 1963 Gib Head Keys and Keyways IS 2389: 1963 Bolts, Screws, Nuts and Lock Nuts IS 4694: 1968 Square threads IS 808: 1967 Structural Steel SKF/NBC Catalogue for Bearings	ISO	Indian Standard Bureau New Delhi
9	Schaum's outline of theory and problems of machine design	A.S. Hall, A.R. Holowenko, H.G. Laughlin	Mcgraw-hill book company, **ISBN-13**: 9780070255951

169. SOFTWARE/LEARNING WEBSITES

a. http://nptel.ac.in/courses/112105124/
b. https://www.youtube.com/watch?v=CLeLFUrvO2g
c. www.machinedesignonline.com
d. www.engineeringtoolbox.com
e. https://www.youtube.com/watch?v=N5SckoiTDxA
f. https://www.youtube.com/watch?v=GfbcxJmjn9s
g. http://www.ignou.ac.in/upload/Unit-5-60
h. https://sizes.com/numbers/preferred_numbers.htm
i. www.robot-and-machines-design.com/en/articles/mech
j. http://www.youtube.com/flangedcoupling
k. http://www.youtube.com/screwjack

170. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	-	-	2	1	3
CO2	2	3	2	-	-	-	1
CO3	2	3	2	-	-	-	3
CO4	2	3	2	-	-	-	1
CO5	1	2	3	-	1	1	2
Average	2	3	2	-	1	1	2

	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	-	-
Average	2	-

Sign: Name: Smt. M. S. Deshmukh (Course Expert /s)	Sign: Name: Shri. N. G. Kulkarn (Head of Department)
Sign: Name: Shri. C. S. Ghadage (Course Expert /s)	Sign: Name: Shri A.S.Zanpure (CDC)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diploma in ME
Programme code	04
Name of Course	**Production Technology**
Course Code	**WS 4101**
Prerequisite course code and name	

171. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	***ESE**	**PA**	
03	00	04	07	**Marks**	80	20	25	25	150
				Exam Duration	3 Hrs	1 Hr	2 Hr		

(*): *OE/POE (Oral Examination/Practical&Oral Examination mention whichever is applicable)*

Legends: L- lecture,T-Tutorial/teacher guided theory practice, P-practical, ESE-End semester examination, PA- Progressive Assesment.

172. RATIONALE

Student should be trained about wide range of production processes involved for mass production of engineering components needs to be employed with due consideration of functional and economical aspects.

173. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- Operate various machines in workshop to produce different components

174. 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**:**

20. Illustrate Drilling, boring, milling and broaching machine with its attachments.

21. Justify Finishing and super finishing processes for given components.
22. Select appropriate machine for gear manufacturing.
23. Suggest types of Jigs and fixtures and their elements for given component.
24. Justify the importance and functions of PPC for manufacturing organization.

175. SUGGESTED PRACTICALS/ EXERCISES

The practical 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**:**

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1.	1	Two composite job and Journal / Report writing.	1	24
2.	2	Gear Milling using module cutter and Polygon milling.	1	24
3.	3	A job on center less Grinder / Demonstration.	3	16
		Total Hrs		**64**

S.No.	Performance Indicators	Weightage in %
fff.	Arrangement of available equipment / test rig or model	20
ggg.	Setting and operation	20
hhh.	Safety measures	10
iii.	Observations and Recording	10
jjj.	Interpretation of result and Conclusion	20
kkk.	Answer to sample questions	10
lll.	Submission of report in time	10
Total		**100**

176. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	PrO. No.
1	Column and knee type milling machine along with dividing head (Length X width of the working table 800 mm X 300 mm)	2
2	Center less Grindner	3

177. THEORY COMPONENTS

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

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
SECTION I	
UNIT 1. DRILLING MACHINE AND BORING MACHINES(Weightage-12 , Hrs- 07)	
1a. Describe construction and working of the given drilling and boring machine with sketches. 1b. List the different types of operations to be perform by drilling and boring machine on given job. 1c. Explain the nomenclature a of twist drill.	1.1 Classification of drilling machines, diagram, construction and working of sensitive drilling machine, Upright drilling machine, Radial drilling machine 1.2 Twist drill nomenclature, Size of drilling machine, Accessories, Attachments 1.3 Classification of boring machines, diagram construction and working of horizontal boring machine, vertical boring machine 1.4 Drilling machine operations:- Drilling, Reaming, Boring, Counterboring, Countersinking and its applications 1.5 Boring operations:- Face milling, Drilling, Machining flat surface, Turning cylindrical surface, Boring by tool head, Boring by boring bar, Cutting off, Forming and its applications
UNIT 2 MILLING MACHINES (Weightage- 12 , Hrs- 14)	
2a. Describe construction and working of the given milling machine with sketches. 2b. Select the relevant milling cutter for the specific operation on the given job with justification. 2c. Name and draw different types of milling cutter.	2.1 Classification of milling machine, diagram construction and working principles of column and knee type milling machine. 2.2 Milling processes, Up milling and Down milling, Milling operations and its applications. 2.3 Milling cutters material, types of standard milling cutters, universal dividing head, different types of indexing methods
UNIT 3 BROACHING MACHINE (Weightage- 06 , Hrs- 04)	
3a. Describe construction and specification of the given broaching machine with sketches. 3b. Name the nomenclature a of the given type of broach. 3c. Name and describe different applications.	3.1 Introduction to broaching, classification of broaching, broaching methods 3.2 Diagram construction working of internal pull broach 3.2 Broaching machines horizontal broaching machine, vertical broaching machine, continuous broaching machine, application.
UNIT 4 FINISHING AND SUPERFINISHING PROCESSES (Weightage- 10 , Hrs- 15)	

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
SECTION I	
4a. Describe construction and specification of the grinding machine with sketches. 4b. Select the grinding process for the given job with justification. 4c. Choose the relevant grinding wheel for the given job with justification. 4d. Describe superfinishing operations with sketch.	4.1 Types of grinding, grinding machines, all types of rough grinders, plain center-type grinders, centreless grinders, all surface grinders 4.2 Grinding wheels, abrasive materials, bonding, selection of grinding wheels, dressing, types of dressing. 4.3 Super finishing honing, lapping.
SECTION II	
UNIT 5 GEAR PRODUCTION MACHINES (Weightage- 18 , Hrs- 10)	
5a. Select relevant indexing and generating method for the given gear. 5b. Choose gear finishing method for the given job. 5c. Explain gear finishing method with sketch. 5d. Explain gear generating method with sketch.	5.1 Gear tooth elements, introduction to gear shaping 5.2 Working principle of gear shaping machine, gear shaping cutter. 5.3 Introduction to gear hobbing cutters, working principle of gear hobbing machine, Gear finishing.
UNIT 6 JIGS AND FIXTURES (Weightage- 14 , Hrs- 08)	
6a. Explain difference between jigs and fixture. 6b. Explain types of jigs and fixtures with sketches. 6c. Explain job holding devices with sketches.	6.1 Definition, Utility in production, Comparison, Principles of Locations, Fool proofing 6.2 Types of Jigs and fixtures 6.3 Job holding devices
UNIT 7 INTRODUCTION OF PRODUCTION PLANNING AND CONTROL (Weightage- 08 , Hrs- 06)	
7a. Explain meaning, scope, need of PPC 7b. Explain functions of PPC.	7.1 Meaning, scope and need of production planning and control 7.2 Outcomes and functions of production planning and control

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
SECTION I	
7c. Identify PPC organization for given example	7.3 Types of PPC organizations.

178. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Drilling machine and boring machine	07	04	04	04	12
II	Milling machine	14	04	04	04	12
III	Broaching machine	04	02	02	02	06
IV	Finishing and superfinishing processes	15	02	02	06	10
V	Gear production machines	10	04	04	10	18
VI	Jigs and Fixtures	08	04	04	06	14
VII	Introduction of production planning and control	06	02	02	04	08
Total		64	**22**	**22**	**36**	**80**

179. 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:

n. Prepare journals based on practical performed in laboratory.
o. Visit to manufacturing industries.
p. Write specifications of different machine tools observed during industrial visit.
q. Undertake micro projects

180. 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:

yyyy. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.

zzzz. 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).

aaaaa. With respect to item No.9 teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.

bbbbb. Guide student(s) in undertaking micro-projects.

ccccc. Use proper equivalent analogy to explain different concepts.

ddddd. Use Flash/Animations to explain various components, operation and

eeeee. Teacher should ask the students to go through instruction and Technical manuals

181. SUGGESTED MICRO-PROJECTS (Only for Class Declaration Courses)

Only one micro-project *is planned to be undertaken by a student that needs to be assigned to him/her.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 is given here. Similar micro-projects could be added by the concerned faculty:

j. Take any 5 components/ machine parts and identify machining processes required to manufacture it and plan the sequence of operations.
k. Prepare display board to demonstrate types of gears.
l. Prepare a report with detail specification of machines available in the institute workshop.

182. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	Workshop Technology Vol- II	Choudhary Hajara S.K., Media Promoters and Publishers Limited, Mumbai, 2005	ISBN: 9788185099156
2	Manufacturing Technology Vol - II	Rao P.N. McGraw Hill, New York, 2005	ISBN: 9781259029561
3	Production Technology Vol-II	Khanna O.P. Dhanpat Rai Publication, New Delhi, 2012	ISBN:10: 9383182032
4	Industrial Engineering and Production Mnagement	Martand Telsang. S.Chand & cOmpany ltd. New Delhi 2004	ISBN:10: 8121917735

183. SOFTWARE/LEARNING WEBSITES

60. http://nptel.ac.in
61. Simulation of machining processes from YouTube and educational websites.

184. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	-	1	2	1	1	2
CO2	2	1	-	2	1	2	2
CO3	2	1	1	2	1	2	3

CO4	2	2	1	1	2	2	3
CO5	1	-	2	-	1	2	3

	PSO1	PSO2
CO1	-	3
CO2	-	3
CO3	-	2
CO4	1	2
CO5	2	-

Sign: Name: Smt.S.S.Panpatil Shri.V.J.Deshpande (Course Expert /s)	Sign: Name: Dr.N.G.Kulkarni (Head of Department)
Sign: Name: Dr.N.G.Kulkarni (Program Head) (Head of Department)	Sign: Name: Shri A.S.Zanpure (CDC)

Government Polytechnic, Pune

'180OB' – **Scheme**

Programme	Diploma in ET/CE/EE//**ME**/MT/CM/IT/DDGM
Programme code	01/02/03/**04**/05/06/07/08/16/17/21/22/23/**24**/26
Name of Course	**Computer aided 3D Modeling.**
Course Code	**ME5101**
Prerequisite course code and name	**ME3101 (Machine Drawing)**

185. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			**Total Credits (L+T+P)**		**Examination Scheme**				
					Theory		**Practical**		**Total Marks**
L	**T**	**P**	**C**		**ESE**	**PA**	***ESE**	**PA**	150
1	0	04	05	**Marks**	--	50	50	50	
				Exam Duration	--	1 Hr	2 Hr		

(*):*POE (Practical Examination)*

Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, ESE-End semester examination, PA- Progressive Assessment.

186. RATIONALE

The market driven economy demands frequent changes in product design, data collection, analysis & retrieval at much faster rates. Computers play very important role in this diversified fields such as CAD, CAM, CIM and simulation etc. It is essential for a Diploma Technician to have a knowledge regarding the latest Solid Modeling software used in the industries and to acquire skill in operating different software's available such as Pro-E/ Creo, Catia, Solid Works, Unigraphics etc. This course deals with concepts of solid modeling to enhance modeling skills of diploma students.

187. COMPETENCY

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

- Develop 'Solid Models' of given machine components using any parametric CAD software.

188. 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**:**

1. Prepare 2D Drawing using sketcher workbench of any parametric CAD software.
2. Generate 3D Solid models from 2D sketch using Part workbench of any parametric CAD software.
3. Prepare assembly of part models using Assembly workbench of any parametric CAD software.
4. Generate orthographic views of 3D solid models/assemblies using drafting workbench of any parametric CAD software.
5. Plot/Print a drawing for given part model/assembly.

189. 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**:**

Ex.No	Unit No	Practical Exercises (Outcomes in Psychomotor Domain)	Relevent CO	Hrs
1	**1,2**	Introduction to Modeling software & it's environments. Draw 2D sketches of the machine parts using 3-D modeling software (Minimum 05)	01	08
2	**3**	Create simple parts using features like extrude, revolve, ribs, chamfer, fillet, hole, pattern etc. from the given orthographic views. (Minimum 5)	02	08
3	**5**	Prepare drawing template consisting of Name plate , boundary lines and projection symbol.	04	04
4	**5,6**	Generate drawing views of Parts created in Ex. No.-2 on the drawing template giving all dimensions and Print on A4 size paper.	04	04
5	**3**	Create complex parts using features extrude, revolve, sweep, ribs, chamfer, fillet, hole, pattern, draft, and shell etc. from the given pictorial view. (Minimum 5)	02	08
6	**5,6**	Generate drawing views of Parts created in Ex. No.-5 on the drawing template giving all dimensions and Print on A4 size paper.	04	04
7	**3,5,6**	Create 3D part models of individual components of any TWO assemblies consisting of at least five parts.(e.g. assembly of Bench Vice, Drill Jig, Joints, Couplings, Bearings, Valves, Screw Jack, Lathe Tool Post, I.C.Engine piston and connecting rod etc). Generate drawing views of the parts on the drawing template with dimensions and Print on A4 size paper.	02,04	16
8	**4,5,6**	Assemble parts created in Ex. No. 7. Generate orthographic views of assembly on the drawing	03,04	08

		template. Prepare Bill of material. Create one of the assembly views in Section. Print on A4 size paper.		
9	**4,5,6**	Create exploded view of assemblies created in Ex. No. 7.Generate view and print on A4 size paper.	03,04	04
			Total	**64**

S.No.	Performance Indicators	Weightage in %
mmm.	Use and selection of proper commands, Presentation and printing of drawings	40
nnn.	Able to answer oral questions	20
ooo.	Timely submission	20
ppp.	Attendance and punctuality.	20
Total		**100**

190. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No	Major Equipment/ Instruments Required	PrO. No.
1	Hardware: Desk Top PC. IntelCore i3 having Windows10 Pro 64 Bit with 8 GB RAM with 1TB hard disk.	All
2	ftware: Any parametric solid modelling software.	All
3	nter/ Plotter	10

191. THEORY COMPONENTS

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

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
UNIT 1. INTRODUCTION TO MODELING SOFTWARE (Weightage-N.A , Hrs- 02)	

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
1a. Use the 3D Modeling software. 1b.Explain use of all toolbars. 1c.Explain use of various working environments is Modeling software.	1.1 Introduction to CAD,CAM and CAE . Various available CAD software. Parametric, associative and feature based nature of CAD/modeling software. 1.2Tool bars:-Standard Toolbar, Sketch Toolbar, Relationship Toolbar ,View Toolbar, Drawing Toolbar, Feature Toolbar, Annotation Toolbar. 1.3Feature Manager Design Tree: Design Manager, Property Manager, Configuration Manager. 1.4Selection Method: Selection From Design Tree, Graphic Area
UNIT 2. SKETCHING WITH MODELING SOFTWARE(Weightage-N.A. , Hrs- 04)	
2a. Describe the given sketcher commands. 2b. Demonstrate the given modify Commands. 2c. Apply dimensioning and Geometrical Constraints	2.1 Drawing tools: Line, Rectangle, Circle, Arc, Ellipse, Spline, etc. 2.2 Editing tools: Trim, Extend, Erase, Mirror, etc. 2.3 Modify tools: Chamfer, Fillet, Copy, Move, etc. 2.4 Linear, angular dimensions. 2.5 Dimensioning constraint and Geometrical constraint. 2.6 Drawing template: prepare drawing template consisting of Name plate, boundary lines and projection symbol.
UNIT 3. PART MODELING (Weightage- N.A. , Hrs- 04)	
3a. Prepare 3D model of the part using different commands 3b.Use various editing and modifying commands. 3c. Describe intersection of given solid.	3.1 Working in 3D environment: Creating 3D Solid Models of simple machine parts. 3.2 Reference Geometry : Creating axis, Creating reference planes 3.3 Part tool: Extrude, Revolve, Sweep, Swept blend, Pattern, Hole, Rib etc. 3.4 Part Editing tool: Trim, Extend, Erase, Mirror, 3.5 Part Modify tool: Chamfer, Round, Copy, Move, Draft, Shell etc. 3.6 Intersect 2 solid components by inserting new body option. Boolean operations: Union, subtract, intersection.
UNIT 4. ASSEMBLY OF PARTS(Weightage-N.A., Hrs- 03)	
4a. Use assembly tools to create assembly of parts. 4b. Use explode command to get the exploded view of assembly..	4.1 Assembly toolbar, Feature manager deign tree conventions. 4.2 Assembly constraints. 4.3 Exploded view. Generating Exploded view. View manager tools.
UNIT 5. DRAWING ENVIRONMENT (Weightage- N.A. , Hrs- 02)	

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
5a. Use drawing module to create orthographic views of part model. 5b. Use drawing module to create orthographic views of given assembly. 5c. Prepare bill of material for assembly drawing.	5.1 Drawing environment. Using template in drawing. 5.2 Adding Model / assembly in drawing module. 5.3 Generating orthographic views, isometric views. Creating sectional views, auxiliary view, detailed view, exploded view. 5.4 Adding dimensions, notes, tolerances, surface roughness symbol, bill of material.
UNIT 6. PLOTTING AND PRINTING (Weightage-N.A. , Hrs- 01)	
6a. Plot / Print the drawing on sheet.	6.1 Plotters- Types of plotters and Printers. 6.2 Sheet setup. Page setup. Print selection, Print Preview and print document.

192. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

N.A.

193. 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:

r. Prepare journals based on practical performed inlaboratory.
s. Collect information about various CAD,CAM and CAE software used in industry,their applications and use.

194. 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:

fffff. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.

ggggg. 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).

hhhhh. Guide student(s) in undertaking micro-projects.

iiiii. Use proper equivalent analogy to explain different concepts.

jjjjj. Use LCD projector to explain all topics and experiments.
kkkkk. Teacher should ask the students to go through instruction and Technical manuals

195. SUGGESTED MICRO-PROJECTS

(Only for Class Declaration Courses)

Only one micro-project *is planned to be undertaken by a student that needs to be assigned to him/her.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 is given here. Similar micro-projects could be added by the concerned faculty:

a. 2D drawing: Each student will collect one or two drawings from the nearby industry/workshop and prepare model and generate 2D drawing production drawings from it.
b. 3D model: Each student will identify a small assembly from the institute workshop/laboratory. Measure the dimensions of each part and prepare sketches. Using sketches prepared 3D model of parts and assembly. Plot the assembly and detail drawings. (eg. Bench vice, Machine vice, Tool post, Couplings, Joints, Bearings etc.)
c. Create models for parts to be manufactured in their manufacturing type of project and generate assembly and detail drawings.

196. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	CATIA for Designers.	Sham Tickoo	Softcover,Cadcim Technologies
2	Pro/Engieer Wildfire 5.0 for Designers	Sham Tickoo	Softcover,Cadcim Technologies
3	Solid Works for Designers	Sham Tickoo	Softcover,Cadcim Technologies
4	Autodesk Inventor for Designers. Release 10.	Sham Tickoo	Softcover,Cadcim Technologies
5	NX4 for designers	Sham Tickoo, Deepak Maini	Softcover,Cadcim Technologies

6	CAD/CAM	M Groover	Pearson Education

197. SOFTWARE/LEARNING WEBSITES

62. www.nptel.com
63. https://en.wikipedia.org/
64. www.slideshare.net/
65. http://www.solidworks.inlsw/products/3d-cad/3d-solid-modeling.htm
66. https:llwww.youtube.com/watch?v=vjX4PDJcFOI
67. https://www.youtube.com/watch?v=5BDHS4FN2-
68. https:llwww.youtube.com/watch?v=JjKs-lePlPY
69. https://www.youtube.com/watch?v=LaPp6DiYdOY&list=PLbjkHL0f0OsgqYNDDMhk4EOh_pbNRinc6
70. https://www.youtube.com/watch?v=MoHbGBb5_HE&list=PLbjkHL0f0OsgqYNDDMhk4EOh_pbNRinc6&index=2
71. https://www.youtube.com/watch?v=EfBVhLoWCqc&list=PLbjkHL0f0OsgqYNDDMhk4EOh_pbNRinc6&index=3
72. https://www.youtube.com/watch?v=2ahR_9M9DVs&list=PLbjkHL0f0OsgqYNDDMhk4EOh_pbNRinc6&index=4
73. https://www.youtube.com/watch?v=Z5ALvJf3sn0&list=PLbjkHL0f0OsgqYNDDMhk4EOh_pbNRinc6&index=5
74. https://www.youtube.com/watch?v=ku3u6jcaJtY&list=PLbjkHL0f0OsgqYNDDMhk4EOh_pbNRinc6&index=6
75. https://www.youtube.com/watch?v=R00W6bstVe4&list=PLbjkHL0f0OsgqYNDDMhk4EOh_pbNRinc6&index=9
76. https://www.youtube.com/watch?v=vSBp4ZXntSU&list=PLbjkHL0f0OsgqYNDDMhk4EOh_pbNRinc6&index=10
77. https://www.youtube.com/watch?v=UH_6-JigVcY&list=PLbjkHL0f0OsgqYNDDMhk4EOh_pbNRinc6&index=20
78. https://www.youtube.com/watch?v=6glpCzXvCbw
79. https://www.youtube.com/watch?v=Xf953H-WHqg
80. https://www.youtube.com/watch?v=xCR6wK1avyc
81. https://www.youtube.com/watch?v=OooD3Qib_q0
82. https://www.youtube.com/watch?v=5u4-xMnl2aQ
83. https://www.youtube.com/watch?v=hA27dgnjI9Y
84. https://www.youtube.com/watch?v=hpMFQnyqfg8
85. https://www.youtube.com/watch?v=IyJMksXemsA
86. https://www.youtube.com/watch?v=UH_6-JigVcY&list=PLbjkHL0f0OsgqYNDDMhk4EOh_pbNRinc6&index=20
87. https://www.youtube.com/watch?v=1DSJ795_3i0
88. https://www.youtube.com/watch?v=rK-4O0E6pCA
89. https://www.youtube.com/watch?v=JPJ2WXOCvyM
90. https://www.youtube.com/watch?v=CeK17bZo2k4
91. https://www.youtube.com/watch?v=QvWGAMLFxTY&list=PLbjkHL0f0OsgqYNDDMhk4EOh_pbNRinc6&index=18
92. https://www.youtube.com/watch?v=_qo7wUJbHf4
93. https://www.youtube.com/watch?v=Gsdy5cK5V8E

198. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	1	-	-	1	2
CO2	3	3	1	2	-	1	2
CO3	3	3	1	2	-	1	2
CO4	3	3	1	2	-	1	2
CO5	2	2	-	-	-	-	-

	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

Sign: Name: M.W.Giridhar. C.S.Ghadge. (Course Expert /s)	Sign: Name: Dr.N.G.Kulkarni. (Head of Department)
Sign: Name: Dr.N.G.Kulkarni. (Program Head) (Mechanical Dept.)	Sign: Name: Shri A.S.Zanpure (CDC)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diplôma in ME
Programme code	04
Name of Course	**Refrigeration and Air Conditioning**
Course Code	**ME 5102**
Prerequisite course code and name	Thermal Engineering (ME 3102), L1

199. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	**ESE**	**PA**	150
3		2	5	**Marks**	80	20	25	25	
				Exam Duration	03	01	02		

***(*):** Under the theory PA, Out of 20 marks, 10 marks are for micro-project assessment*
Legends: L- lecture,T-Tutorial/teacher guided theory practice,P-practical,ESE-End semester examination,PA- Progressive Assesment.

200. RATIONALE

The 21st century predicts revolutionary developments in Heating, Ventilation and Air Conditioning. Considering the wide and increasing use of Heating, Ventilation and Air Conditioning for domestic, commercial and industrial applications and the challenges put in it is absolutely necessary that Diploma Engineers should learn these systems. They should know the processes, equipment, systems of Heating, Ventilation and Air Conditioning with their functioning, maintenance, repairs and measures to meet the current demand

201. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- Maintain refrigeration and air-conditioning systems.

202. 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**:**

1 Calculate COP of given refrigeration system.
2 Select different systems of refrigeration and air conditioning for given application.
3 Select different refrigeration components and refrigerants for given refrigeration and air conditioning applications.
4 Calculate psychometric properties using psychometric chart.
5 Determine cooling loads for Air-conditioning systems.

203. 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**:**

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1	1	Identify different components of Vapor compression cycle with their specification	1	2
2	1	Determine COP of given Vapor compression system	1	2
3	1	Demonstrate construction of Vapor absorption refrigeration System	1	2
4	2	Identify refrigerant for given applications	3	2
5	2	Demonstrate Leak Testing, Evacuation and Refrigerant charging process of any refrigeration system.	2	2
6	3	Dismantle hermitically Sealed compressor	3	2
7	3	Assemble hermitically Sealed compressor	3	2
8	3	Demonstrate construction of Ice plant	3	4
9	3	Identify different components of Household refrigerator	2	2
10	4	Determine air properties using Psychrometer	4	2
11	5	Calculate cooling load of given laboratory	4,5	2
12	6	Determine the refrigeration capacity of unitary air conditioner	1,4,5	4
13	6	Identify different components of window/split air conditioner	2	2
14	6	Identify different components and control systems of Car air conditioner	2	2
15	6	Perform piping operations like tube/pipe cutting, swedging, bending, flaring and brazing	2	2
		Total Hrs		**32**

(Note-Any minimum ten laboratory experiments from above needs to be performed in the laboratory)

S.No.	Performance Indicators	Weightage in %
qqq.	Arrangement of available equipment or model	20
rrr.	Setting and operation	20
sss.	Safety measures	10

S.No.	Performance Indicators	Weightage in %
ttt.	Observations and Recording	20
uuu.	Interpretation of result and Conclusion	10
vvv.	Answer to sample questions	10
www.	Submission of report in time	10
Total		**100**

204. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	PrO. No.
59	Vapour compression Test rig consisting of Hermetically sealed compressor 1TR capacity, Air cooled condenser, Expansion devices like TEV and capillary tube, Evaporator coils.	1,2
60	Water cooler test rig up to 100 liters capacity- consisting of Hermetically sealed compressor 1.5 TR capacity, Forced Air cooled condenser, Expansion devices like TEV and capillary tube, Evaporator coils	1,2
61	Aqua- Ammonia Vapour Absorption Refrigeration Test rig	3
62	Ice plant test Rig- consisting of Hermetically sealed compressor 2TR capacity, Forced Air cooled condenser, Expansion devices like TEV and capillary tube, Evaporator coils, brine tank, Stirrer	8
63	Household refrigerator cut section model	7
64	Hermetically sealed compressor	6,7
65	Psychrometer digital	10,11
66	Anemometer	11,12
67	Window air conditioner cut section Model	13
68	Split / Window air conditioner test rig r- consisting of Hermetically sealed compressor 1.5 TR capacity, Forced Air cooled condenser, Expansion devices like TEV and capillary tube, Evaporator coils	12,13
69	Refrigerant Cylindersr12,R 22, R 134a, R 60` a, R602a9Qty one each)	5
70	Charging kit with vacuum pump, Brazing Tool, Halide torch, flaring tools, swaging Tools, bending tool	5,15
71	Working model of Car air conditioner	14

205. THEORY COMPONENTS

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

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
SECTION 1(Refrigeration)	
UNIT 1.Refrigeration Cycles(Weightage-16 , Hrs-10)	

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
1a. Define basic terminologies of refrigeration 1b. Represent Bell- Colemen cycle on P-v and T-s digram 1c. Calculate Actual and theoretical COP of given Vapour compression cycle. 1d. Represent VCC on P-H and T-S diagram for different conditions. 1e. Calculate the refrigeration capacity for the given system 1f. State functions of different components used in Vapour Absorption refrigeration system 1g. Explain working of different vapour absorption system	1.1 Necessity of Refrigeration, Unit of Refrigeration, concept of COP (actual and Theoretical) 1.2 Bell-Coleman cycle and its representation on P-V and T-S diagram with simple numerical. 1.3 Principle of Vapor Compression Cycle, Main components, Representation on P-H and T-S diagram, conditions- dry compression, effect of superheating, effect of under cooling, Calculation of Refrigeration capacity and Power required 1.4 Vapor Absorption Cycle -- principle, its component, working of Aqua – Ammonia Vapour absorption system, working of Li-Br absorption system, Electrolux refrigerator- working, main components, applications. Comparison between Vapour Compression system. and Vapour absorption system
UNIT 2 Refrigerants (Weightage- 08 , Hrs- 04)	
2a. List desirable properties of refrigerant 2b. Classify refrigerants 2c. Designate refrigerant 2d. Explain the effect of Refrigerant on Environment 2e. State the legislation imposed for controlling environment degradation by refrigerant.	2.1 Refrigerants, desirable properties, classification, designation of refrigerant, selection of refrigerant for relevant applications, 2.2 System vacuumization Charging processes, leak testing methods and process. 2.3 Montreal protocol, Kyoto protocol. Concept of Ozone Layer Depletion, Green House effect, Global warming, Eco friendly Refrigerants.
UNIT 3 Vapor Compression Refrigeration Components and Systems (Weightage-16 , Hrs- 10)	
3a. Explain working of Refrigeration compressor for given refrigeration system. 3b. Select condenser for given refrigeration system with justification.	3.1 Refrigeration compressor, classifications, construction and working of hermetically sealed compressor, open type compressor, rotary compressors- centrifugal, Screw and Scroll compressors and their applications. 3.2 Condensers- classifications, working of air and water-cooled condensers, evaporative condensers, comparison and applications.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
3c. Explain construction and working of evaporator for given refrigeration system 3d. Select relevant Expansion device for given refrigeration system with justification. 3e. Explain the working of specified auxiliary devices used in refrigeration system 3f. Describe the working of different applications of vapour compression refrigeration system.	3.3 Evaporators- Classification- working of finned type, bared tube, plate type, flooded, shell and tube type evaporators, their applications. Chillers- Direct expansion and flooded type chillers, working and applications. 3.4 Expansion device- classifications, capillary tube, automatic expansion valve, thermostatic expansion valve, selection, working and application. 3.5 Other components- Drier, Solenoid valve, Thermostatic switch, defrosting devices, working and applications 3.6 Applications of Refrigeration, House hold refrigerators, Water coolers, name of Manufacturers and their products with capacity.
SECTION II (Airconditioning)	
UNIT 4 Psychrometry (Weightage-10 , Hrs- 06)	
4a. Represent the given psychrometric processes in Psychrometric chart 4b. Select relevant auxiliary components for given air conditioning system. 4c. Describe the procedure to maintain the given air conditioning component	4.1 Air conditioning- necessity, types of air conditioning- comfort air conditioning, industrial air conditioning, applications. 4.2 Principle of Psychrometry, DBT,WBT DPT,RH etc Dalton's law of partial pressure, air properties referring to ASHRAE Handbook. 4.3 Psychrometric processes, Representation of processes on Psychrometric. chart. Types and construction of Psychrometers. 4.4 Components used for air conditioning-Humidifiers, dehumidifiers, filters, heating and cooling coils.
UNIT 5 Cooling Load Calculation (Weightage- 10 , Hrs- 06)	
5a. List human comfort conditions 5b. Identify the relevant sources of heat gain for the given situation with justification. 5c. Calculate cooling load for the given situation	5.1 Comfort condition, heat exchange by human body with environment, factors affecting on human comfort. 5.2 Calculation of Sensible and Latent heat gain sources. 5.3 Cooling load calculation for- CAD LAB, HMED Cabin,. auditorium, Metrology laboratory, class room
UNIT 6 Air Conditioning Systems(Weightage- 20 , Hrs- 12)	
6a. Classify Air conditioning system 6b. Explain working of Unitary air conditioning system	6.1 Classification of air conditioning system- Summer and winter, Year around air conditioning, construction, application, comparison. 6.2 Construction and working of window, split, package type air conditioners.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
6c. Explain the constructional features of central air conditioning 6d. Select relevant components for given air distribution system 6e. Select the insulating material for given air conditioning system. 6f. Describe the procedure to maintain the given type of air conditioning system 6g. Explain working of Automobile Air conditioning System	6.3 Central air conditioning- types, direct and indirect central air conditioning construction, capacity, application. 6.4 Concept of air handling unit, air distribution system- closed perimeter system, extended perimeter system, radial duct system, losses in ducts, construction and application of supply, return and make up ducts, grills diffusers, types of fans and blowers. 6.5 Insulation- purpose, types of insulation, material and their properties. 6.6 Automobile Air conditioning system- working, different sensors and components. Climatic control system.

206. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	**Refrigeration Cycle**	10	4	4	8	16
II	**Refrigerants**	04	2	2	4	08
III	**Vapor Compression Refrigeration Components and Systems**	10	4	4	8	16
IV	**Psychrometry**	06	2	2	6	10
V	**Cooling Load Calculation**	06	2	2	6	10
VI	**Air Conditioning Systems**	12	4	4	12	20
Total		48	**18**	**18**	**44**	**80**

207. 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) Prepare journals based on practical performed in laboratory.
b) Follow the safety precautions.
c) Use various mechanical measuring instruments and equipment related to Heating, Ventilation and air conditioning
d) Read and use specifications of the Refrigeration and air conditioning equipment.
e) Library / Internet survey of HVAC systems
f) Prepare power point presentation or animation for understanding constructional details and working of different Centralised air conditioning systems.
g) Visit nearby malls/auditoriums/commercial complex/Dairy/Cold storages/Ice cream factory/Ice plant/Cinema Theaters to identify different components of Refrigeration and air conditioning system.

208. 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:

lllll. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.

mmmmm. 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).

nnnnn. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.

ooooo. Guide student(s) in undertaking micro-projects.

ppppp. Correlate subtopics with actual domestic and industrial Refrigeration and air conditioning systems.

qqqqq. Use proper equivalent analogy to explain different concepts related to Psychrometry.

rrrrr. Use Flash/Animations to explain various applications of Refrigeration and air conditioning.

209. 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 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 is given here. Similar micro-projects could be added by the concerned faculty:

a) Prepare a duct layout of your institute building from AHU
b) Prepare a chart of showing all the components of house hold refrigerator.
c) Prepare a demonstration model of cold storage.
d) Measure Refrigeration capacity of split air conditioner.
e) Collect different air outlet devices used in Central air conditioning system
f) Download Manufacturer,s catalogue of Refrigeration compressors.
g) Prepare display chart of types of refrigerant used in commercial and Industrial applications.
h) Visit to nearby Central air conditioning plant/Malls/Showrooms and collect information regarding air conditioning
i) Conduct market survey of household refrigerators, make, capacity, arrangement, features, commercial terms etc.
j) Conduct market survey of window air conditioner make, capacity, arrangement, features, commercial terms etc.
k) Collect information of automobile air conditioning of different vehicles.
l) Comparative study of various types of compressors with detailed specification & market survey.
m) Comparative study of various types of condensers with detailed specification & market survey.

n) Comparative study of various types of evaporators with detailed specification & market survey.
o) Comparative study of various types of expansion devices with detailed specification & market survey.
p) Study of different types of refrigerants with properties, designation, selection & applications.
q) Comparative study of different types of central air-conditioning system with detailed specification and visit analysis report. (viz. AHU,FCU,VAV)

210. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	Refrigeration and Air conditioning	Khurmi R. S.	S Chand publication, New Delhi, (2008), ISBN-10: 8121927811
2	Refrigeration and Air conditioning	Arora C. P.	Tata McGrawHill Publication, New Delhi, (2009), ISBN-13-978-07-008390-5
3	Basic Refrigeration and Air conditioning	Ananthnarayan P. M.	Tata McGrawHill Publication, New Delhi, (2013), ISBN-9781259062704
4	Refrigeration and Air conditioning	Sapali S. N.	PHI publication, New Delhi, (2013) ISBN - 9788120348721
5	Refrigeration and Air conditioning	Prasad Manohar	New Age International, New Delhi, (2011), ISBN- 9788122414295
6	Refrigeration and Air conditioning	Ameen Ahmdul	PHI Publication, New Delhi, ISBN - 9788120326712
7	Principles of refrigeration	Dossat R. J.	John Wiley and Sons Ltd, UK, (2009) ISBN 978-0130272706
8	ASHRAE Handbook	American Society of Heating, Refrigerating and Air-Conditioning Engineers	Amer Society of Heating; Har/Cdr edition (30 June 2016)

211. SOFTWARE/LEARNING WEBSITES

a. www.youtube.com/watch?v=52P0KbTNvok
b. www.youtube.com/watch?v=OXIZhqypNUI
c. www.youtube.com/watch?v=cobFAMZDS0o&start_radio=1&list=RDcobFAMZDS0o
d. www.youtube.com/watch?v=cobFAMZDS0o&list=RDcobFAMZDS0o&index=1
e. www.youtube.com/watch?v=Ll8Ku-mFQxE
f. www.youtube.com/watch?v=yQGFmBBvw1g&t=134s
g. www.youtube.com/watch?v=GSWt0zjLgIY
h. www.youtube.com/watch?v=PL0vU02QC4w
i. www.youtube.com/watch?v=lMqoKLli0Y4
j. www.youtube.com/watch?v=oSLOHCOw3yg
k. www.youtube.com/watch?v=6UMqdD6ejZQ
l. www.youtube.com/watch?v=7FxltQ41bZc

212. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	-	3	1`	1	2
CO2	2	2	1	-	2	1	2
CO3	3	2	1	-	3	1	3
CO4	3	2	2	1	-	1	2
CO5	3	2	1	2	2	2	1

	PSO1	PSO2
CO1	-	2
CO2	-	-
CO3	-	-
CO4	2	-
CO5	2	1

Sign: Name 1- Mr.A..S. Zanpure 2- Mr. V. J .Deshpande (Course Expert /s)	Sign: Name: Dr. N.G.Kulkarni (Head of Department)
.Sign: Name: Dr. N.G.Kulkarni (Head of Department)	Sign: Name: Shri A.S.Zanpure (CDC)

Government Polytechnic, Pune

'180OB'– Scheme

Programme	Diplôma in ME
Programme code	04/18
Name of Course	**Tool Engineering**
Course Code	**ME 5105**
Prerequisite course code and name	

213. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	**ESE**	**PA**	150
3		2	5	**Marks**	80	20	25	25	
				Exam Duration		03			

***(*):** Under the theory PA, Out of 20 marks, 10 marks are for micro-project assessment*
Legends: L- lecture,T-Tutorial/teacher guided theory practice,P-practical,ESE-End semester examination,PA- Progressive Assesment.

214. RATIONALE

Tools are basic component required for any machining process. The quality and efficiency of any machining operation basically depends upon quality of tools which in turn depends upon the proper shape, size and material of the tools. Productivity and quality of machining operations may further be enhanced by proper and quick mounting of tools and jobs on machines using suitable Jigs and Fixtures. Therefore, this course attempts to develop abilities in students to select a tool of proper size and shape for required machining operation. The design of basic cutting tools, jigs and fixtures are also dealt with in this course

215. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Use different types of tools, dies, jigs and fixtures to machine simple components**

216. 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**:**

1. Select proper tool for manufacturing operations.
2. Interpret designation system of cutting tools and tool holders.
3. Select locating and clamping devices for components.

4. Select jig and fixture for components.
5. Use various press tools and dies for given press tools operation.

217. 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**:**

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1	1	Identify different types of tools, and their designation.	1	2
2	2	Draw the cutting tool nomenclatureof a given single point cutting tool.	2	2
3	2	Re-sharpen any one Single Point Cutting Tool as per given specification	2	2
4	2	Determine forces on tool by merchant's circle	2	2
5	3	Identify multipoint cutting tools available in the workshop with their designation	3	2
6	3	Select relevant cutting fluid for different machine tools available in workshop with justification	3	2
7	4	Design a Jig and Fixture for machining of a given simple component	4	2
8	4	Draw assembly and detail drawing of the designed Jig.	4	4
9	4	Draw assembly and detail drawing of the designed Fixture.	4	4
10	5	Design a progressive cutting die for a simple component.	5	2
11	5	Draw assembly and detail drawing of the designed progressive cutting die	5	4
12	6	Design a bending dies for given component	5	2
13	6	Draw bending die indicating all parts and dimensions	5	2
		Total Hrs		**32**

S.No.	Performance Indicators	Weightage in %
xxx.	Arrangement of availableequipment or model	20
yyy.	Setting and operation	20
zzz.	Safety measures	10
aaaa.	Observations and Recording	20
bbbb.	Interpretation of result and Conclusion	10
cccc.	Answer to sample questions	10
dddd.	Submission of report in time	10
Total		**100**

218. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	PrO.No.
72	Single point cutting tool- 2 Qty	1,2,3,4
73	Drill – M12/M16/M20 size	5
74	Grinding Machine- Grinder Size 100 mm min.	2
75	Different Types of Cutting Fluid (any 4)	6

219. THEORY COMPONENTS

The following topics/subtopicsshould betaught and assessed in order to develop UOs for achieving the COs to attain the identified competency**.**

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
SECTION 1	
UNIT 1.Mechanics of Metal Cutting (Weightage-08 , Hrs-04)	
1h. State the mechanism of chip formation 1i. Differentiate ASA and ORS system 1j. Classify chips 1k. Define Machinability Index	1.1 Introduction, mechanics of chip formation 1.2 Single point tool geometry- ASA System, ORS System, importance of tool angles 1.3 Methods of machining- orthogonal and oblique cutting 1.4 Types of chips, tool materials 1.5 Machinability – index, chip breakers
UNIT 2 Design of Single Point Cutting Tool (Weightage-18 , Hrs- 10)	
2f. State the shear angle required for the given job with justification 2g. Estimate cutting forces in the given simple numerical problem situation 2h. List factors affecting on Tool life 2i. Calculate Tool life of a given tool.	2.4 Shear angle and its determination 2.5 Velocities in metal cutting processes, determination of un-deformed chip thickness 2.6 Force relations, merchant's circle, theory of Lee and Shaffer, cutting power, MRR, energy consideration in metal cutting, oblique cutting 2.7 Tool wear- types, tool life- definition, criteria, variables affecting tool life 2.8 Types of single point cutting tools- solid tools, tipped tools, dimensions of tool shank 2.9 Economics of metal cutting (problems on tool angles and on tool life
UNIT 3 Design of Multi Point Cutting Tool and cutting Fluids (Weightage-14 , Hrs- 10)	
3a. Design Milling cutter and drill for given operation 3b. Classify cutting fluids 3c. Write applications of Cutting fluid 3d. State the necessity of Form tool	3.1 Design of milling cutter 3.2 Design of drills 3.3 Cutting fluids- requirement, types, application, selection of cutting fluids 3.4 Form Tools-necessity, types, applications

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
SECTION II	
UNIT 4Jigs and Fixtures (Weightage-14 , Hrs- 08)	
4a. Concept, definition locating and clamping. 4b. Use of locating and clamping principles on shop floor 4c. Jigs- Types construction, working and applications. 4d. Fixtures - Types construction, working and Applications 4e. Design considerations and procedure for designing of Jigs andFixtures	4.1 Introduction, definition, principle of pin location, design principle for location purposes 4.2 Clamping- principles devices 4.3 Design principles for jigs and fixtures 4.4 Drilling jigs- design principles, bushes, types 4.5 Design principles of milling fixtures, lathe fixtures, assembly fixtures 4.6 Jigs and fixture construction- casting, fabrication, welding and comparison
UNIT 5-- Press working and Cutting Dies (Weightage-14 , Hrs- 08)	
5d. Select suitable press tool operation for the given simple press tool component with justification. 5e. Prepare scrap strip layout for the given press tool component 5f. Design progressive cutting die for the given simple press tool component 5g. Design Blanking die for the given simple press tool component	5.1 Introduction, definitions of various press operations, types of press, press working terminology 5.2 Cutting dies- types, principle , scrap strip layout, clearance applications, cutting forces, methods to reduce cutting forces , minimum diameter of piercing 5.7 Design of progressive cutting die: a) Sketch the component. b) Prepare scrap strip layout. c) Calculate tonnage. d) Determine centre of pressure. e) Determine dimensions of punches, die block and die shoe. f) Prepare sketch of stripper plate. g) General assembly sketch of punches arrangement, die block, die shoe and stripper plate. 5.3 Strippers- types, stock stop- latch stop, automatic stop, solid stop, strip feeding, knock-outs 5.4 Blanking dies- types, die block, die block thickness, die opening, fastening of die block, punch, backup plate, centre of pressure
UNIT 6 Drawing, Bending and Forging Dies (Weightage-12 , Hrs- 08)	
6h. Calculate bend radius, bend allowance and spring back for the given simple part. 6i. Draw labeled sketch of the given die(s).	6.1 Drawing dies- design consideration, types, no. of draws, drawing pressure, blank holding pressure, redraw dies 6.2 Bending dies- bending methods, design principles, spring back, bending pressure

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
6j. Select die(s) for the given part with justification.	6.3 Forging dies- open die forging and closed die forging, Forging design factors- draft, fillet, parting line, shrinkage and die wear, mismatch, finish allowances, tolerance, webs and ribs

220. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Mechanics of Metal Cutting	04	2	2	4	08
II	Design of Single Point Cutting Tool	10	4	6	8	18
III	Design of Multi Point Cutting Tool and cutting Fluids	10	2	4	8	14
IV	Jigs and Fixtures	08	2	4	8	14
V	Press working and Cutting Dies	08	2	4	8	14
VI	Drawing, Bending and Forging Dies	08	2	2	8	12
Total		48	**14**	**22**	**44**	**80**

221. 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:

t. Visit any industry and collect information related to tool engineering practices.
u. Prepare journal based on practical performed in Tool Engineering laboratory. Journal consists of drawing, observations, required materials, tools, equipments, date of performance with teacher signature.
v. Prepare/Download specifications of followings:
    i. Tools and equipment in Tool engineering laboratory.
    ii. Machineries in Tool Engineering laboratory
w. Undertake a market survey of local dealers for tools, equipments; machineries and raw material and prepare a report.
x. Visit to any press tool industry and prepare a report consisting of
    i. Types of press
    ii. Types of dies
    iii. Types of operations
    iv. Types of fool proofing arrangement
    v. Safety precautions observed.

222. 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:

sssss. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.

ttttt. 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).

uuuuu. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.

vvvvv. Guide student(s) in undertaking micro-projects.

wwwww. Correlate subtopics with power plant system and equipment.

xxxxx. Use proper equivalent analogy to explain different concepts.

yyyyy. Use Flash/Animations to explain various components, operation and

zzzzz. Teacher should ask the students to go through instruction and Technical manuals

223. 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 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 is given here. Similar micro-projects could be added by the concerned faculty:

a. Preparation of Wax/Rubber model of various dies/single point cutting tools.
b. Collect various Carbide inserts as per ISO specification.
c. Measure press capacity of any press available in industry or nearby industry.
d. Design simple Clamming devices/Jigs/Fixtures/locating for simple jobs.
e. Collect specifications of different Jigs and fixtures.
f. Sketch different jigs /fixtures/clamping devices available in institute workshop.
g. Identify and restrict degree of freedom of a given component for designing a clamping/locating device for a given machining operation.

224. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	Tool Engineering and Design	Nagpal G. H.	Khanna Publication, 2003 ISBN : 817409203X
2	Tool Design	Donaldson Cyril	TATA Mcgraw Hill Education, 2000 ISBN: 9780070153929, 0070153922
3	Tool Engineering, Jigs and Fixture	Atkins Albert	McGraw-Hill, 1922 ISBN/ASIN: 1151454966
4	Fundamentals of Tool Engineering Design	Basu S. K.	Oxford Ibh, 1979 ISBN 812040016X, 9788120400160

5	Machine tool and Tool Design	Sharma P. C.	S.Chand Publishing, 2012 SBN: 9788121923620,
6	Fundamentals of tool design	ASTME	Prentice hall of India
7	Principles of tool & jig design	M. H. A. Kempster	English Universities Press;

225. SOFTWARE/LEARNING WEBSITES

m. https://www.youtube.com/watch?v=Mn9jpqI8rao
n. https://www.youtube.com/watch?v=bUrp8JMRwx4andvl=en
o. https://www.youtube.com/watch?v=qaG_vxsfLUg
p. https://www.youtube.com/watch?v=EgTzD_8dUFc
q. https://www.youtube.com/watch?v=CrWxJ58la1E
r. https://www.youtube.com/watch?v=Pb20Rkx25yA
s. https://www.youtube.com/watch?v=Hp7UC5ite5M
t. https://www.youtube.com/watch?v=lcrK2Po8fJI
u. https://www.youtube.com/watch?v=_E1GCE2dDcY
v. https://www.youtube.com/watch?v=7yzvno4AvKw
w. https://www.youtube.com/watch?v=yoUxqeAN0So
x. https://www.youtube.com/watch?v=_r7djWX8X34
y. https://www.youtube.com/watch?v=Us7kjBmRL-Q
z. https://www.youtube.com/watch?v=S9qzJat3Mzk
aa. https://www.youtube.com/watch?v=I71YrXafg0o
bb. https://www.youtube.com/watch?v=wulJZzORm3wandpbjreload=10
cc. https://www.youtube.com/watch?v=i5ZGSMXw5nU
dd. https://www.youtube.com/watch?v=WJ_VlWd0EsA
ee. https://www.youtube.com/watch?v=93-VH01ACB4
ff. https://www.youtube.com/watch?v=MtNTFvP0uAI
gg. https://www.youtube.com/watch?v=eqKa2gv9Kx0
hh. https://www.youtube.com/watch?v=m8EoGASM0SI
ii. https://www.youtube.com/watch?v=til4UOBTRg0
jj.

226. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	-	-	-	-	2	1
CO2	2	-	-	1	1	1	3
CO3	3	1	-	1	-	1	3
CO4	3	2	2	1	1	1	2
CO5	3	2	3	-	1	1	3

	PSO1	PSO2
CO1	-	2
CO2	-	*2*

Sign: Name Mr. N.B Hirlekar Mr. V J Deshpande (Course Expert /s)	Sign: Name: Dr. N.G.Kulkarni (Head of Department)
.Sign: Name: Dr. N.G.Kulkarni (Head of Department)	Sign: Name: ShriA.S.Zanpure (CDC)