MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION (MSBTE)

I – Scheme
I – Semester Course Curriculum

Course Title: **Workshop Practice** (FG, AE, ME, PT, EE, CE, CH, PS)
(Course Code: .....)

Diploma programme in which this course is offered	Semester in which offered
Mechanical, Production Technology, Automobile, Fabrication Technology and Erection Engineering, Civil, Electrical, Chemical, Plastics Engineering	First

1. RATIONALE

Workshop Practice is a basic practical engineering course. The knowledge of basic workshops such as wood working, fitting, welding, plumbing and sheet metal shop is essential for technician to perform his/her duties in industries. Students are able to perform various operations using hand tool equipment and machineries in various shops. Working in workshop develops the attitude of group working and safety awareness. This course provides miniature industrial environment in the educational institute.

2. COMPETENCY

The course should be taught and implemented with the aim to develop the course outcomes (COs) so that student demonstrates the following competency needed by the industry:

- **Prepare simple jobs on the shop floor of the engineering workshop.**

3. COURSE OUTCOMES (COs)

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

a. Select tools and machinery according to job.
b. Use hand tools in different shops for performing different operation.
c. Operate equipment and machinery in different shops.
d. Prepare job according to drawing.
e. Maintain workshop related tools, equipment and machinery.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
1#	0	4	4	-	-	50	50~[2]	100

(~[2]): *For the **practical only courses,** the PA has two components under practical marks i.e. the assessment of practicals (seen in section 6) has a weightage of 60% (i.e.30 marks) and micro-project assessment (seen in section 12) has a weightage of 40% (i.e.20 marks). This is designed to facilitate attainment of COs holistically, as there is no theory ESE.*

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

5. COURSE MAP (with sample COs, Learning Outcomes i.e.LOs and topics)

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

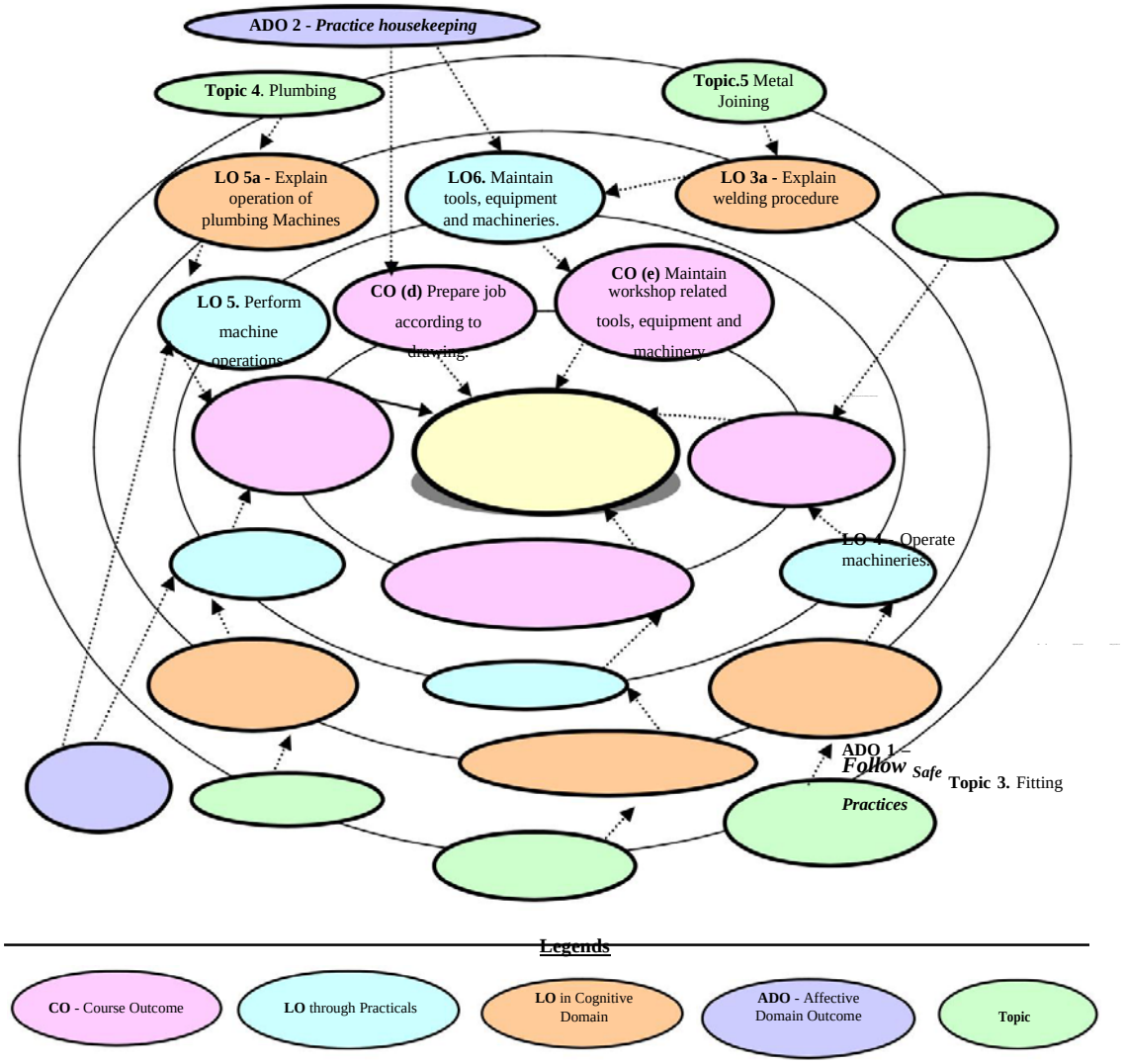

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals/exercises/tutorials in this section are psychomotor domain LOs (i.e. sub-components of the COs), to be developed and assessed in the student to lead to the attainment of the competency.

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
1	Perform mock drill session in group of minimum 10 students for extinguishing fire – Part I	I	2*
2	Perform mock drill session in group of minimum 10 students for	I	2

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
	extinguishing fire – Part II		
3	Prepare job with following operations: – Part I a. Marking operation as per drawing b. punching operation as per drawing c. filing operation as per drawing d. chamfering operation as per drawing e. sawing operation as per drawing f. drilling operation as per drawing g. tapping operation as per drawing	II	2*
4	Prepare job with following operations: – Part II a. Marking operation as per drawing b. punching operation as per drawing c. filing operation as per drawing d. chamfering operation as per drawing e. sawing operation as per drawing f. drilling operation as per drawing g. tapping operation as per drawing	II	2
5	Prepare job with following operations: – Part III a. Marking operation as per drawing b. punching operation as per drawing c. filing operation as per drawing d. chamfering operation as per drawing e. sawing operation as per drawing f. drilling operation as per drawing g. tapping operation as per drawing	II	2
6	Prepare job with following operations: – Part IV a. Marking operation as per drawing b. punching operation as per drawing c. filing operation as per drawing d. chamfering operation as per drawing e. sawing operation as per drawing f. drilling operation as per drawing g. tapping operation as per drawing	II	2
7	Prepare job with following operations: – Part V a. Marking operation as per drawing b. punching operation as per drawing c. filing operation as per drawing d. chamfering operation as per drawing e. sawing operation as per drawing f. drilling operation as per drawing g. tapping operation as per drawing	II	2
8	Prepare job with following operations: – Part VI a. Marking operation as per drawing b. punching operation as per drawing c. filing operation as per drawing d. chamfering operation as per drawing e. sawing operation as per drawing	II	2

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
	f. drilling operation as per drawing g. tapping operation as per drawing		
9	Prepare job with following operations: – Part VII a. Marking operation as per drawing b. punching operation as per drawing c. filing operation as per drawing d. chamfering operation as per drawing e. sawing operation as per drawing f. drilling operation as per drawing g. tapping operation as per drawing	II	2
10	Prepare T joint pipe fitting job as per given drawing (individually)	III	2*
11	Prepare elbow joint pipe fitting job as per given drawing	III	2*
12	Prepare bill of material for given pipeline layout – Part I	III	2*
13	Prepare bill of material for given pipeline layout – Part II	III	2
14	Prepare lap joint using gas welding as per given drawing – Part I	IV	2*
15	Prepare lap joint using gas welding as per given drawing – Part II	IV	2
16	Prepare butt joint using gas welding as per given drawing – Part I	IV	2
17	Prepare butt joint using gas welding as per given drawing – Part II	IV	2*
18	Prepare utility job(like stool, benches, tables or similar jobs) involving arc welding and artificial wood as per given drawing (in group of 4 to 5 students) – Part I a. Fabrication operation involve measuring, marking, cutting, edge preparation, welding b. Carpentry operation involve measuring, marking cutting and assembly with fabrication part.	IV, V	2 *
19	Prepare utility job(like stool, benches, tables or similar jobs) involving arc welding and artificial wood as per given drawing (in group of 4 to 5 students) – Part II a. Fabrication operation involve measuring, marking, cutting, edge preparation, welding b. Carpentry operation involve measuring, marking cutting and assembly with fabrication part.	IV, V	2
20	Prepare utility job(like stool, benches, tables or similar jobs) involving arc welding and artificial wood as per given drawing (in group of 4 to 5 students) – Part III a. Fabrication operation involve measuring, marking, cutting, edge preparation, welding b. Carpentry operation involve measuring, marking cutting and assembly with fabrication part.	IV, V	2*
21	Prepare utility job(like stool, benches, tables or similar jobs) involving arc welding and artificial wood as per given drawing (in group of 4 to 5 students) – Part IV a. Fabrication operation involve measuring, marking, cutting, edge preparation, welding b. Carpentry operation involve measuring, marking cutting and assembly with fabrication part.	IV, V	2

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
22	Prepare utility job(like stool, benches, tables or similar jobs) involving arc welding and artificial wood as per given drawing (in group of 4 to 5 students) – Part V a. Fabrication operation involve measuring, marking, cutting, edge preparation, welding b. Carpentry operation involve measuring, marking cutting and assembly with fabrication part.	IV, V	2
23	Prepare utility job(like stool, benches, tables or similar jobs) involving arc welding and artificial wood as per given drawing (in group of 4 to 5 students) – Part VI a. Fabrication operation involve measuring, marking, cutting, edge preparation, welding b. Carpentry operation involve measuring, marking cutting and assembly with fabrication part.	IV, V	2*
24	Prepare utility job(like stool, benches, tables or similar jobs) involving arc welding and artificial wood as per given drawing (in group of 4 to 5 students) – Part VII a. Fabrication operation involve measuring, marking, cutting, edge preparation, welding b. Carpentry operation involve measuring, marking cutting and assembly with fabrication part.	IV, V	2
25	Prepare utility job(like stool, benches, tables or similar jobs) involving arc welding and artificial wood as per given drawing (in group of 4 to 5 students) – Part VIII a. Fabrication operation involve measuring, marking, cutting, edge preparation, welding b. Carpentry operation involve measuring, marking cutting and assembly with fabrication part.	IV, V	2
26	Prepare sheet metal utility job using following operations – Part I: a. Cutting and Bending b. Edging c. End Curling d. Lancing e. Soldering f. Riveting	VI	2*
27	Prepare sheet metal utility job using following operations – Part II: a. Cutting and Bending b. Edging c. End Curling d. Lancing e. Soldering f. Riveting	VI	2
28	Prepare sheet metal utility job using following operations – Part III: a. Cutting and Bending b. Edging c. End Curling d. Lancing	VI	2

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
	e. Soldering f. Riveting		
29	Prepare sheet metal utility job using following operations – Part IV: a. Cutting and Bending b. Edging c. End Curling d. Lancing e. Soldering f. Riveting	VI	2
30	Prepare sheet metal utility job using following operations – Part V: a. Cutting and Bending b. Edging c. End Curling d. Lancing e. Soldering f. Riveting	VI	2
31	Prepare sheet metal utility job using following operations – Part VI: a. Cutting and Bending b. Edging c. End Curling d. Lancing e. Soldering f. Riveting	VI	2
32	Prepare sheet metal utility job using following operations – Part VI: a. Cutting and Bending b. Edging c. End Curling d. Lancing e. Soldering f. Riveting	VI	2
	Total		**64**

Note

i. *A suggestive list of practical LOs is given in the above table, more such practical LOs can be added to attain the COs and competency. A judicial mix of minimum 24 or more practical LOs/tutorials need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. *Hence, the 'Process' and 'Product' related skills associated with each LO of the laboratory/workshop/field work are to be assessed according to a suggested sample given below:*

S. No.	Performance Indicators	Weightage in %
1	Setting of experimental set up	20
2	Operate equipment skillfully	30
3	Follow Safety measures	10
4	Work in team	10

S. No.	Performance Indicators	Weightage in %
5	Record Observations	10
6	Interpret Results to conclude	10
7	Answer to sample questions	5
8	Submit report in time	5
Total		**100**

Additionally, the following affective domain LOs (social skills/attitudes), are also important constituents of the competency which can be best developed through the above mentioned laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical practices.

The development of the attitude related LOs of Krathwohl's 'Affective Domain Taxonomy', the achievement level may reach:

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Exp. S.No.
1	Fire buckets of standard size.	I, II, III, IV,V, VI
2	Fire extinguisher A,B and C types	I, II, III, IV,V, VI
3	Wood Turning Lathe Machine, Height of Centre: 200mm, Distance between Centers: 1200mm, Spindle Bore: 20mm with Taper, Range of Speeds: 425 to 2800 with suitable Motor Drive. with all accessories	II
4	Circular Saw Machine, Diameter of saw blade 200 mm, Maximum Depth of Cut 50 mm, Table Size -350 x 450 mm, Table Tilting - 45^0	II
5	Wood working tools- marking and measuring tools, saws, claw hammer, mallet, chisels, plans, squares,	II
6	Carpentry Vice 200 mm	II
7	Work Benches- size:1800 x 900 x 750 mm	III
8	Bench Drilling machine (upto 13 mm drill cap.) with ½ H.P. Motor 1000 mm. Height.	III
9	Power Saw machine 350 mm mechanical with 1 HP Motor & all Accessories.	III
10	Bench Grinder 200 mm Grinding Disc diameter 200 mm. with 25 mm. bore 32 mm. with ½ HP/1HP Motor.	III
11	Vernier height Guage 450 mm	III
12	Surface Plate 600 x 900 mm Grade I	III

S. No.	Equipment Name with Broad Specifications	Exp. S.No.
13	Angle Plate 450 x 450 mm	III
14	Welding machine 20 KVA 400A welding current 300A at 50, 100, 200, 250, 300 with std. Accessories and Welding Cable 400 amp. ISI with holder	IV
15	Oxygen and acetylene gas welding and cutting kit with cylinders and regulators.	IV
16	Pipe Bending Machine	IV
17	Pipe Vice – 100 mm	IV
18	Pipe Cutter- 50 mm	IV
19	Bench Vice 100 mm	II,III,IV, V,VI
20	Portable Hammer Drill Machine 0-13 mm A.C. 230 V, 2.5Amp, Pistol type, having different types of bits	II, III, IV,V, VI
21	Sheet Bending Machine	VI
22	Sheet Cutting Machine	VI
23	Brazing Equipment	VI
24	Fitting tools - hammers, chisels, files, hacksaw, surface plate, punch, v block, angle plate, try square, marking block, steel rule, twist drills, reamers, tap set, die set.	III
25	Plumbing tools- pipe vice, pipe bending equipment, pipe wrenches, dies.	IV
26	Gas welding hand tools- welding torch, welding tip, pressure regulator, oxygen and acetylene cylinders, spark lighter	V
27	Arc welding hand tools- electrode holder, cable connector, cable lugs, chipping hammer, earthing clamp, wire brush.	V
28	Sheet metal hand tools- snip, shears sheet gauge, straight edge, L square, scriber, divider, trammel, punches, pliers, stakes, groovers, limit set	VI

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I General Workshop Practice	1a. Describe the procedure for extinguishing the given type of fire 1b. Describe the procedure to use the given firefighting equipment 1c. Locate the specified equipment in workshop 1d. Describe the ways to maintain good housekeeping in the given situation.	1.1 Safety Practices, Causes of accidents, General safety rules, Safety signs and symbols. 1.2 First Aid 1.3 Fire, Causes of Fire, Basic ways of extinguishing the fire Classification of fire, Class A, B,C, D, Firefighting equipment, fire extinguishers, and their types . 1.4 Workshop Layout 1.5 Issue and return system of tools, equipment and consumables
Unit– II Fitting	2a. Explain operation of the given fitting shop machines	2.1 Fitting hand tools bench vice, hammers, chisels, files, hacksaw,

	2b. Describe the procedure to use the given fitting tools 2c. Describe the operation the given machinery. 2d. Describe the procedure to perform fitting operations 2e. Describe the procedure to maintain tools, equipment and machinery.	surface plate, punch, v block, angle plate, try square, marking block , steel rule, twist drills, reamers, tap set, die set and their Specifications 2.2 Operation of fitting shops machineries - Drilling machine, Power saw, grinder their specifications and maintenance. 2.3 Basic process chipping, filling, scraping, grinding, marking, sawing, drilling, tapping, dieing, reaming.
Unit– III Plumbing	3a. Explain operation of fitting shop machines 3b. Describe the procedure to use the given plumbing tools 3c. Describe the procedure to operate the given type of plumbing machinery. 3d. Describe the procedure to maintain the given type of plumbing tools, equipment and machinery.	3.1 Plumbing hand tools pipe vice, pipe bending equipment, pipe wrenches, dies and their Specifications 3.2 Pipe fittings- bends, elbows, tees, cross, coupler, socket, reducer, cap, plug, nipple and their Specifications 3.3 Operation of Machineries in plumbing shops- pipe bending machine their specifications and maintenance. 3.4 Basic process cutting, threading.
Unit– IV Metal Joining	4a. Describe the procedure to identify the given metal joining tools. 4b. Explain the given type of welding procedure 4c. Describe the procedure to use the given metal joining tools. 4d. Describe the procedure to perform the given type of joining metals	4.1 Gas welding hand tools- welding torch, welding tip, pressure regulator, oxygen and acetylene cylinders, spark lighter and their Specifications 4.2 Arc welding hand tools- electrode holder, cable connector, cable lugs, chipping hammer, earthing clamp, wire brush and their Specifications 4.3 Operation of machineries in welding shops- arc welding transformer their specifications and maintenance. 4.4 Welding Electrode, filler rod, fluxes, and solders. 4.5 Basic process welding, brazing and soldering.
Unit– V Furniture Making	5a. Select wood working tools as per job/ requirement with justification 5b. Explain operation of wood working machines 5c. Describe the procedure to use the given furniture making tools 5d. Describe the procedure to operate the given wood	5.1 Types of artificial woods such as plywood, block board, hardboard, laminated boards, Veneer, fiber Boards and their applications. 5.2 Wood working hand tools carpentry vice, marking and measuring tools, saws, claw hammer, mallet, chisels, plans, squares, and their specifications 5.3 Operation of wood working machineries - Wood turning lathe,

	working machinery. 5e. Describe the procedure to maintain given wood working tools, equipment and machinery.	circular saw, their specifications and maintenance. 5.4 Basic process- marking, sawing, planning, chiseling, turning, grooving, boring.
Unit–VI Sheet Metal	6a. Identify sheet metal tools. 6b. Explain operation of sheet metal machineries. 6c. Use sheet metal tools 6d. Describe the procedure to operate the sheet metal machinery. 6e. Describe the procedure to perform the given bending operations 5f. Describe the procedure to maintain the given sheet metal tools, equipment and machinery.	6.1 Sheet metal hand tools snip, shears sheet gauge, straight edge, L square, scriber, divider, trammel, punches, pliers, stakes, groovers, limit set and their Specifications 6.2 Operation of machineries in sheet metal shops- sheet cutting and bending machine their specifications and maintenance. 6.3 Basic process- marking, bending, folding, edging, seaming, staking, riveting.

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

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN - Not applicable.-

10. SUGGESTED STUDENT ACTIVITIES

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

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

11. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.

c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the LOs/COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.
f. Arrange visit to nearby industries and workshops for understanding various manufacturing process.
g. Show video/animation films to explain functioning of various processes like shaping, lapping, honing, turning, milling, knurling etc.
h. Prepare maintenance charts various workshop machineries.

12. SUGGESTED TITLES OF MICRO-PROJECTS

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

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

a. Prepare a utility job using various wood working shop operations as per given drawing.
b. Prepare a utility job using various plumbing operations as per given drawing.
c. Prepare a utility job using various sheet metal operations as per given drawing.

Note:

i. Utility job will be assigned by the teacher.
ii. Utility Job will be completed in a group of 4 to 5 students and students have to maintain work diary consist of job drawing, operations details, required raw materials, tools, equipments, date wise performance record.

13. SUGGESTED LEARNING RESOURCES

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

14. SOFTWARE/LEARNING WEBSITES

a. http://www.asnu.com.au
b. http://www.abmtools.com/downloads/Woodworking%20Carpentry%20Tools.pdf
c. http://www.weldingtechnology.org
d. http://www.newagepublishers.com/samplechapter/001469.pdf
e. http://www.youtube.com/watch?v=TeBX6cKKHWY
f. http://www.youtube.com/watch?v=QHF0sNHnttw&feature=related
g. http://www.youtube.com/watch?v=Kv1zo9CAxt4&feature=relmfu
h. http://www.piehtoolco.com
i. http://sourcing.indiamart.com/engineering/articles/materials-used-hand-tools/
j. https://www.youtube.com/watch?v=9_cnkaAbtCM

Maharashtra State Board of Technical Education (MSBTE)

I – Scheme
II – Semester Course Curriculum

Course Title: **Basic Mathematics** (Common)
(Course Code: .....)

Diploma Programme in which this course is offered	Semester in which offered
Common to all programmes	First

1. RATIONALE

Mathematics is the core course to develop the competencies of most of the technological courses. This basic course of Mathematics is being introduced as a foundation which will help in developing the competency and the requisite course outcomes in most of the engineering diploma programmes to cater to the needs of the industry and thereby enhance the employability. This course is an attempt to initiate the multi-dimensional logical thinking and reasoning capabilities. It will help to apply the principles of basic mathematics to solve related technology problems. Hence, the course provides the insight to analyze engineering problems scientifically using logarithms, determinants, matrices, trigonometry, coordinate geometry, mensuration and statistics.

2. COMPETENCY

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

- **Solve broad-based technology problems using the principles of basic mathematics.**

3. COURSE OUTCOMES (COs)

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

a. Apply the concepts of algebra to solve engineering related problems.
b. Utilize basic concepts of trigonometry to solve elementary engineering problems.
c. Solve basic engineering problems under given conditions of straight lines.
d. Solve the problems based on measurement of regular closed figures and regular solids.
e. Use basic concepts of statistics to solve engineering related problems.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
4	2	-	6	70	30*	-	-	100

(*): *Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain LOs required for the attainment of the COs.*

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

5. COURSE MAP (with sample COs, Learning Outcomes i.e.LOs and topics)

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

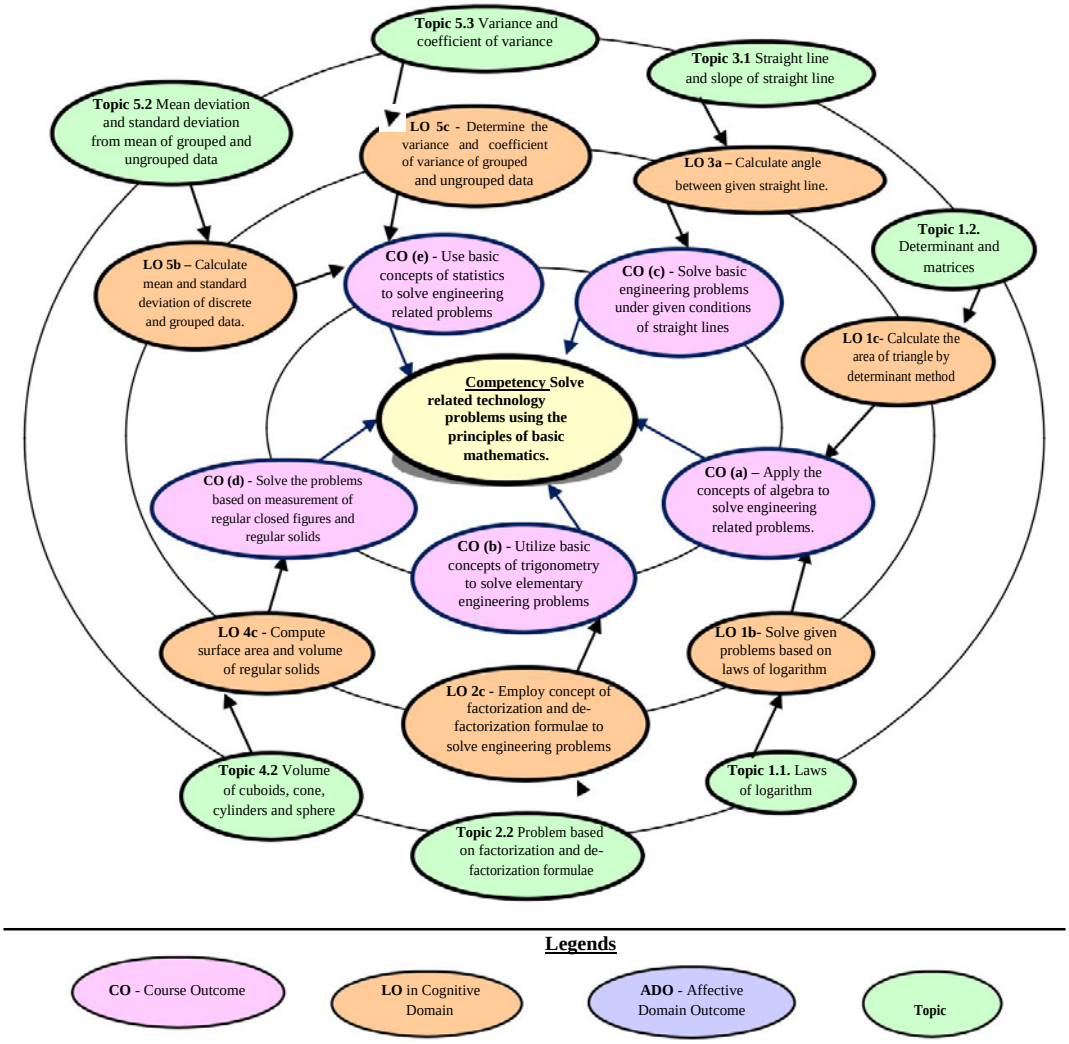

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

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

S. No.	Tutorials	Unit No.	Appro. Hrs. required
1	Solve simple problems of Logarithms based on definition and laws.	I	2
2	Solve problems on determinant to find area of triangle, and solution	I	2

S. No.	Tutorials	Unit No.	Appro. Hrs. required
	of simultaneous equation by Cramer's Rules.		
3	Solve elementary problems on Algebra of matrices.	I	2
4	Solve solution of Simultaneous Equation using inversion method.	I	2
5	Resolve into partial fraction using linear non repeated, repeated, and irreducible factors.	I	2
6	Solve problems on Compound, Allied, multiple and sub multiple angles.	II	2
7	Practice problems on factorization and de factorization.	II	2
8	Solve problems on inverse circular trigonometric ratios.	II	2
9	Practice problems on equation of straight lines using different forms.	III	2
10	Solve problems on perpendicular distance, distance between two parallel lines, and angle between two lines.	III	2
11	Solve problems on Area, such as rectangle, triangle, and circle.	IV	2
12	Solve problems on surface and volume, sphere, cylinder and cone.	IV	2
13	Solve practice problems on the surface area, volumes and its applications.	IV	2
14	Solve problems on finding range, coefficient of range and mean deviation.	V	2
15	Solve problems on standard deviation.	V	2
16	Solve problems on coefficient of variation and comparison of two sets.	V	2
Total			**32**

Note: *The above tutorial sessions are for guideline only. The remaining tutorial hours are for revision and practice.*

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

- Not applicable -

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Algebra 1.1	1a. Solve the given simple problem based on laws of logarithm. 1b. Calculate the area of the given triangle by determinant method. 1c. Solve given system of linear equations using matrix inversion method and by Cramer's rule. 1d. Obtain the proper and improper partial fraction for the given simple rational function.	Logarithm: Concept and laws of logarithm 1.2 Determinant and matrices a. Value of determinant of order 3x3 b. Solutions of simultaneous equations in three unknowns by Cramer's rule. c. Matrices, algebra of matrices, transpose adjoint and inverse of matrices. Solution of simultaneous equations by matrix inversion method.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
		d. Types of partial fraction based on nature of factors and related problems.
Unit– II Trigonometry	2a. Apply the concept of Compound angle, allied angle, and multiple angles to solve the given simple engineering problem(s). 2b. Apply the concept of Sub- multiple angle to solve the given simple engineering related problem(s). 2c. Employ concept of factorization and de-factorization formulae to solve the given simple engineering problem(s). 2d. Investigate given simple problems utilizing inverse trigonometric ratios.	2.1 Trigonometric ratios of Compound, allied, multiple and sub-multiple angles (without proofs) 2.2 Factorization and de-factorization formulae(without proofs) 2.3 Inverse trigonometric ratios and related problem. 2.4 Principle values and relation between trigonometric and inverse trigonometric ratio.
Unit– III Coordinate Geometry	3a. Calculate angle between given two straight lines. 3b. Formulate equation of straight lines related to given engineering problems. 3c. Identify perpendicular distance from the given point to the line. 3d. Calculate perpendicular distance between the given two parallel lines.	3.1 Straight line and slope of straight line a. Angle between two lines. b. Condition of parallel and perpendicular lines. 3.2 Various forms of straight lines. a. Slope point form, two point form. b. Two points intercept form. c. General form. d. Perpendicular distance from a point on the line. e. Perpendicular distance between two parallel lines.
Unit-IV Mensuration	4a. Calculate the area of given triangle and circle. 4b. Determine the area of the given square, parallelogram, rhombus and trapezium. 4c. Compute surface area of given cuboids, sphere, cone and cylinder. 4d. Determine volume of given cuboids, sphere, cone and cylinder.	4.1 Area of regular closed figures, Area of triangle, square, parallelogram, rhombus, trapezium and circle. 4.2 Volume of cuboids, cone, cylinders and sphere.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit –V Statistics	5a. Obtain the range and coefficient of range of the given grouped and ungrouped data. 5b. Calculate mean and standard deviation of discrete and grouped data related to the given simple engineering problem. 5c. Determine the variance and coefficient of variance of given grouped and ungrouped data. 5d. Justify the consistency of given simple sets of data.	5.1 Range, coefficient of range of discrete and grouped data. 5.2 Mean deviation and standard deviation from mean of grouped and ungrouped data, weighted means 5.3 Variance and coefficient of variance. 5.4 Comparison of two sets of observation.

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

9. 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	Algebra	20	02	08	10	20
II	Trigonometry	18	02	08	10	20
III	Coordinate Geometry	08	02	02	04	08
IV	Mensuration	08	02	02	04	08
V	Statistics	10	02	05	07	14
Total		**64**	**10**	**25**	**35**	**70**

***Legends**: R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note**: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of LOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom 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.

a. Identify engineering problems based on real world problems and solve with the use of free tutorials available on the internet.
b. Use graphical softwares: EXCEL, DPLOT and GRAPH for related topics.
c. Use MathCAD as Mathematical Tools and solve the problems of Calculus.
d. Identify problems based on applications of matrix and use MATLAB to solve these problems.
e. Prepare models to explain different concepts.
f. Prepare a seminar on any relevant topic.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the LOs/COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.
f. Apply the mathematical concepts learnt in this course to branch specific problems.

12. SUGGESTED MICRO-PROJECTS

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

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

a. Prepare charts using determinants to find area of regular shapes.
b. Prepare models using matrices to solve simple problems based on cryptography.
c. Prepare models using matrices to solve simple mixture problems.
d. Prepare charts displaying regular solids.
e. Prepare charts displaying regular closed figures.
f. Prepare charts for grouped and ungrouped data.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Higher Engineering Mathematics	Grewal, B.S.	Khanna publications, New Delhi, 2015 ISBN: 8174091955
2	Advanced Engineering Mathematics	Krezig, Ervin	Wiley Publications, New Delhi, 2014 ISBN :978-0-470-45836-5
3	Engineering Mathematics (third edition).	Croft, Anthony	Pearson Education, New Delhi, 2014 ISBN 978-81-317-2605-1
4	Getting Started with MATLAB-7	Pratap, Rudra	Oxford University Press, New Delhi, 2014, ISBN: 0199731241

S. No.	Title of Book	Author	Publication
5	Advanced Engineering Mathematics	Das, H.K.	S. Chand & Co.; New Delhi; 2008, ISBN-9788121903455

14. SOFTWARE/LEARNING WEBSITES

a. www.scilab.org/ - SCI Lab
b. www.mathworks.com/products/matlab/ - MATLAB
c. www.dplot.com/ - DPlot
d. www.allmathcad.com/ - MathCAD
e. www.wolfram.com/mathematica/ - Mathematica
f. https://www.khanacademy.org/math?gclid=CNqHuabCys4CFdOJaAoddHoPig
g. www.easycalculation.com
h. www.math-magic.com

Maharashtra State Board of Technical Education (MSBTE)

I – Scheme
I – Semester Course Curriculum

Course Title: **Basic Science** (Common)
(Course Code: .....)

Diploma programme in which this course is offered	Semester in which offered
Common to all	First

1. RATIONALE

Diploma engineers (also called technologists) have to deal with various materials and machines. This course is designed with some fundamental information to help the technologists apply the basic concepts and principles of physics and chemistry to solve broad-based engineering problems. The study of basic principles of sciences and the concepts related to various materials such as metals, alloys, inorganic salts, polymers, lubricants, paints, varnishes, adhesives, heat, electricity, magnetism, optics, semiconductors and others will help in understanding the technology courses where emphasis is on the applications of these in different technology applications.

2. COMPETENCY

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

- **Solve broad-based engineering problems applying principles of physics and chemistry.**

3. COURSE OUTCOMES (COs)

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

a. Estimate errors in measurement of physical quantities.
b. Apply the principles of electricity and magnetism to solve engineering problems.
c. Use the basic principles of heat and optics in related engineering applications.
d. Apply the catalysis process in industries.
e. Use corrosion preventive measures in industry.
f. Use relevant engineering materials in industry.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)			Examination Scheme				
						Theory Marks		Practical Marks		Total Marks
L	**T**	**P**	**C**			**ESE**	**PA**	**ESE**	**PA**	
4	-	4	Applied	Physics	2+2	35	15*	25	25	200
			Science	Chemistry	2+2	35	15*	25	25	

(*): *Under the theory PA, out of 30 marks, 10 marks are for micro-project assessment (5 marks each for Physics and Chemistry) to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain LOs required for the attainment of the COs.*

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

5. COURSE MAP (with sample COs, Learning Outcomes i.e.LOs and topics)

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

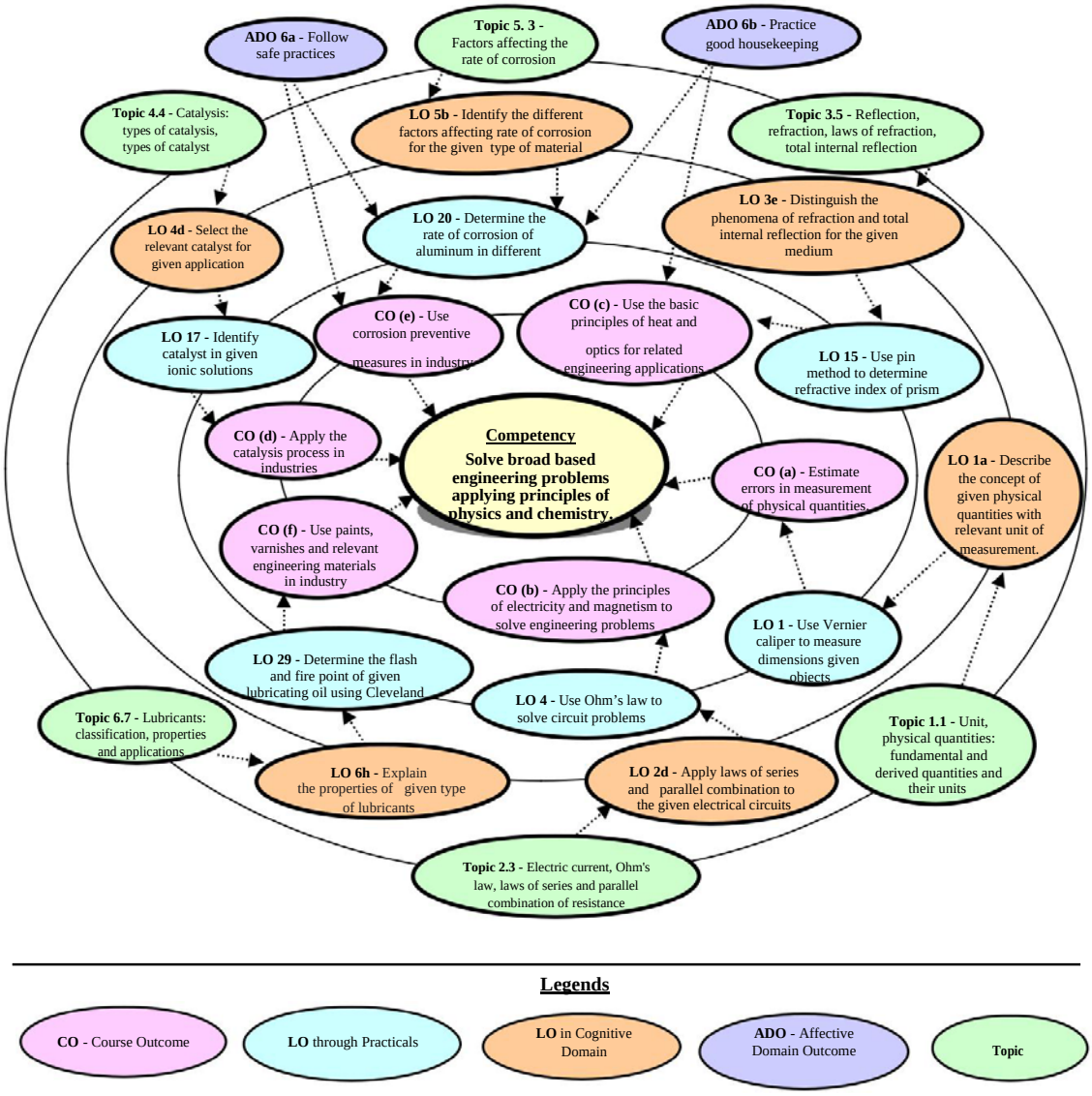

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals/exercises/tutorials in this section are psychomotor domain LOs (i.e.sub-components of the COs), to be developed and assessed in the student to lead to the attainment of the competency.

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. Required
	Physics		
1	Use Vernier caliper to : (i)Measure dimensions of given objects. (ii) Measure the dimensions of objects of known dimensions. (iii) Estimate the errors in measurement.	I	02*
2	Use Screw gauge to: (i)Measure dimensions of given objects. (ii) Measure the dimensions of objects of known dimensions. (iii) Estimate the errors in measurement.	I	02*
3	Use Spherometer to measure radius of curvature of any curved surface.	I	02
4	Use Ohm's law to solve circuit problems.	II	02*
5	Determine the specific resistance of given wire.	II	02*
6	Use the principle of series resistance in solving electrical engineering problems.	II	02
7	Use the principle of parallel resistance in solving electrical engineering problems.	II	02
8	Use magnetic compass to draw the magnetic lines of forces of magnet of different shapes.	II	02*
9	Use magnetic compass to determine the neutral points when (i) North pole of bar magnets points towards the north pole of earth. (ii) South pole of bar magnets points towards the north pole of earth.	II	02
10	Use p-n junction diode to draw forward bias and reverse bias I-V characteristics.	II	02*
11	Determine forbidden energy band gap in semiconductors.	II	02
12	Determine the pressure-volume relation using Boyle's law.	III	02
13	Use Joule's calorimeter to determine Joule's mechanical equivalent of heat.	III	02*
14	Use Searle's thermal conductivity apparatus to find co-efficient of thermal conductivity of a given material.	III	02*
15	Use pin method to determine refractive index of prism.	III	02*
16	Determine the refractive index of glass slab using TIR phenomenon.	III	02
	Chemistry		
17	Identify cation in given ionic solutions.	IV	02*
18	Identify anion in given ionic solutions.	IV	02
19	Determine the percentage of iron in the given sample using redox titration.	IV, V	02*
20	Prepare the corrosive medium for Aluminium at different temperature.	V	02
21	Determine the rate of corrosion on different temperatures for Aluminium.	V	02*
22	Determine the electrode potential of Copper metal.	V	02
23	Determine the electrode potential of Iron metal.	V	02*

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. Required
24	Determine the voltage generated from chemical reaction using Daniel Cell.	V	02
25	Determine the pH value of given solution using pH meter and universal indicator.	V	02*
26	Determine electrochemical equivalent of Cu metal using Faraday's first law.	V	02
27	Determine equivalent weight of metal using Faraday's second law.	V	02
28	Determine the effect of temperature on viscosity for given lubricating oil using Redwood viscometer-I.	VI	02*
29	Determine the steam emulsification number of given lubricating oil.	VI	02
30	Determine the flash and fire point of given lubricating oil using Cleveland open cup apparatus.	VI	02*
31	Determine the flash point of given lubricating oil using Abel's closed cup apparatus.	VI	02*
32	Determine thinner content in oil paint.	VI	02*
	Total		**64**

Note

i. *A suggestive list of practical LOs is given in the above table, more such practical LOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical LOs/tutorials need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. *Hence, the 'Process' and 'Product' related skills associated with each LO of the laboratory/workshop/field work are to be assessed according to a suggested sample given below:*

S. No.	Performance Indicators	Weightage in %
1	Preparation of experimental set up	20
2	Setting and operation	20
3	Safety measures	10
4	Observations and Recording	10
5	Interpretation of result and Conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
Total		**100**

Additionally, the following affective domain LOs (social skills/attitudes), are also important constituents of the competency which can be best developed through the above mentioned laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical practices.

The development of the attitude related LOs of Krathwohl's 'Affective Domain Taxonomy', the achievement level may reach:

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Exp. S.No.
1	Vernier Calipers: Range: 0-150mm, Resolution: 0.1mm	1
2	Micrometer screw gauge: Range: 0-25mm, Resolution:0.01mm, Accuracy: ±0.02mm or better	2
3	Spherometer: range:-10 to +10 mm, LC = 0.01mm	3
4	Digital multimeter: 3½ digit display, 9999 counts, digital multimeter measures: V_{ac}, V_{dc} (1000V max), A_{dc}, A_{ac} (10 amp max), Hz, Resistance (0-100 MΩ), Capacitance and Temperature	4, 5, 6, 7, 21, 22, 23
5	Resistance Box: 4 decade ranges from 1 ohm to 1KΩ ,accuracy 0.1 % - 1 %	4,5,6,7
6	Battery eliminator: 0- 12V, 2A	6,7, 25, 26
7	Boyle's apparatus: U tube manometer, digital barometer	12
8	Joule's calorimeter: well insulated 'mechanical equivalent of heat apparatus' in wooden box, digital/analog thermometer	13
9	Searle's thermal conductivity apparatus : Cylindrical copper, aluminum, brass, glass and iron rod, steam chamber, digital / analogue thermometer, arrangement for fitting tubes and thermometer	14
10	Forbidden energy band gap set up: Oven : temperature range up to 100^0C, thermometer, micro ammeter, Ge diode	11
11	pH meter reading up to pH14; ambient temp. -40 to 70^0 C.; pH/mV resolution:13 bit	24
12	Electronic balance, with the scale range of 0.001g to 500gm pan size 100 mm; response time 3-5 sec.: power requirement 90-250 V, 10 watt	13,17, 19, 25, 26, 31
13	Electric oven inner size 18''x18''x18''; temperature range 100 to 250^0 C. with the capacity of 40 lt.	31
14	Ammeter 0-2 amp	25,26
15	Redwood viscometer-I	27
16	Cleveland open cup apparatus	29
17	Abel's close cup apparatus	30

8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop LOs in cognitive domain for achieving the COs to attain the identified competency:

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Physics		
Unit – I	1a. Describe the concept of given	1.1 Unit, physical quantities: fundamental

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Units and Measurements	physical quantities with relevant unit of measurement. 1b. Explain various systems of units and its need for the measurement of the given physical quantities. 1c. Determine the dimensions of the given physical quantities. 1d. State the error in the given measurement with justification.	and derived quantities and their units 1.2 Systems of unit: CGS, MKS, FPS and SI 1.3 Dimensions, dimensional formula 1.4 Errors, types of errors: instrumental, systematic and random error, estimation of errors: absolute, relative and percentage error, significant figures
Unit– II Electricity, Magnetism and Semiconductors	2a. Calculate electric field, potential and potential difference of the given static charge. 2b. Describe the concept of given magnetic intensity and flux with relevant units. 2c. Explain the heating effect of the given electric current. 2d. Apply laws of series and parallel combination in the given electric circuits.	2.1 Concept of charge, Coulomb's inverse square law, Electric field, Electric field intensity, potential and potential difference 2.2 Magnetic field and magnetic field intensity and its units, magnetic lines of force, magnetic flux 2.3 Electric current, Ohm's law, specific resistance, laws of series and parallel combination of resistance, heating effecting of electric current
	2e. Distinguish the given conductors, semiconductors and insulators on the basis of energy bands. 2f. Explain the I-V characteristics and applications of the given p-n junction diodes.	2.4 Conductors, Insulators and Semiconductors, Energy bands, intrinsic and extrinsic semiconductors 2.5 p-n junction diode, I-V characteristics of p-n junction, applications of p-n junction diode
Unit– III Heat and Optics	3a. Convert the given temperature in different temperature scales. 3b. Describe the properties of the given good and bad conductors of heat. 3c. Relate the characteristics of the three gas laws. 3d. Determine the relation between specific heats for the given materials.	3.1 Heat, temperature, temperature scales 3.2 Modes of transfer of heat, good and bad conductors of heat, law of thermal conductivity 3.3 Boyle's law, Charle's law, Gay Lussac's law, perfect gas equation 3.4 Specific heat of gas at constant pressure and volume (C_p and C_V), ratio of specific heats
	3e. Distinguish the phenomena of total internal reflection for the given mediums. 3f. Describe light propagation in	3.5 Reflection , refraction, laws of refraction, total internal reflection 3.6 Optical fiber: Principle, construction and path of light through optical fiber,

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	the given type of optical fiber.	applications of optical fibers.
	Chemistry	
Unit-IV Chemical bonding and Catalysis	4a. Explain the properties of given material based on the bond formation. 4b. Describe the molecular structure of given solid, liquid and gases. 4c. Describe the crystalstructure of the given solids. 4d. Select the relevant catalyst for given application.	4.1 Electronic theory of valency, chemical bonds: types and characteristics, electrovalent bond, covalent bond, coordinate bond, hydrogen bond, metallic bond, metallic properties, intermolecular force of attraction. 4.2 Molecular arrangement in solid, liquid and gases. 4.3 Structure of solids: crystalline and amorphous solid, properties of metallic solids-, unit cell- of simple cubic, body centre cubic, face centre cubic, hexagonal close pack crystals. 4.4 Catalysis: Types of catalysis, Catalyst, Types of Catalyst, Positive Catalyst, Negative Catalyst, Auto-catalyst, Catalytic Promoter and Catalytic inhibitor, Industrial Application of Catalyst
Unit –V Metal Corrosion, its prevention and Electrochemistry	5a. Describe the phenomenon of the given type of corrosion and its prevention. 5b. Identify the different factors affecting rate of corrosion for the given type of material. 5c. Select the protective measures to prevent the corrosion in the given corrosive medium.	5.1 Corrosion: Types of corrosion- Dry corrosion, Wet corrosion. Oxidation corrosion (Atmospheric corrosion due to oxygen gas), mechanism, Types of oxide film, Wet corrosion mechanism (Hydrogen evolution in acidic medium) 5.2 Concentration cell corrosion -oxygen absorption mechanism in neutral or alkaline medium, Pitting corrosion, Waterline corrosion, Crevice corrosion. 5.3 Factors affecting the rate of corrosion control: Modification of environment, Use of protective coatings- coating of less active metal like Tin (Tinning), coating of more active metal like Zinc (Galvanizing), Anodic and cathodic protection, Choice of material-using pure metal and using metal alloys
	5d. Differentiate the salient features of the given electrolytic cell and electrochemical cell. 5e. Distinguish the given primary and secondary electrolytic cells.	5.4 Electrolyte- strong and weak, Non-Electrolyte, Electrolytic cell, Electrochemical cell. Cathode, Anode, Electrode potential- oxidation and reduction, Construction and working of Daniel cell Ionisation and dissociation 5.5 Faradays first and second law

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	5f. Describe the process of electrolysis for the given electrolyte. 5g. Describe the process of electroplating of the given material.	5.6 Primary cell and secondary cell Electrolysis- Mechanism, Electroplating and electro-refining of copper.
Unit-VI Paints, Varnishes, Insulators, Polymer, Adhesives and Lubricants	6a. Identify the ingredients of the given paints. 6b. Differentiate salient properties of the given paint and varnish. 6c. Describe the properties of insulating materials for the given application.	6.1 Paints: Purpose of applying paint, Characteristics of paints, Ingredients of paints, Function and Examples of each ingredients 6.2 Varnish: Types, Difference between paints and varnishes 6.3 Insulators: Characteristics, Classification, Properties and Application of Glass wool, Thermo Cole
	6d. Differentiate the given types of structural polymers. 6e. Describe the polymerization process of the given polymer. 6f. Explain the properties and uses of the given polymer, elastomer and adhesive. 6g. Describe the application of relevant adhesives required for the given material. 6h. Explain the properties of given type of lubricants.	6.4 Polymer and Monomer, Classification: on the basis of Molecular structure, on the basis of monomers (homo polymer and copolymer), on the basis of Thermal behavior(Thermoplastics and Thermosetting) 6.5 Types Polymerization Reaction, Addition Polymerization, Condensation Polymerization, Synthesis, properties and application of Polyethylene, Polyvinyl chloride, Teflon. Polystyrene, Phenol formaldehyde, Epoxy Resin 6.6 Adhesives: Characteristics, Classification and their uses 6.7 Lubricants: Classification, properties and applications

***Note**: To attain the COs and competency, above listed Learning Outcomes (LOs) need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.*

9. 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
	Physics					
I	Units and Measurements	06	02	03	-	05
II	Electricity, Magnetism and Semiconductors	14	03	05	08	16
III	Heat and Optics	12	03	05	06	14
	Chemistry					

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
IV	Chemical bonding and Catalysis	08	02	03	04	09
V	Metal Corrosion, prevention and Electrochemistry	12	03	04	05	12
VI	Paints, Varnishes, Insulators, Polymer Adhesives and Lubricants	12	03	05	06	14
Total		**64**	**16**	**25**	**29**	**70**

***Legends**: R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note**: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of LOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

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:

a. Market survey of different resins and compare the following points.
   i. Structure
   ii. Properties
   iii. Applications.
b. Library survey regarding engineering material used in different industries.
c. Power point presentation or animation for showing different types of bonds or molecules.
d. Seminar on any relevant topic.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the LOs/COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of practicals, cognitive domain and affective domain LOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain dated work diary consisting of

individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course.

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

a. **Optical Fiber and TIR**: Prepare models by using water and diode laser to demonstrate total internal reflection and the working of optical fiber.
b. **Conductivity**: Collect different materials such as metal, plastics, glass etc. and prepare models to differentiate between good and bad conductor within collected materials.
c. **Gas laws:** Prepare models to demonstrate Boyle's laws, Charle's Law and Gay Lussac's law using house hold materials.
d. **Battery and Cell: C**ollect wastage material from lab and household and prepare working model of cell.
e. **Adhesives:** Prepare model to demonstrate the applications of various adhesives.
f. **Polymer:** Collect the samples of different polymers and list their uses.
g. **Series and parallel resistances:** Prepare models for combination of series and parallel resistances using bulbs/ LED.
h. **Systems and units:** Prepare chart on comparison of systems of units for different physical quantities.
i. **Magnetic flux:** Prepare models to demonstrate magnetic lines of lines of forces of different types of magnets.
j. **Dimensional analysis:** Prepare chart on dimensions of fundamental and derived physical quantities and highlights the applications of dimensional analysis.
k. **Types of bonds:** Prepare chart and models displaying different types of bonds with examples.
l. **Ionization:** Prepare chart displaying ionization phenomenon.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Physics Textbook Part I - Class XI	Narlikar, J. V.; Joshi, A. W.; Mathur, Anuradha; *et al*	National Council of Education Research and Training, New Delhi, 2010, ISBN : 8174505083
2	Physics Textbook Part II - Class XI	Narlikar, J. V.; Joshi, A. W.; Mathur, Anuradha; *et al*	National Council of Education Research and Training, New Delhi, 2015, ISBN : 8174505660
3	Physics Textbook Part I - Class XII	Narlikar, J.V.; Joshi, A. W.; Ghatak A.K. *et al*	National Council of Education Research and Training, New Delhi, 2013, ISBN : 8174506314
4	Physics Textbook Part II - Class XII	Narlikar, J.V.; Joshi, A. W.; Ghatak A.K. *et al*	National Council of Education Research and Training, New Delhi, 2013, ISBN : 8174506713
5	Fundamentals of Physics	Haliday, David; Resnik, Robert and Walker, Jearl	John Wiley and sons, Hoboken, USA, 2014 ISBN : 812650823X

S. No.	Title of Book	Author	Publication
6	Engineering Chemistry	Jain and Jain	Dhanpat Rai and sons; New Delhi, 2015, ISBN : 9352160002
7	Engineering Chemistry	Dara, S. S.	S.Chand. Publication, New Delhi, 2013, ISBN: 8121997658
8	Fundamental of electrochemistry	Bagotsky,V.S.	Wiley International N. J.,2005, ISBN: 9780471700586

14. SOFTWARE/LEARNING WEBSITES

a. http://nptel.ac.in/course.php?disciplineId=115
b. http://nptel.ac.in/course.php?disciplineId=104
c. http://hperphysics.phy-astr.gsu.edu/hbase/hph.html
d. www.physicsclassroom.com
e. www.physics.org
f. www.fearofphysics.com
g. www.sciencejoywagon.com/physicszone
h. www.science.howstuffworks.com
i. https://phet.colorado.edu
j. www.chemistryteaching.com
k. www.visionlearning.com
l. www.chem1.com
m. www.onlinelibrary.wiley.com
n. www.rsc.org
o. www.chemcollective.org

Maharashtra State Board of Technical Education (MSBTE)

I – Scheme
I – Semester Course Curriculum

Course Title: **English** (Common)
(Course Code: .....)

Diploma Programme in which this course is offered	Semester in which offered
Common to all programmes	First

1. RATIONALE

In the era of globalization, the most commonly used medium to express oneself is the English language, especially in the industry, where almost all the service manuals, installation and commissioning manuals of the various equipment are in English and the technologist has to interpret them correctly. English is the dire need, not only for the Indian industry, but also worldwide, where the diploma engineers have the opportunity to take up jobs. Therefore, the basic English reading and writing skills have become almost mandatory for employment in the industry. Hence, English language has become quite a necessity for engineering diploma students. This course is therefore designed to help the students to learn the correct grammatical structures and use the relevant vocabulary while reading and writing.

2. COMPETENCY

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

- **Communicate in English in spoken and written form.**

3. COURSE OUTCOMES (COs)

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

a. Formulate grammatically correct sentences.
b. Summarise comprehension passages.
c. Formulate different types of dialogues.
d. Use relevant vocabulary to compose paragraphs to express ideas, thoughts and emotions.
e. Use relevant words in writing and delivering short and long speeches.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	150
3	-	2	5	70	30*	25	25	

(*): *Under the theory PA, out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain LOs required for the attainment of the COs.*

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

5. COURSE MAP (with sample COs, Learning Outcomes i.e. LOs and topics)

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

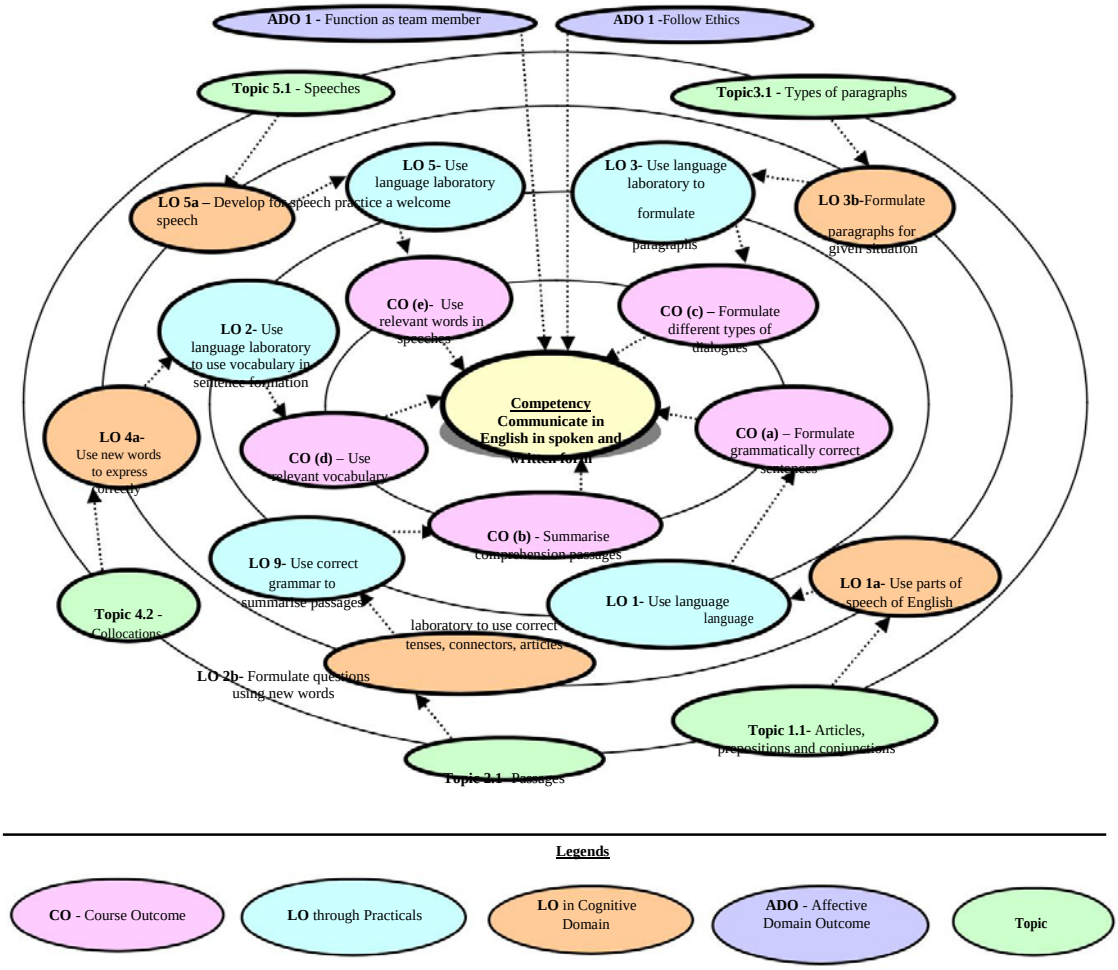

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals/exercises/tutorials in this section are psychomotor domain LOs (i.e.sub-components of the COs), to be developed and assessed in the student to lead to the attainment of the competency.

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
	Use 'language laboratory' for different practical tasks		
1	Make sentences using correct articles.	I	2*
2	Make sentences using correct prepositions.	I	2
3	Make sentences using correct conjunctions.	I	2

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
4	Make sentences using correct active and passive voice.	I	2
5	Make sentences using correct direct and indirect speech.	I	2
6	Make sentences using correct tenses.	I	2*
7	Make sentences using correct connectors.	I	2
8	Make oral presentations using correct grammar.	I	2*
9	Write short paragraphs emphasizing on syntax and sentence structure.	II	2*
10	Write different types of dialogues for role plays.	III	2*
11	Write different types of dialogues for drama.	III	2
12	Describe episodes in own words using idioms and phrases.	IV	2
13	Write anecdotes of various situations.	IV	2
14	Construct sentences using various collocations.	IV	2*
15	Use synonyms and antonyms in sentences.	IV	2
16	Read aloud Newspapers with correct pronunciations and intonations.	IV	2
17	Write different types of speeches using new vocabulary.	IV	2
18	Deliver short prepared speeches of 3-5 minutes.	V	2*
19	Deliver extempore short speeches of 3-5 minutes.	V	2
20	Deliver extempore long speeches of 8-10 minutes.	V	2
	Total		**40**

Note

i. A suggestive list of practical LOs is given in the above table, more such practical LOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical LOs/tutorials need to be performed, out of which, the practicals marked as '' are compulsory.*

ii. Hence, the 'Process' and 'Product' related skills associated with each LO of the laboratory/workshop/field work are to be assessed according to a suggested sample given below.

S. No.	Performance Indicators	Weightage in %
a.	Setting up of language laboratory	10
b.	Using the language laboratory skillfully	30
c.	Follow Safety measures	10
d.	Work in team	20
e.	Interpret moral of the stories	20
f.	Answer to sample questions	10
Total		**100**

Additionally, the following affective domain LOs (social skills/attitudes), are also important constituents of the competency which can be best developed through the above mentioned laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical practices.

The development of the attitude related LOs of Krathwohl's 'Affective Domain Taxonomy', the achievement level may reach:

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Exp. S.No.
1	Language Lab with relevant software and Computer system with all necessary components like; motherboard, random access memory (RAM), read-only memory (ROM), Graphics cards, sound cards, internal hard disk drives, DVD drive, network interface card	all
2	LCD Projector with document reader	all
3	Smart Board with networking	all

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Major Learning Outcomes (in cognitive domain)		Topics and Sub-topics
	Writing Skills	**Speaking Skills**	
Unit – I Applied Grammar	1a. Use relevant articles in constructing sentences. 1b. Apply prepositions to construct meaningful sentences. 1c. Identify conjunctions to connect phrases and clauses in the specified sentences. 1d. Use correct form of tenses in given situation. 1e. Identify the active and passive voice from the specified passage/list. 1f. Apply direct and indirect speech for the given situation.	1g. Formulate grammatically correct sentences for the specified situation. 1h. Use relevant Prepositions for the situation mentioned. 1i. Apply relevant conjunctions to use idiomatic language for the given situation. 1j. Apply the relevant voice in formal communication for the given passage. 1k. Use relevant narrations for the given situation.	1.1. Articles: definite and indefinite 1.2. Prepositions: Types and usage 1.3. Conjunctions: coordinating and subordinating 1.4. Active and Passive voice 1.5. Direct and Indirect Speech 1.6. **Tenses** - Present Tense (Simple, Continuous, Perfect) - Past Tense (Simple, Continuous, Perfect) - Future Tense (Simple) 1.7. **Connectors**: And, But, Or, Nor, Though, Although, If, Unless, Otherwise,

Unit	Major Learning Outcomes (in cognitive domain)		Topics and Sub-topics
	Writing Skills	**Speaking Skills**	
			Because, as, Therefore, So, Who, Whom, Whose, Which, Where, When, Why, What
Unit– II Comprehension Passages	2a. Answer the given questions of the specified passage. 2b. Formulate sentences using the given new words 2c. Describe in a paragraph about the given object/product. 2d. Use correct syntax to construct meaningful sentences for the given situation. 2e. Answer the questions on the given unseen passage.	2f. Pronounce the words correctly in the given passage. 2g. Give oral instructions with correct pronunciation and intonation for the given situation. 2h. Answer the questions orally on the given unseen passage with correct pronunciation.	2.1 Seen passages from MSBTE text book. 2.2 Unseen passages from different sources
Unit– III Paragraph and Dialogue Writing	3a. Differentiate the given types of paragraphs with justification. 3b. Formulate a paragraph in words with synchronized sentence structure on the given situation / topic. 3c. Explain the theme omgiven paragraph precisely.	3d. Summarise the given paragraph with correct pronunciation and intonation. 3e. Take part in debates with correct pronunciation, intonation and using verbal and non-verbal gestures on the given themes.	3.1 Paragraph writing 3.2 Types of paragraph i. Technical ii. Descriptive iii. Narrative iv. Compare and contrast 3.3 Dialogue writing i. Greetings ii. Development of dialogue iii. Closing sentence
Unit– IV Vocabulary Building	4a. Use relevant words to correctly express for the given themes/situation. 4b. Use correct synonyms and antonyms to write	4e. Speak in specified formal situations with correct pronunciation. 4f. Speak in specified informal situations with correct	4.1. Words often confused 4.2. Collocations 4.3. Prefix and suffix 4.4. Synonyms and Antonyms

Unit	Major Learning Outcomes (in cognitive domain)		Topics and Sub-topics
	Writing Skills	**Speaking Skills**	
	paragraphs for given themes/situations. 4c. Use the correct collocations in the given sentences. 4d. Use the correct prefix and suffix in the given sentences.	pronunciation.	
Unit-V Speeches	5a. Develop a welcome speech on the given theme/situation. 5b. Develop a farewell speech for the given theme/situation. 5c. Formulate a speech for introducing a guest in the given situation. 5d. Develop a vote of thanks for the given situation	5e. Undertake public speaking with correct pronunciation, intonation and using verbal and non-verbal gestures for the given theme/ situation. 5f. Give extempore talks with correct pronunciation, intonation and using verbal and non-verbal gestures for the given theme/ situation. 5g. Compere panel discussions/debates	5.1. Welcome speech 5.2. Farewell speech 5.3. Summarise an event 5.4. Summarise debates 5.5. Summarise panel discussions. 5.6. Compere panel discussions 5.7. Introducing a guest 5.8. Vote of thanks

***Note**: To attain the COs and competency, above listed Learning Outcomes (LOs) need to be undertaken to achieve the 'Application Level' of Blooms's 'Cognitive Domain Taxonomy'*

9. 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	Applied Grammar	10	02	04	08	14
II	Comprehension Passages	15	05	06	13	24
III	Paragraph and Dialogue Writing	08	02	04	06	12
IV	Vocabulary Building	08	02	03	06	11
V	Speeches	07	02	03	04	09
Total		**48**	**13**	**20**	**37**	**70**

***Legends**: R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note**: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of LOs. The actual*

distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

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:

a. Collect good articles from newspapers and write the summary.
b. Listen to TV news and summarise the major news items
c. Summarise articles from standard English magazines
d. Undertake micro-projects.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the LOs/COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
a. Arrange various communication activities using functional grammar.
b. Show video/animation films to develop listening skills and enhance vocabulary.
c. Use real life situations for explanation.
d. Prepare and give oral presentations.
e. Guide micro-projects in groups as well as individually.

12. SUGGESTED TITLES OF MICRO-PROJECTS

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

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

a. Report different types of episodes/anecdotes.
b. Seminar preparation and presentations.
c. Prepare written speeches on given topics.
d. Prepare and participate in debates and extempore speeches.

e. Prepare Brochure for Seminar/ Conference
f. Prepare different types of assignments:
   i. Prepare a seminar brochure
   ii. Prepare a National conference brochure
   iii. Prepare an International conference brochure
   iv. Prepare poster for Inter Polytechnic Paper Presentation competition
   v. Prepare a leaflet(three fold) giving information about your Institute
   vi. Prepare a leaflet about the admission process of Polytechnic
g. Compose review on the following:
   i. Short stories
   ii. Novels
   iii. Films.
h. Prepare a questionnaire and conduct the interview of Principal/Head of Department/ Senior Faculty Members/ Senior Students/ Industry Personnel.
i. Summarise views of the authors of editorial columns of English newspapers.
j. Write 'Letters to Editor' column expressing views on social issues.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	English	MSBTE	MSBTE, Mumbai, 2008
2	Effective English with CD	Kumar, E. Suresh; Sreehari, P.; Savithri, J.	Pearson Education, Noida, New Delhi, 2009 ISBN: 978-81-317-3100-0
3	English Grammar at Glance	Gnanamurali, M.	S. Chand and Co. New Delhi, 2011 ISBN:9788121929042
4	Essential English Grammar	Murphy, Raymond	Cambridge University Press, New Delhi, Third edition, 2011, ISBN: 9780-0-521-67580-9
5	Living English Structure	Allen, W.S.	Pearson Education, New Delhi, Fifth edition, 2009, ISBN:108131728498,99

14. SOFTWARE/LEARNING WEBSITES

a. https://www.britishcouncil.in/english/learn-online
b. http://learnenglish.britishcouncil.org/en/content
c. http://www.talkenglish.com/
d. languagelabsystem.com
e. www.wordsworthelt.com

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION (MSBTE)

I - Scheme
I – Semester Course Curriculum

Course Title: **Fundamentals of ICT** (Common)
(Course Code: .....)

Diploma Programme in which this course is offered	Semester in which offered
Common to all programmes	First

1. RATIONALE

In any typical business setup in order to carry out routine tasks related to create business documents, perform data analysis and its graphical representations and making electronic slide show presentations, the student need to learn various software as office automation tools like word processing applications, spreadsheets and presentation tools. They also need to use these tools for making their project reports and presentations. The objective of this course is to develop the basic competency in students for using these office automation tools to accomplish the job.

2. COMPETENCY

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

- **Use computers for internet services, electronic documentation, data analysis and slide presentation.**

3. COURSE OUTCOMES (COs)

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

a. Use computer system and its peripherals.
b. Prepare business document using word processing tool.
c. Interpret data and represent it graphically using spreadsheet.
d. Prepare professional presentations.
e. Use different types of web browsers.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	**T**	**P**	**C**	**ESE**	**PA**	**ESE**	**PA**	
2#	-	2	4	-	-	25	25~[1]	50

(~[1]): *For the **practical only courses,** the PA has two components under practical marks i.e. the assessment of practicals (seen in section 6) has a weightage of 60% (i.e.15 marks) and micro-project assessment (seen in section 12) has a weightage of 40% (i.e.10 marks). This is designed to facilitate attainment of COs holistically, as there is no theory ESE.*

Legends: ***L****-Lecture;* ***T*** *– Tutorial/Teacher Guided Theory Practice;* ***P*** *- Practical;* ***C*** *– Credit,* ***ESE*** *- End Semester Examination;* ***PA*** *- Progressive Assessment;* ***#*** *No theory exam.*

5. COURSE MAP (with sample COs, Learning Outcomes i.e. LOs and topics)

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

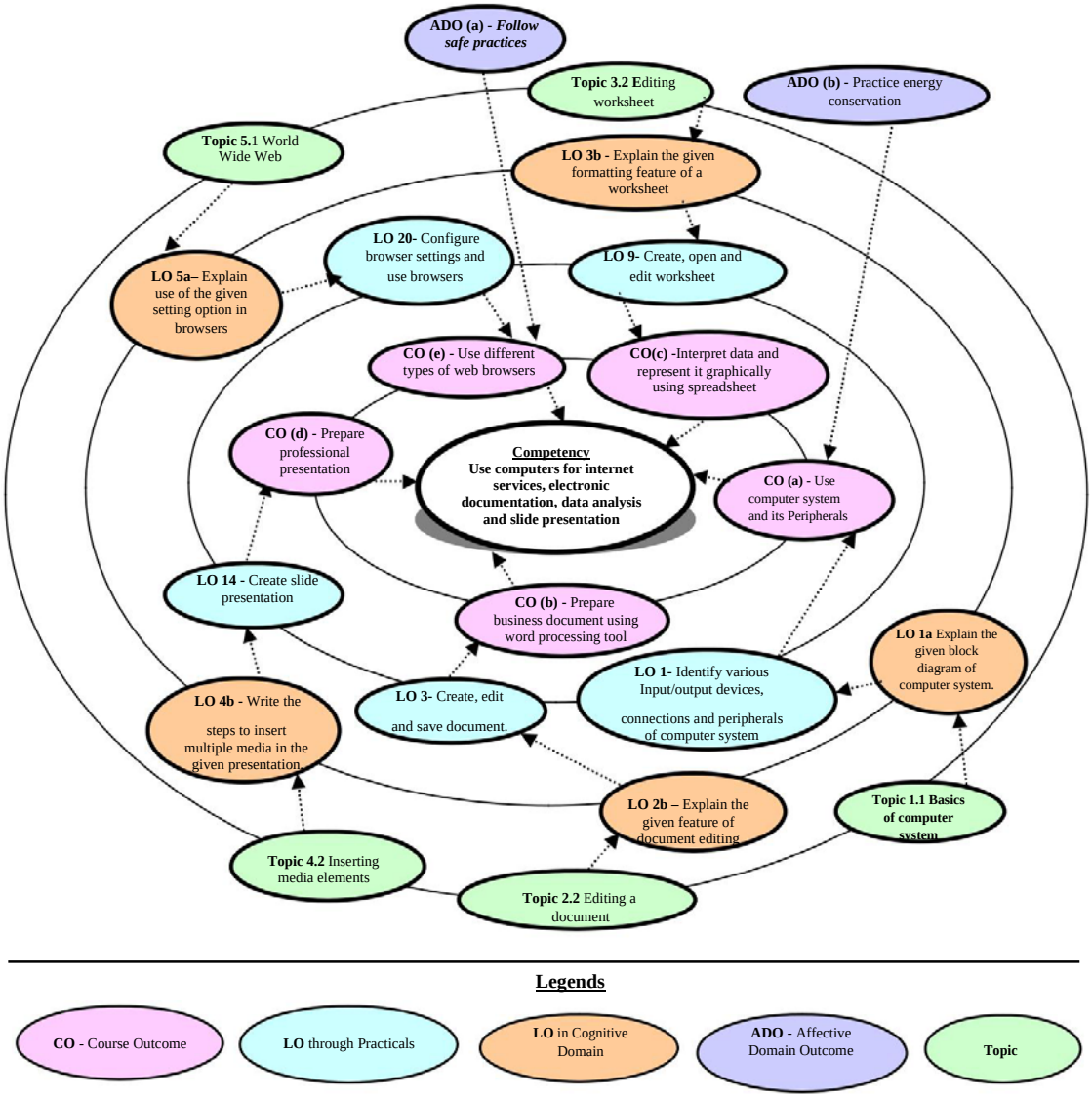

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals/exercises/tutorials in this section are psychomotor domain LOs (i.e. sub-components of the COs) are to be developed and assessed in the student to lead to the attainment of the competency.

S. No.	Practical Exercises (Learning Outcomes to be achieved through practicals)	Unit No.	Approx. Hrs. required
Computer system and Operating system:			
1	Identify various Input/output devices, connections and peripherals of	I	1*

S. No.	Practical Exercises (Learning Outcomes to be achieved through practicals)	Unit No.	Approx. Hrs. required
	computer system		
2	Manage files and folders : Create, copy, rename, delete, move files and folder	I	1
	Word Processing		
3	Create, edit and save document : apply formatting features on the text - line, paragraph	II	2*
4	Use bullets, numbering, page formatting	II	2
5	Insert and edit images and shapes, sizing, cropping, colour, background, group/ungroup	II	2
6	Insert and apply various table formatting features on it.	II	2
7	Apply page layout features i. Themes, page background, paragraph, page setup ii. Create multicolumn page iii. Use different options to print the documents	II	2*
8	Use mail merge with options.	II	1
	Spreadsheets		
9	Create, open and edit worksheet i. Enter data and format it, adjust row height and column width ii. Insert and delete cells, rows and columns iii. Apply wrap text, orientation feature on cell.	III	2*
10	Insert formulas, "IF" conditions, functions and named ranges in worksheet.	III	2
11	Apply data Sort, Filter and Data Validation features.	III	2*
12	Create charts to apply various chart options.	III	2
13	Apply Page setup and print options for worksheet to print the worksheet.	III	1
	Presentation Tool		
14	Create slide presentation i. Apply design themes to the given presentation ii. Add new slides and insert pictures/images, shapes	IV	2*
15	i. Add tables and charts in the slides. ii. Run slide presentation in different modes iii. Print slide presentation as handouts	IV	2
16	Apply animation effects to the text and slides.	IV	1
17	Add audio and video files in the given presentation	IV	1
	Internet Basics		
18	Configure Internet connection	V	1
19	Use internet for different web services.	V	2*
20	Configure browser settings and use browsers.	V	1*
	Total		**32**

'': compulsory practicals to be performed.*

Note

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

ii. Hence, the 'Process' and 'Product' related skills associated with each LO of the laboratory/workshop/field work are to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
a.	Use of Appropriate tool to solve the problem (Process)	40
b.	Quality of output achieved (Product)	30
c.	Complete the practical in stipulated time	10
d.	Answer to sample questions	10
e.	Submit report in time	10
Total		**100**

Additionally, the following affective domain LOs (social skills/attitudes), are also important constituents of the competency which can be best developed through the above mentioned laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical practices.

The development of the attitude related LOs of Krathwohl's 'Affective Domain Taxonomy', the achievement level may reach:

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Exp. S.No.
1	Computer system with all necessary components like; motherboard, random access memory (RAM), read-only memory (ROM), Graphics cards, sound cards, internal hard disk drives, DVD drive, network interface card.	1
2	Double side printing laser printer.	1,6,12,13
3	Hubs, Switches, Modems.	1, 16,17
4	Any operating system.	2 to18
5	Any Office Software.	2 to 15
6	Any browser.	16,17,18

Note: *There are no specifications fixed for the above listed systems, devices and instruments. Depending on the availability in the institute they can be utilized for the purpose.*

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Introduction to Computer System	1a. Explain the given block diagram of computer system. 1b. Classify the given type of software 1c. Explain characteristics of the specified type of network. 1d. Describe procedure to manage a file /folder in the given way. 1e. Describe application of the specified type of network connecting device	1.1 **Basics of Computer System:** Overview of Hardware and Software: block diagram of Computer System, Input/Output unit CPU, Control Unit, Arithmetic logic Unit (ALU), Memory Unit 1.2 **Internal components:** processor, motherboards, random access memory (RAM), read-only memory (ROM), video cards, sound cards and internal hard disk drives) 1.3 **External Devices:** Types of input/output devices, types of monitors, keyboards, mouse, printers: Dot matrix, Inkjet and LaserJet, plotter and scanner, external storage devices CD/DVD, Hard disk and pen drive 1.4 **Application Software:** word processing, spreadsheet, database management systems, control software, measuring software, photo-editing software, video-editing software, graphics manipulation software System Software compilers, linkers, device drivers, operating systems and utilities 1.5 **Network environments**: network interface cards, hubs, switches, routers and modems, concept of LAN, MAN, WAN, WLAN, Wi-Fi and Bluetooth 1.6 **Working with Operating Systems**: Create and manage file and folders, Copy a file, renaming and deleting of files and folders, Searching files and folders, application installation, creating shortcut of application on the desktop.
Unit– II Word Processing	2a. Write steps to create the given text document. 2b. Explain the specified feature for document editing. 2c. Explain the given page setup features of a document. 2d. Write the specified table formatting feature.	2.1. **Word Processing:** Overview of Word processor Basics of Font type, size, colour, Effects like Bold, italic, underline, Subscript and superscript, Case changing options, Previewing a document, Saving a document, Closing a document and exiting application. 2.2. **Editing a Document:** Navigate through a document, Scroll through text, Insert and delete text, Select text, Undo and redo commands, Use drag and drop to move text, Copy, cut and paste, Use the clipboard, Clear formatting, Format and align text, Formatting Paragraphs, Line and paragraph spacing, using FIND and REPLACE, Setting line

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
		spacing, add bullet and numbers in lists, add borders and shading, document views, Page settings andmargins, Spelling and Grammatical checks 2.3. **Changing the Layout of a Document:** Adjust page margins, Change page orientation, Create headers and footers, Set and change indentations, Insert and clear tabs. 2.4. **Inserting Elements to Word Documents**: Insert and delete a page break, Insert page numbers, Insert the date and time, Insert special characters (symbols), Insert a picture from a file, Resize and reposition a picture 2.5. **Working with Tables:** Insert a table, Convert a table to text, Navigate and select text in a table, Resize table cells, Align text in a table, Format a table, Insert and delete columns and rows, Borders and shading, Repeat table headings on subsequent pages, Merge and split cells. 2.6. **Working with Columned Layouts and Section Breaks:** a Columns, Section breaks, Creating columns, Newsletter style columns, Changing part of a document layout or formatting, Remove section break, Add columns to remainder of a document, Column widths, Adjust column spacing, Insert manual column breaks.
Unit– III Spreadsheets	3a. Write steps to create the given spreadsheet. 3b. Explain the specified formatting feature of a worksheet. 3c. Write steps to insert formula and functions in the given worksheet. 3d. Write steps to create charts for the specified data set. 3e. Explain steps to perform advance operation on the given data set.	3.1. **Working with Spreadsheets:** Overview of workbook and worksheet, Create Worksheet Enteringsampledata,Save,Copy Worksheet, Delete Worksheet, Close and open Workbook. 3.2. **Editing Worksheet:** Insert and select data, adjust row height and column width, delete, move data, insert rows and columns, Copy and Paste, Find and Replace, Spell Check, Zoom In-Out, Special Symbols, Insert Comments, Add Text Box, Undo Changes, - Freeze Panes, hiding/unhiding rows and columns. 3.3. **Formatting Cells and sheet:** Setting Cell Type, Setting Fonts, Text options, Rotate Cells, Setting Colors, Text Alignments, Merge and Wrap, apply Borders and Shades, Sheet Options, Adjust Margins, Page

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
		Orientation, Header and Footer, Insert Page Breaks, Set Background. 3.4. **Working with Formula:** Creating Formulas, Copying Formulas, Common spreadsheet Functions such as sum, average, min, max, date, In, And, or, mat hemat ical funct ions such as sqrt, power, applying conditions using IF. 3.5. **Working with Charts:** Introduction to charts, overview of different types of charts, Bar, Pie, Line charts, creating and editing charts. Using chart options: chart title, axis title, legend, data labels, Axes, grid lines, moving chart in a separate sheet. 3.6. **Advanced Operations:** Conditional Formatting, Data Filtering, Data Sorting, Using Ranges, Data Validation, Adding Graphics, Printing Worksheets, print area, margins, header, footer and other page setup options.
Unit– IV Presentation Tool	4a. Write the steps to create the specified slide presentation. 4b. Write the steps to insert multiple media in the given presentation. 4c. Write steps to apply table features in the given presentation 4d. Write steps to manage charts in the given presentation	4.1 **Creating a Presentation:** Outline of an effective presentation, Identify the elements of the User Interface, Starting a New Presentation Files, Creating a Basic Presentation, Working with textboxes, Apply Character Formats, Format Paragraphs, View a Presentation, Saving work, creating new Slides, Changing a slide Layout, Applying a theme, Changing Colours, fonts and effects, apply custom Colour and font theme, changing the background, Arrange Slide sequence, 4.2 **Inserting Media elements:** Adding and Modifying Graphical Objects to a Presentation - Insert Images into a Presentation, insert audio clips, video/animation, Add Shapes, Add Visual Styles to Text in a Presentation, Edit Graphical Objects on a Slide, Format Graphical Objects on a Slide, Group Graphical Objects on a Slide, Apply an Animation Effect to a Graphical Object, Add Transitions, Add Speaker Notes, Print a Presentation. 4.3 **Working with Tables:** Insert a Table in a Slide, Format Tables, and Import Tables from Other Office Applications.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
		4.4 **Working with Charts:** Insert Charts in a Slide, Modify a Chart, Import Charts from Other Office Applications.
Unit– V Basics of Internet	5a. Explain use of the given setting option in browsers. 5b. Explain features of the specified web service. 5c. Describe the given characteristic of cloud. 5d. Explain the specified option used for effective searching in search engine.	5.1 **World Wide Web**: Introduction, Internet, Intranet, Cloud, Web Sites, web pages, URL, web servers, basic settings of web browsers-history, extension, default page, default search engine, creating and retrieving bookmarks, use search engines effectively for searching the content. 5.2 **Web Services**: e-Mail, Chat, Video Conferencing, e-learning, e-shopping, e-Reservation, e-Groups, Social Networking.

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

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

- Not Applicable -

10. SUGGESTED STUDENT ACTIVITIES

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

a. Prepare journal of practicals.
b. Prepare a sample document with all word processing features.(Course teacher shall allot appropriate document type to each students)
c. Undertake micro projects

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the LOs/COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.
f. Guide student(s) in undertaking various activities in the lab/workshop.
g. Demonstrate students thoroughly before they start doing the practice.
h. Show video/animation films for handling/functioning of instruments.
i. Observe continuously and monitor the performance of students in Lab.

12. SUGGESTED MICRO-PROJECTS

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

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

a. **Word documents**: Prepare Time Table, Application, Notes, Reports .(Subject teacher shall assign a document to be prepared by the each students)
b. **Slide Presentations:** Prepare slides with all Presentation features such as: classroom presentation, presentation about department, presentation of report. (Subject teacher shall assign a presentation to be prepared by the each student).
c. **Spreadsheets:** Prepare Pay bills, tax statement, student's assessment record using spreadsheet. (Teacher shall assign a spreadsheet to be prepared by each student).

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Computer Fundamentals	Goel, Anita	Pearson Education, New Delhi, 2014, ISBN: 978-8131733097
2	Computer Basics Absolute Beginner's Guide, Windows 10	Miller, Michael	QUE Publishing; 8th edition August 2015, ISBN: 978-0789754516
3	Linux: Easy Linux for Beginners	Alvaro, Felix	CreatevSpace Independent Publishing Platform- 2016, ISBN: 978-1533683731
4	Microsoft Office 2010: On Demand	Johnson, Steve	Pearson Education, New Delhi India, 2010; ISBN: 9788131770641
5	Microsoft Office 2010 for Windows: Visual Quick Start	Schwartz, Steve	Pearson Education, New Delhi India, 2012, ISBN:9788131766613
6	OpenOffice.org for Dummies	Leete, Gurdy, Finkelstein Ellen, Mary Leete	Wiley Publishing, New Delhi, 2003 ISBN: 978-0764542220

14. SOFTWARE/LEARNING WEBSITES

a. https://www.microsoft.com/en-in/learning/office-training.aspx
b. http://www.tutorialsforopenoffice.org/
c. https://s3-ap-southeast-1.amazonaws.com/r4ltue295xy0d/Special_Edition_Using_StarOffice_6_0.pdf

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION (MSBTE)

I – Scheme

I – Semester Course Curriculum

Course Title: **Engineering Graphics** (AE, CE, CH, DC, EE,FG, ME, PS, PT, TC, TX)
(Course Code: .....)

Diploma programme in which this course is offered	Semester in which offered
Fabrication Technology and Erection Engineering, Fashion and Clothing Technology, Textile Manufacturing, Textile Technology, Automobile, Chemical, Civil, Electrical, Mechanical, Plastic Engineering and Production Technology.	First

1. RATIONALE

Engineering graphics is the language of engineers. The concepts of graphical language are used in expressing the ideas, conveying the instructions, which are used in carrying out the jobs on the sites, shop floor. It covers the knowledge and application of drawing instruments and also familiarizes the learner about Bureau of Indian standards related to engineering drawing. The curriculum aims at developing the ability to draw and read various engineering curves, projections and dimensioning styles. The course mainly focuses on use of drawing instruments, developing imagination and translating ideas into sketches. The course also helps to develop the idea of visualizing the actual object or part on the basis of drawings and blue prints. This preliminary course aims at building a foundation for the further courses related to engineering drawing and other allied courses in coming semesters.

2. COMPETENCY

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

- **Prepare engineering drawing manually using prevailing drawing instruments**.

3. COURSE OUTCOMES (COs)

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

a. Draw geometrical figures and engineering curves.
b. Draw the views of given object using principles of orthographic projection.
c. Draw isometric views of given component or from orthographic projections.
d. Use drawing codes, conventions and symbols as per IS SP-46 in engineering drawing.
e. Draw free hand sketches of given engineering elements.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
2#	-	4	6	-	-	50**	50~[2]	100

(**) *marks should be awarded on the basis of internal end semester theory exam of 50 marks based on the specification table given in S. No. 9.*

(~[2])*: For the* ***practical only courses,*** *the PA has two components under practical marks i.e. the assessment of practicals (seen in section 6) has a weightage of 60% (i.e.30 marks) and micro-project assessment (seen in section 12) has a weightage of 40% (i.e.20 marks). This is designed to facilitate attainment of COs holistically, as there is no theory ESE.*
Legends: L*-Lecture;* ***T*** *– Tutorial/Teacher Guided Theory Practice;* ***P*** *- Practical;* ***C*** *– Credit,* ***ESE*** *- End Semester Examination;* ***PA*** *- Progressive Assessment, #: No theory paper.*

5. COURSE MAP (with sample COs, Learning Outcomes i.e.LOs and topics)

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

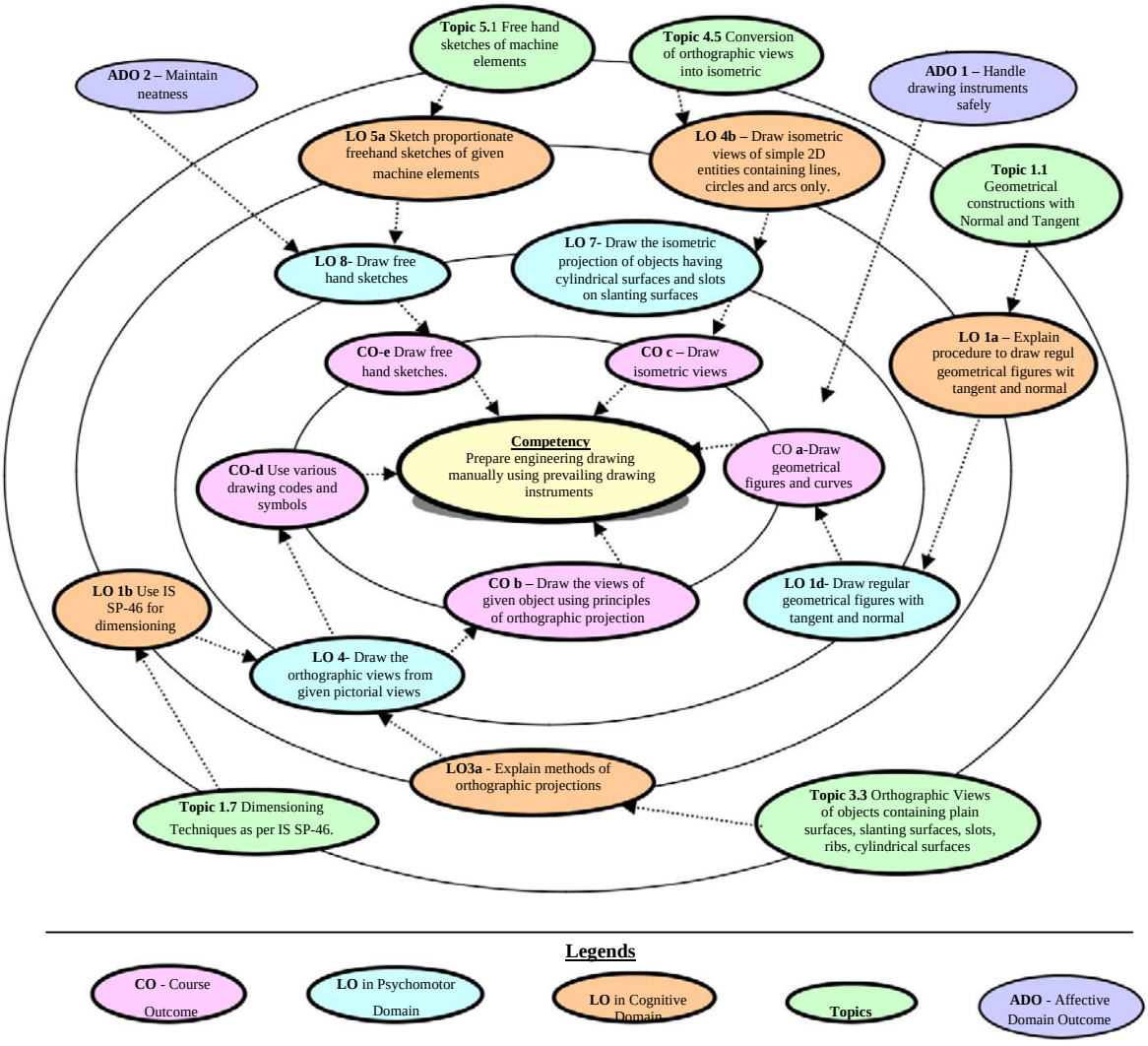

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals/exercises/tutorials in this section are psychomotor domain LOs (i.e.sub-components of the COs), to be developed and assessed in the student to lead to the attainment of the competency.

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 Tee and Set squares/ drafter. (do this exercise in sketch book)	I	02*
2	Write alphabets and numerical (Vertical only) (do this exercise in sketch book)	I	02*
3	Draw regular geometric constructions and redraw the given figure (do this exercise in sketch book) Part I	I	02*
4	Draw regular geometric constructions and redraw the given figure (do this exercise in sketch book) Part II	I	02
5	Draw one figure showing dimensioning techniques. Part I	I	02*
6	Draw one problem on redraw the figure. Part II	I	02
7	Draw one problem on loci of points - slider crank mechanism. Part III	I	02*
8	Draw Engineering Curves. Part I	II	02*
9	Draw Engineering Curves. Part II	II	02
10	Draw Engineering Curves. Part III	II	02
11	Draw Engineering Curves. Part IV	II	02
12	Draw a problem on orthographic projections using first angle method of projection having plain surfaces. Part I	III	02*
13	Draw another problem on orthographic projections using first angle method of projection having plain surfaces. Part II	III	02
14	Draw a problem on orthographic projections using first angle method of projection having slanting surfaces. Part III	III	02
15	Draw another problem on orthographic projections using first angle method of projection having slots on slanting surfaces. Part IV	III	02
16	Draw two problems on orthographic projections using first angle method of projection having cylindrical surfaces, ribs. Part I	III	02*
17	Draw two problems on orthographic projections using first angle method of projection having cylindrical surfaces, ribs. Part II	III	02
18	Draw two problems on orthographic projections using first angle method of projection having cylindrical surfaces, ribs. Part III	III	02
19	Draw two problems on orthographic projections using first angle method of projection having cylindrical surfaces, ribs. Part IV	III	02
20	Draw two problems on orthographic projections using first angle method of projection having cylindrical surfaces, ribs. Part V	III	02
21	Draw two problems on Isometric view of simple objects having plain and slanting surface by using natural scale. Part I	IV	02*
22	Draw two problems on Isometric view of simple objects having plain and slanting surface by using natural scale. Part II	IV	02

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. Required
23	Draw two problems on Isometric view of simple objects having plain and slanting surface by using natural scale. Part III	IV	02
24	Draw a problem on Isometric Projection of objects having cylindrical surface by using isometric scale. Part I	IV	02*
25	Draw another problem on Isometric Projection of objects having cylindrical surface by using isometric scale. Part II	IV	02
26	Draw a problem on Isometric Projection of objects having slanting surface by using isometric scale. Part III	IV	02
27	Draw another problem on Isometric Projection of objects having slot on slanting surface by using isometric scale. Part IV	IV	02
28	Draw free hand sketches/conventional representation of machine elements in sketch book such as thread profiles, nuts, bolts, studs, set screws, washers, Locking arrangements. Part I	V	02*
29	Draw free hand sketches/conventional representation of machine elements in sketch book such as thread profiles, nuts, bolts, studs, set screws, washers, Locking arrangements. Part II	V	02
30	Draw free hand sketches/conventional representation of machine elements in sketch book such as thread profiles, nuts, bolts, studs, set screws, washers, Locking arrangements. Part III	V	02
31	Problem Based Learning: Given the orthographic views of at least three objects with few missing lines, the student will try to imagine the corresponding objects, complete the views and draw these views in sketch book. Part I	III, II, V	02*
32	Problem Based Learning: Given the orthographic views of at least three objects with few missing lines, the student will try to imagine the corresponding objects, complete the views and draw these views in sketch book. Part II	III, II, V	02
	Total		**64**

Note

i. *A suggestive list of practical LOs is given in the above table, more such practical LOs can be added to attain the COs and competency. A judicial mix of minimum 24 or more practical LOs/tutorials need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. *Hence, the 'Process' and 'Product' related skills associated with each LO of the laboratory/workshop/field work are to be assessed according to a suggested sample given below:*

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

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

Additionally, the following affective domain LOs (social skills/attitudes), are also important constituents of the competency which can be best developed through the above mentioned laboratory/field based experiences:

a. Follow cleanliness and neatness.
b. Follow ethics and standards.

The development of the attitude related LOs of Krathwohl's 'Affective Domain Taxonomy', the achievement level may reach:

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Exp. S.No.
1	Drawing Table with Drawing Board of Full Imperial/ A1 size.	All
2	Models of objects for orthographic / isometric projections	4,5,6,7
3	Models/ Charts of objects mentioned in unit no. 5	-
4	Set of various industrial drawings being used by industries.	All
5	Set of drawings sheets mentioned in section 6.0 could be developed by experienced teachers and made used available on the MSBTE portal to be used as reference/standards.	All
6	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
7	Interactive board with LCD overhead projector	All

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Basic elements of Drawing	1a. Prepare drawing using drawing instruments. 1b. Use IS SP-46 for dimensioning. 1c. Use different types of	1.1 Drawing Instruments and supporting material: method to use them with applications. 1.2 Standard sizes of drawing sheets (ISO-A series)

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	lines. 1d. Draw regular geometrical figures. 1e. Draw figures having tangency constructions.	1.3 I.S. codes for planning and layout. 1.4 Letters and numbers (single stroke vertical) 1.5 Convention of lines and their applications. 1.6 Scale - reduced, enlarged and full size 1.7 Dimensioning techniques as per SP-46 (Latest edition) – types and applications of chain, parallel and coordinate dimensioning 1.8 Geometrical constructions.
Unit– II Engineering curves and Loci of Points	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 2e. Plot Loci of points from given data.	2.1 Concept of focus, directrix, vertex and eccentricity. Conic sections. 2.2 Methods to draw an ellipse by Arcs of circle method and Concentric circles method. 2.3 Methods to draw a parabola by Directrix-Focus method and Rectangle method 2.4 Methods to draw a hyperbola by Directrix-Focus method. 2.5 Methods to draw involutes: circle and pentagon, 2.6 Methods to draw Cycloidal curve: cycloid, epicycloid and hypocycloid 2.7 Methods to draw Helix and Archimedean spiral. 2.8 Loci of points on Single slider crank mechanism with given specifications.
Unit– III Orthographic projections	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 Projections-orthographic, perspective, isometric and oblique: concept and applications.(No question to be asked in examination) 3.2 Orthographic projection, First angle and Third angle method, their symbols. 3.3 Conversion of pictorial view into Orthographic Views – object containing plain surfaces, slanting surfaces, slots, ribs, cylindrical surfaces. (use First Angle Projection Method Only)
Unit– IV Isometric projections	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. 4d. Draw Isometric views from given orthographic	4.1 Isometric projection. 4.2 Isometric scale and Natural Scale. 4.3 Isometric view and isometric projection. 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 isometric View/projection.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	views.	
Unit– V Free Hand Sketches of engineering elements	5a. Sketch proportionate freehand sketches of given machine elements. 5b. 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. (For branches other than mechanical Engineering, the teacher should select branch specific elements for free hand sketching)

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

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER (INTERNAL) DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Principles of Drawing	04	-	02	04	06
II	Engineering curves and Loci of Points.	06	02	02	04	08
III	Orthographic projections	06	-	02	08	10
IV	Isometric projections	08	02	07	07	16
V	Free Hand Sketches of m/c elements	08	02	02	08	12
Total		**32**	**6**	**15**	**31**	**50**

***Legends:** R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note**: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of LOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*
This specification table also provides a general guideline for teachers to frame internal end semester practical theory exam paper which students have to undertake on the drawing sheet.

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**:**

a. Student should maintain a separate A3 size sketch book which will be the part of term work and submit it along with drawing sheets. Following assignment should be drawn in the sketch book
   i. Single stoke vertical Letters and Numbers.
   ii. Type of lines.
   iii. Redraw the figures (any one).
   iv. Engineering Curves. One problem for each type of curve.
   v. Orthographic projections. Minimum 5 problems.
   vi. Isometric Projections/Views. Minimum 5 problems.

vii. Free hand sketches. All types of machine elements mentioned in Unit no-5.
viii. Note- Problems on sheet and in the sketch book should be different.

b. Students should collect Maps, Production drawings, Building Drawings, Layouts from nearby workshops/industries/builders/contractors and try to list
   i. Types of lines used
   ii. Lettering styles used
   iii. Dimension styles used
   iv. IS code referred.
c. 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).
d. Take one circular shape. Assume one point on circumference and mark it. Roll that shape on flat and circular surface. Observe the path of the point and try to correlate with the theory taught in the class
e. Take circular and pentagonal shape and wrap a thread over the periphery, now unwrap this thread and observe the locus of the end of the thread and try to correlate with the theory taught in the class
f. Each student should explain at least one problem for construction and method of drawing in sheet to all batch colleagues. Teacher will assign the problem of particular sheet to be explained to each student batch.
g. Each student will assess at least one sheet of other students (May be a group of 5-6 students identified by teacher can be taken) and will note down the mistakes committed by them. Student will also guide the students for correcting the mistakes, if any.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the LOs/COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
a. Guide student(s) in undertaking micro-projects.
b. Guide student(s) in fixing the sheet and mini drafter on drawing board..
c. Show video/animation films to explain orthographic and Isometric projection.
d. Demonstrate first and third angle method using model.
   Use charts and industrial drawing/drawing sheets developed by experienced faculty to teach standard symbols and current industrial/teaching practices

12. SUGGESTED MICRO PROJECTS

Only one micro-project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of practicals, cognitive domain and affective domain LOs. The micro-

project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course.

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

a. **Helical springs:** Each batch will collect 5 open coil and closed coil helical springs of various sizes. Each student will measure the significant parameters of one spring and draw corresponding helix curve in his sketch book.
b. **Flat coil or spiral springs:** Each batch will collect 10 spiral springs of various sizes. Each student will measure the significant parameters of one spring and draw corresponding helix curve in his sketch book.
c. **Isometric views**: Each student of the batch will try to collect at least one production drawings/ construction drawings/plumbing drawings from local workshops/builders /electrical and mechanical contractors and try to generate isometric views from the orthographic views given in the drawings.
d. **Isometric views**: Each student of a batch will select a household/industrial real item and will draw its isometric view in the sketch book.
e. **Isometric and orthographic views**: Each batch will collect a single point cutting tool from workshop and draw its Isometric and orthographic views with a ten times enlarged scale. In carpentry shop each batch will try to make wooden model from these views.
f. **Isometric views**: The teacher will assign one set of orthographic projections and ask the student to develop 3D thermocol models of the same.
g. **Involute curves:** Each batch will try to develop cardboard/thermocol working models which can generate involute curve of any regular geometrical shape.
h. **Cycloidal curves:** Each batch will collect 3 different sizes bicycle tyres and compare the locus of tube air valve by rolling them on flat road.
i. **Conic curves:** Each batch will go to institute's play ground and one student standing on the boundary throws a ball to the wicket keeper who is 30 meters away from the thrower and the ball has reached a maximum height of 20 meters from the ground, draw the path of the ball and identify the type of conic curve it has traced in air.
j. **Involute and Cycloidal curves:** Each batch will collect one Involute and one cycloidal tooth profile spur gear and find out the Involute function.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1.	Engineering Drawing Practice for Schools and Colleges IS: SP-46	Bureau of Indian Standards.	BIS, Government of India, Third Reprint, October 1998; ISBN:. 81-7061-091-2
2.	Engineering Drawing	Bhatt, N.D.	Charotar Publishing House, Anand, Gujarat 2010; ISBN: 978-93-80358-17-8
3.	Machine Drawing	Bhatt, N.D.; Panchal, V. M	Charotar Publishing House, Anand, Gujarat 2010; ISBN: 978-93-80358-11-6

S. No.	Title of Book	Author	Publication
4.	Engineering Drawing	Jolhe, D.A.	Tata McGraw Hill Edu. New Delhi, 2010, ISBN: 978-0-07-064837-1
5.	Engineering Drawing	Dhawan, R. K.	S. Chand and Company New Delhi, ISBN:81-219-1431-0
6.	Engineering Drawing	Shaha, P. J.	S. Chand and Company, New Delhi, 2008, ISBN: 81-219-2964-4

14. SOFTWARE/LEARNING WEBSITES

a. https://www.youtube.com/watch?v=TJ4jGyD-WCw
b. https://www.youtube.com/watch?v=dmt6_n7Sgcg
c. https://www.youtube.com/watch?v=_MQScnLXL0M
d. https://www.youtube.com/watch?v=3WXPanCq9LI
e. https://www.youtube.com/watch?v=fvjk7PlxAuo
f. http://www.me.umn.edu/courses/me2011/handouts/engg%20graphics.pdf
g. https://www.machinedesignonline.com

Maharashtra State Board of Technical Education, Mumbai

Teaching and Examination Scheme for Post S.S.C. Diploma Courses

Program Name : Civil Engineering Groups

Program Code : CE/CR/ CS — **With Effect From Academic Year: 2017 - 18**

Duration of Program : 6 Semesters — **Duration : 16 Weeks**

Semester : Second — **Scheme - I**

S. N.	Course Title	Course Abbreviation	Course Code	Teaching Scheme			Credit (L+T+P)	Examination Scheme												Grand Total
								Theory						Practical						
								Exam Duration in Hrs.	ESE		PA		Total		ESE		PA		Total	
				L	T	P			Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	
1	Applied Mathematics	AMS	22201	3	1	-	4	3	70	28	30*	00	100	40	--	--	--	--	--	--	100
2	Applied Science – Physics	ASM	22202	2	-	4	8	90 Min	70*#	28	15*	00	100	40	25@	10	25	10	50	20	200
	Applied Science – Chemistry			2	-						15*	00			25@	10	25	10	50	20	
3	Applied Mechanics	AME	22203	3	1	2	6	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
4	Construction Materials	CMA	22204	3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
5	Basic Surveying	BSU	22205	3	-	4	7	3	70	28	30*	00	100	40	50#	20	50	20	100	40	200
6	Civil Engineering Workshop and Practice	CEW	22008	-	-	4	4	--	--	--	--	--	--	--	50#	20	50~	20	100	40	100
7	Business Communication Using Computers	BCC	22009	-	-	2	2	--	--	--	--	--	--	--	35@^	14	15~	06	50	20	50
			Total	**16**	**2**	**18**	**36**	--	**350**	--	**150**	--	**500**	--	**235**	--	**215**	--	**450**	--	**950**

Student Contact Hours Per Week: **36 Hrs.** Medium of Instruction: **English**

Theory and practical periods of 60 minutes each. Total Marks : **950**

Abbreviations: ESE- End Semester Exam, PA- Progressive Assessment, L - Lectures, T - Tutorial, P - Practical

@ Internal Assessment, # External Assessment, *# On Line Examination , ^ Computer Based Assessment

* Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment (5 marks each for Physics and Chemistry) to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain LOs required for the attainment of the COs.

~ For the courses having ONLY Practical Examination, the PA marks Practical Part - with 60% weightage and Micro-Project Part with 40% weightage

- **It is mandetory for the candidate to appear for practical (ESE) of both the part of Applied Science (Physics & Chemistry). Candidate remaining absent in exam of any one part, will be considered as absent for the head ESE (PR) of Applied Science.**
- **If Candidate not securing minimum marks for passing in the "PA" part of practical of any course of any semester then the candidate shall be declared as "Detained" for that semester.**

Program Name : **Civil Engineering Program Group**
Program Code : **CE/CR/CS**
Semester : **Second**
Course Title : **Applied Mathematics**
Course Code : **22201**

1. RATIONALE

This course is an extension of Basic Mathematics of first semester namely Applied Mathematics which is designed for its applications in engineering and technology using the techniques of calculus, differentiation, integration, differential equations and in particular numerical integration. Derivatives are useful to find slope of the curve, maxima and minima of the function, radius of curvature. Integral calculus helps in finding the area. Differential equation is used in finding the curve and its related applications for various engineering models. Numerical integration is used to find the area of the functions especially whose integration cannot be evaluated easily with routine methods. This course further develops the skills and understanding of mathematical concepts which underpin the investigative tools used in engineering.

2. COMPETENCY

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

- **Solve civil engineering related broad-based problems using the principles of applied mathematics.**

3. COURSE OUTCOMES (COs)

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

a. Calculate the equation of tangent, maxima, minima, radius of curvature by differentiation.
b. Solve the given problems of integration using suitable methods.
c. Apply the concept of integration to find area and volume.
d. Solve the differential equation of first order and first degree using suitable methods.
e. Apply the concept of numerical integration to investigate the area.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory						Practical					
				Paper	ESE		PA		Total		ESE		PA		Total	
L	T	P		Hrs.	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	1	--	4	3	70	28	30*	00	100	40	--	--	--	--	--	--

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain LOs required for the attainment of the COs.

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

5. COURSE MAP (with sample COs, Learning Outcomes i.e. LOs and topics)

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

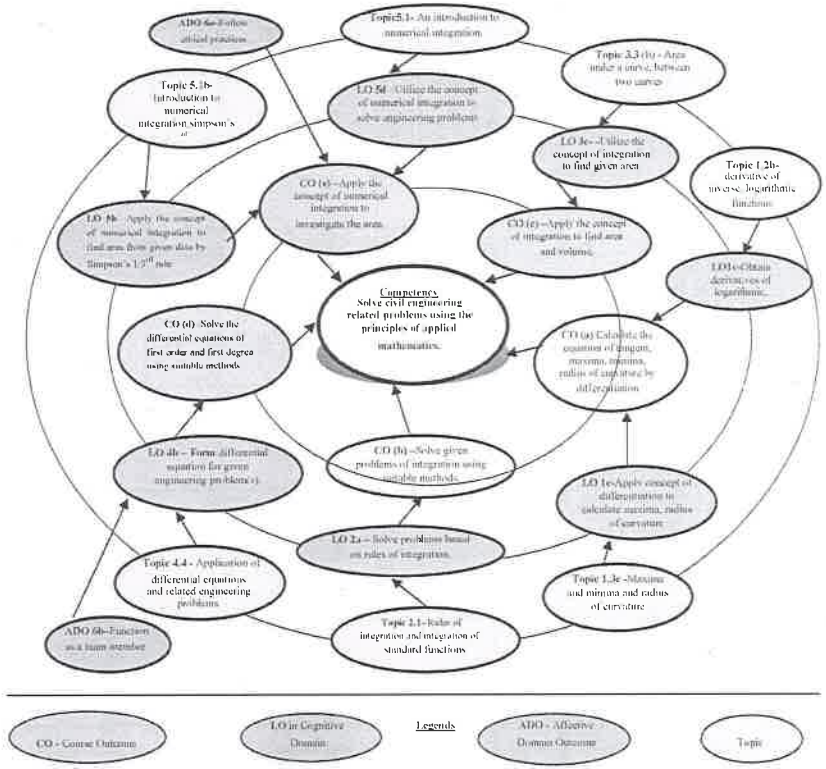

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

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

S. No.	Tutorials	Unit No.	Approx. Hrs. Required
1	Solve problems based on finding value of the function at different points.	I	1
2	Solve problems to find derivatives of implicit function and parametric function	I	1
3	Solve problems to find derivative of logarithmic and exponential functions.	I	1
4	Solve problems based on finding equation of tangent and normal.	I	1
5	Solveproblems based on finding maxima, minima of function and radius of curvature at a given point.	I	1
6	Solve the problems based on standard formulae of integration.	II	1
7	Solve problems based on methods of integration, substitution, partial fractions.	II	1
8	Solve problems based on integration by parts.	II	1
9	Solve practice problems based on properties of definite integration.	III	1
10	Solve practice problems based on finding area under curve, area between two curves and volume of revolutions.	III	1
11	Solve the problems based on formation, order and degree of differential equations.	IV	1
12	Develop a model using variable separable method to related engineering problem.	IV	1
13	Develop a model using the concept of linear differential equation to related engineering problem.	IV	1
14	Solve problems based on Trapezoidal rule	V	1
15	Solve problems based on Simpson's $1/3^{rd}$ rule and Simpson's $3/8^{th}$ rule.	V	1
16	Make use of concept of numerical integration to solve related civil engineering problems.	V	1
	Total		16

Note: The above tutorial sessions are for guideline only. The remaining tutorial hours are for revision and practice.

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED:

- Not applicable -

7. UNDERPINNING THEORY COMPONENTS

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

Unit	Major Cognitive Domain Learning Outcomes	Topics and Sub-topics
Unit – I Differential Calculus	1a. Solve the given simple problems based on functions. 1b. Solve the given simple problems based on rules of differentiation. 1c. Obtain the derivatives of logarithmic, exponential functions. 1d. Apply the concept of differentiation to find given equation of tangent and normal 1e. Apply the concept of differentiation to calculate maxima and minima and radius of curvature for given function.	1.1 Functions and Limits : a) Concept of function and simple examples b) Concept of limits without examples. 1.2 Derivatives : a) Rules of derivatives such as sum, product, quotient of functions. b) Derivative of composite functions (chain Rule), implicit and parametric functions. c) Derivatives of inverse, logarithmic and exponential functions. 1.3 Applications of derivative : a) Second order derivative without examples. b) Equation of tangent and normal c) Maxima and minima d) Radius of curvature
Unit– II Integral Calculus	2a. Solve the given simple problem(s) based on rules of integration. 2b. Obtain the given simple integral(s) using substitution method. 2c. Integrate given simple functions using the integration by parts. 2d. Evaluate the given simple integral by partial fractions.	2.1 Simple Integration: Rules of integration and integration of standard functions. 2.2 Methods of Integration: a) Integration by substitution. b) Integration by parts c) Integration by partial fractions.
Unit– III Applications of Definite Integration	3a. Solve given simple problems based on properties of definite integration. 3b. Apply the concept of definite integration to find the area under the given curve(s). 3c. Utilize the concept of definite integration to find area between given two curves. 3d. Invoke the concept of definite integration to find the volume of revolution of given surface.	3.1 Definite Integration: a) Simple examples b) Properties of definite integral (without proof) and simple examples. 3.2 Applications of integration : a) Area under the curve. b) Area between two curves. c) Volume of revolution.
Unit-IV First Order First Degree Differential Equations	4a. Find the order and degree of given differential equations. 4b. Form simple differential equations for given simple engineering problem(s). 4c. Solve given differential equations using the method of variable separable. 4d. Solve the given simple problems	4.1 Concept of differential equation 4.2 Order, degree and formation of differential equation. 4.3 Solution of differential equation a. Variable separable form. b. Linear differential equation 4.4 Application of differential equations and related engineering problems.

Unit	Major Cognitive Domain Learning Outcomes	Topics and Sub-topics
	based on linear differential equations.	
Unit –V Numerical Integration	5a. Apply the concept of numerical integration to find area from given data by Trapezoidal rule. 5b. Apply the concept of numerical integration to find area from given data by Simpson's $1/3^{rd}$ rule. 5c. Apply the concept of numerical integration to find area from given data by Simpson's $3/8^{th}$ rule. 5d. Utilize the concept of numerical integration to solve related engineering problems.	5.1 An introduction to numerical integration. a. Trapezoidal rule. b. Simpson's $1/3^{rd}$ rule. c. Simpson's $3/8^{th}$ rule.

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

8. 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	Differential calculus	14	04	08	12	24
II	Integral calculus	12	02	06	08	16
III	Applications of Definite Integration.	08	02	02	04	08
IV	First Order First Degree Differential Equations	06	02	02	04	08
V	Numerical integration	08	02	05	07	14
Total		**48**	**12**	**23**	**35**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*

Note: *This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of LOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

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:

a. Identify engineering problems based on real world problems and solve with the use of free tutorials available on the internet.
b. Use graphical software's: EXCEL, DPLOT, and GRAPH for related topics.
c. Use Mathcad as Mathematical Tools and solve the problems of Calculus.
d. Identify problems based on applications of differential equations and solve these problems.
e. Prepare models to explain different concepts of applied mathematics.
f. Prepare a seminar on any relevant topic based on applications of integration.
g. Prepare a seminar on any relevant topic based on applications of numerical integration to related engineering problems.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the LOs/COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.

11. SUGGESTED MICRO-PROJECTS

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

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

a. Prepare models using the concept of tangent and normal to bending of roads in case of sliding of a vehicle.
b. Prepare models using the concept of radius of curvature to bending of railway track.
c. Prepare charts displaying the area of irregular shapes using the concept of integration.
d. Prepare charts displaying volume of irregular shapes using concept of integration.
e. Prepare models using the concept of differential equations for mixing problem.
f. Prepare models using the concept of differential equations for radio carbon decay.
g. Prepare models using the concept of differential equations for population growth.
h. Prepare models using the concept of differential equations for thermal cooling.
i. Prepare charts displaying the area of irregular shapes using the concept of Simpson's $1/3^{rd}$ rule.
j. Prepare charts displaying the area of irregular shapes using the concept of Simpson's $3/8^{th}$ rule.

12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Higher Engineering Mathematics	Grewal, B.S.	Khanna publications, New Delhi , 2013 ISBN- 8174091955
2	A Text Book of Engineering Mathematics	Dutta, D.	New Age International Publications, New Delhi, 2006, ISBN: 978-81-224-1689-3
3	Advanced Engineering Mathematics	Krezig, Ervin	Wiley Publications, New Delhi, 2016 ISBN:978-81-265-5423-2,
4	Advanced Engineering Mathematics	Das, H.K.	S. Chand Publications, New Delhi, 2008, ISBN: 9788121903455
5	Engineering Mathematics, Volume 1 (4th edition)	Sastry, S.S.	PHI learning, New Delhi, 2014 ISBN-978-81-203-3616-2,
6	Comprehensive Basic Mathematics, Volume 2	Veena, G.R.	New Age International Publications, New Delhi, 2005 ISBN:978-81-224-1684-8
7	Getting Started with MATLAB-7	Pratap, Rudra	Oxford University Press, New Delhi, 2009 ISBN: 0199731241
8	Engineering Mathematics (3rd edition)	Croft, Anthony.	Pearson Education, New Delhi,2010 ISBN: 978-81-317-2605-1

13. SOFTWARE/LEARNING WEBSITES

a. www.scilab.org/ - SCI Lab
b. www.mathworks.com/products/matlab/ - MATLAB
c. Spreadsheet applications
d. www.dplot.com/ - DPlot
e. www.allmathcad.com/ - MathCAD
f. www.wolfram.com/mathematica/ - Mathematica
g. http://fossee.in/
h. https://www.khanacademy.org/math?gclid=CNqHuabCys4CFdOJaAoddHoPig
i. www.easycalculation.com
j. www.math-magic.com

Program Name : **Mechanical and Civil Engineering Program Group**
Program Code : **AE/CE/FG/ME/PT/PG**
Semester : **Second**
Course Title : **Applied Science (Physics & Chemistry)**
Course Code : **22202**

1. RATIONALE

Diploma engineers have to deal with various materials and machines. The study of concepts and principles of science like elasticity, viscosity, surface tension, motion, thermo couples, photo-sensors, LASERs, X-Rays, metals, alloys, cement, lime, refractory materials water treatment and analysis, fuel and combustion will help the student to select and use relevant materials and methods which will be economical and eco-friendly.

2. COMPETENCY

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

- **Solve broad-based engineering problems using principles of advanced physics and chemistry.**

3. COURSE OUTCOMES (COs)

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

a. Select relevant material in industry by analyzing its physical properties.
b. Apply laws of motion in various applications.
c. Use LASERs, X-Rays and photo electric sensors..
d. Select the relevant metallurgical process related to industrial applications.
e. Use relevant water treatment process to solve industrial problems.
f. Use relevant fuel in relevant applications.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory						Practical					
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
L	T	P			Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
2	-	4	8	90 Min	70*#	28	15*	00	100	40	25@	10	25	10	50	20
2	-						15*	00			25@	10	25	10	50	20

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment (5 marks each for Physics and Chemistry) to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.
Legends: ***L****-Lecture;* ***T*** *– Tutorial/Teacher Guided Theory Practice;* ***P*** *- Practical;* ***C*** *– Credit,* ***ESE*** *- End Semester Examination;* ***PA*** *- Progressive Assessment*
Note: *Practical of Chemistry and Physics will be conducted in alternate weeks for each batch.*

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

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

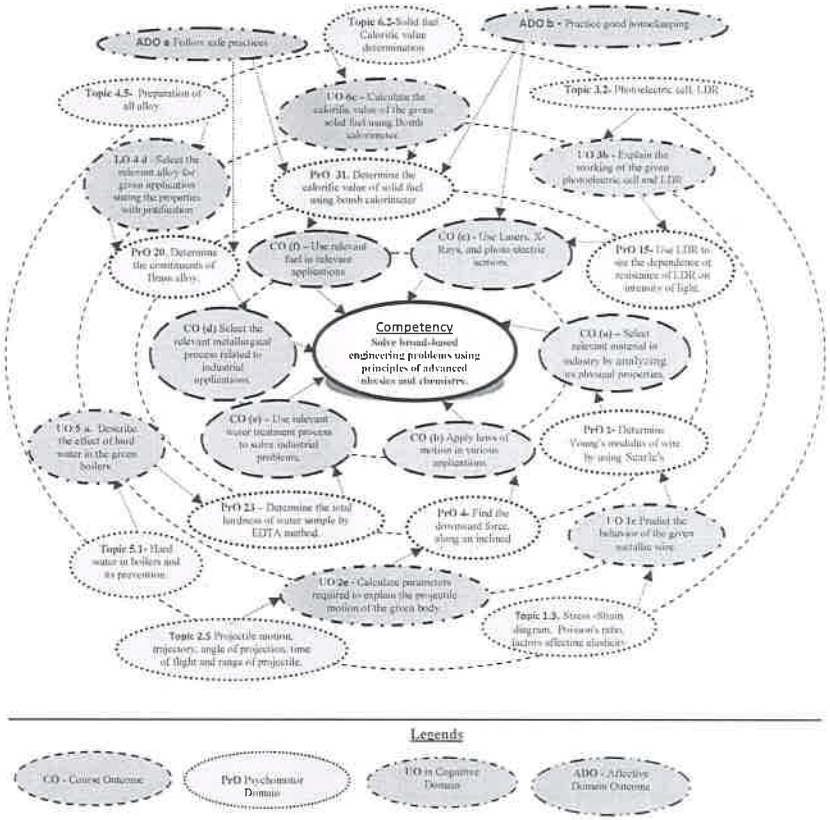

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

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

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	Physics		
1	Use Searle's method to determine the Young's modulus of given	I	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	wire		
2	Apply Archimedes' principle to determine the buoyancy force on a solid immersed in liquid.	I	02
3	Determine the coefficient of viscosity of given liquid by Stoke's method.	I	02
4	Find the downward force, along an inclined plane, acting on a roller due to gravity and its relationship with the angle of inclination.	I	02
5	Predict the range of the projectile from the initial launch speed and angle.	II	02*
6	i) Find the dependence of the stopping potential on the frequency of light source in photo electric effect experiment. ii) Find the dependence of the stopping potential on the intensity of light source in photo electric effect experiment.	III	02
7	Determine the I-V characteristics of photoelectric cell and LDR.	III	02*
8	Determine the divergence of laser beam.	III	02
	Chemistry		
9	Standardization of $KMnO_4$ solution using standard oxalic acid and Determine the percentage of iron present in given Hematite ore by $KMnO_4$ solution.	IV	02*
10	Determine the percentage of copper in given copper ore .	IV	02
11	Determine total hardness, temporary hardness and permanent hardness of water sample by EDTA method.	V	02*
12	Determine the alkalinity of given water sample.	V	02
13	Determine the turbidity of given water sample by Nephelometric method.	V	02
14	Determine the moisture and ash content in given coal sample using proximate analysis.	VI	02*
15	Determine the calorific value of given solid fuel using Bomb calorimeter.	VI	02*
16	Determine the percentage of Sulphur in given coal sample by ultimate analysis.(Gravimetric analysis)	VI	02
		Total	**32**

Note

i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

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

S. No.	Performance Indicators	Weightage in %
1	Preparation of experimental set up	20
2	Setting and operation	20

S. No.	Performance Indicators	Weightage in %
3	Safety measures	10
4	Observations and Recording	10
5	Interpretation of result and Conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
	Total	**100**

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

a. Follow safe practices.
b. Practice good housekeeping.
c. Practice energy conservation.
d. Demonstrate working as a leader/a team member.
e. Follow ethical Practices.

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

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Exp. No.
1	Searle's apparatus(with slotted mass of 0.5 kg each)	1
2	Liquid container	2
3	Solid body (different size and materials)	3,4
4	Stoke's apparatus (glass tube, viscous liquid, spherical balls of varying sizes)	3
5	Stop watch	4,5
6	Photo transducer	4
7	Timer	4
8	Projectile motion detector	5
9	Photo electric effect apparatus	6
10	Experimental setup for characteristics of photoelectric cell	7
11	Experimental setup for characteristics of LDR	7
12	Laser Source (He Ne, diode laser)	8
13	Electronic balance, with the scale range of 0.001g to 500g, pan size 100 mm; response time 3-5 sec.; power requirement 90-250 V, 10 watt.	All
18	Electric oven inner size 18''x18''x18'': temperature range 100 to 250^0 C with the capacity of 40 lt.	14,16
19	Bomb calorimeter	15

S. No.	Equipment Name with Broad Specifications	Exp. No.
20	Muffle furnace, Temperature up to 900^{0}C,digital temperature controller with an accuracy of +/- 3^{0}C	14,16
21	Nephelometer ; Auto-ranging from 20-200 NTU,+/- 2% of reading plus 0.1 NTU, power 220 Volts +/- 10% AC 50 Hz	13

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	Physics	
Unit – I Properties of matter and Non-Destructive Testing	1a. Explain concept of elasticity and plasticity for the given material. 1b. Establish relation between given types of modulii of elasticity. 1c. Predict the behavior of the given metallic wire.	1.1 Deforming Force and Restoring Force, Elasticity, Plasticity, Rigidity 1.2 Stress and Strain and their types, Elastic limit and Hooke's law, types of moduli of elasticity 1.3 Stress -Strain diagram, Poisson's ratio, factors affecting elasticity
	1d. Explain pressure-depth relation for the given law. 1e. Explain Newton's law of viscosity for the given liquid. 1f. Explain Stokes' law for the free fall of the body through the given viscous medium.	1.4 Fluid friction, pressure, pressure- depth relation, Pascal's law, Archimedes' principle 1.5 Viscosity, velocity gradient, Newton's law of viscosity. 1.6 Free fall of spherical body through viscous medium and Stokes' law, derivation of coefficient of viscosity 'η' by Stokes' method, effect of temperature and adulteration on viscosity of liquids.
	1g. Describe the salient features of the given NDT method.	1.7 Non-destructive testing (NDT),Various NDT methods used, Criteria for the selection of NDT method, merits and demerits of NDT
Unit– II Types of Motion	2a. Explain the equations of motion for the given body moving in the given type of path. 2b. Calculate the angular velocity of the given body. 2c. Explain the relevant Newton's laws of motion for the given moving object. 2d. Calculate the work/power/ energy for the given situation. 2e. Calculate the given	2.1 Displacement, velocity, acceleration and retardation, equations of motion, equations of motion under gravity. 2.2 Angular displacement, angular velocity, angular acceleration, three equations of angular motion 2.3 Momentum, impulse, impulsive force, Newton's laws of motion and their Applications 2.4 Work, power and energy: potential energy, kinetic energy, work -energy principle.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	parameters for the given projectile in motion.	2.5 Projectile motion, trajectory, angle of projection, time of flight and range of projectile with formulae.
Unit– III Photoelectricity, X-Rays and LASERs	3a. Explain the concept of the given parameters of the given material. 3b. Explain the working of the given photoelectric device.	3.1 Planck's hypothesis, properties of photons, Photo electric effect: threshold frequency, threshold wavelength, stopping potential, Work function, characteristics of photoelectric effect, Einstein's photoelectric equation. 3.2 Photoelectric cell and LDR: principle, working and applications.
	3c. Explain the production of X-Rays of the given material with properties and applications.	3.3 Production of X-rays by modern Coolidge tube, properties and applications.
	3d. Differentiate between LASER and given colour of light 3e. Explain the given terms with examples.	3.4 Laser: properties, absorption, spontaneous and stimulated emission, applications of Laser 3.5 Population inversion, active medium, optical pumping, three energy level system, He-Ne Laser.
	Chemistry	
Unit-IV Metals, alloys, Cement, and Refractory materials	4a. Describe construction and working of the given type of furnace. 4b. Describe the extraction process of the given ore with chemical reaction. 4c. Explain purposes and preparation methods of making the given alloy. 4d. Select the relevant alloy for the given application stating the properties with justification. 4e. Describe the constituents, hardening and setting process of the given type of cement. 4f. Select the relevant refractory for given application stating the properties with justification.	4.1 Metallurgy: Mineral, ore, gangue, flux, slag. 4.2 Types of furnace: Muffle furnace, Blast furnace. 4.3 Extraction processes of Haematite, copper pyrite ores: Crushing, concentration, reduction, refining. 4.4 Properties of iron and copper: Hardness, tensile strength, toughness, malleability, ductility, refractoriness, fatigue resistance. specific gravity, specific heat, brazing, castability, stiffness. 4.5 Preparation of alloys (Fusion and compression method). 4.6 Ferrous alloys: Low carbon, medium carbon, high carbon steels. 4.7 Non-ferrous alloy: Brass, Bronze, Duralumin, Tinman Solder, Woods metal. 4.8 Cement: Types; Biocement and Portland cement; constituents, setting and hardening, applications 4.9 Lime: classification, constituents, setting and hardening, applications.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
		4.10 Refractory material: Types, properties.
Unit –V Water treatment	5a. Describe the given terminologies related to hard water and their effects 5b. Describe the given process for softening of the given water sample. 5c. Describe with sketches the purification of the given type of water. 5d. Describe the given type of of waste water treatment.	5.1 Hardness; Classification 5.2 Hard water in boilers and prevention: Boiler corrosion, caustic embrittlement, priming and foaming, scales and sludges. 5.3 Water softening: lime soda process (hot lime soda and cold lime soda process), zeolite process, ion exchange process (cation exchange and anion exchange). 5.4 Potable water treatment: Sedimentation, coagulation, filtration and sterilization. 5.5 Waste water treatment: sewage treatment, BOD and COD of sewage water; Reverse Osmosis, recycling of waste water.
Unit-VI Fuels and Combustion	6a. Describe salient properties of the given type of fuel. 6b. Explain the given type of analysis of the given type of coal. 6c. Calculate the calorific value of the given solid fuel using Bomb calorimeter. 6d. Describe composition, properties of given gaseous fuel with their applications. 6e. Calculate the mass and volume of air required for complete combustion of the given fuel.	6.1 Fuel: Calorific value and ignition temperature, classification. 6.2 Solid fuels: Coal, Classification and composition , proximate analysis, Ultimate analysis, Bomb calorimeter. Carbonization of coke by Otto Hofmann's oven. 6.3 Liquid fuels: Fractional distillation of crude petroleum, boiling range, composition, properties. Knocking, cracking, octane number and cetane number. 6.4 Gaseous fuels: Biogas, LPG, and CNG. Combustion equation of gaseous fuels, mass and volume of air required for complete combustion.

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

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
	Physics					
I	Properties of matter and NDT	14	03	05	06	14
II	Types of motion	09	02	02	06	10
III	Photoelectricity, X-Ray and LASER,	09	03	04	04	11
	Chemistry					

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
IV	Metals, alloys, cement, refractory materials	12	02	04	06	12
V	Water treatment	10	02	03	06	11
VI	Fuels and combustion.	10	03	04	05	12
	Total	**64**	**15**	**22**	**33**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

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:

a. Seminar on any relevant topic.
b. Library survey regarding engineering material used in different industries.
c. Prepare power point presentation or animation for showing applications of lasers.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.

12. SUGGESTED MICRO-PROJECTS

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

In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every

student to become problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty:

a. **Elasticity:** Prepare working model to demonstrate the stress – strain behavior of different wires of different thickness and material.
b. **Viscosity:** Collect 3 to 5 liquids and prepare a working model to differentiate liquids on the basis of viscosity and demonstrate their applications.
c. **Motion:** Prepare model of ball rolling down on inclined plane to demonstrate the conservation of energy and motion of an object in inclined plane.
d. **Photo Sensors**: Prepare simple photo sensor using LDR.
e. **Properties of Laser**: Use Key chain laser to differentiate laser with ordinary light.
f. **Water analysis**: Collect water samples from different water sources and find the characteristics like acidity, conductivity, dissolved solids, suspended particles.
g. **Water treatment:** Collect 3 to 5 water samples to find the dosage of bleaching powder required for its sterilization.
h. **Water analysis:** Prepare model to find the soap foaming capacity of bore water on addition of soda ash.
i. **Fuels:** Prepare chart showing different types of liquid fuels showing their calorific values and uses.
j. **Cement:** Collect different samples of cement and find their initial and final setting time.
k. **Refractory materials**: Prepare chart showing properties of refractory materials.
l. **Metal properties:** Prepare chart showing different industrial application of metal and relate it with required property or properties using internet.
m. **Alloy steel:** Find the effect of alloying elements like Mn, Cr, Ni, W, V, Co on properties of steel. Prepare chart of showing percentage composition, properties and industrial applications of different types of steel based on above alloying elements using internet.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Physics Textbook Part I and Part - Class XI	Narlikar, J. V.; Joshi, A. W.; Mathur, Anuradha; *et al*	National Council of Education Research and Training, New Delhi, 2010, ISBN : 8174505083
2	Physics Textbook Part I and part II - Class XII	Narlikar, J.V.; Joshi, A. W.; Ghatak A.K. *et al*	National Council of Education Research and Training, New Delhi, 2013, ISBN : 8174506314
3	Engineering Physics	Bhattacharya, D. K.; Tandon Poonam	Oxford Publishing, New Delhi, ISBN:0199452814
4	Principles of Engineering Physics -I	Md. Nazoor Khan and Simanchala Panigrahi	Cambridge university press; New Delhi, 2016 ISBN : 9781316635643
5	Engineering Physics	Palanisamy, P. K.	SCITECH Publications, Chennai, ISBN: 9788183711012
6	Principles of Physics	Walker, J.; Halliday, D; Resnick, R	Wiley Publications, New Delhi, 10th edition ISBN: 9788126552566
7	Textbook of Engineering Physics	Avadhanulu, M. N.; Kshirsagar, P. G.	S. Chand and Co., New Delhi, 2015 ISBN: 9788121908177
8	Engineering Chemistry	Agarwal, Shikha	Cambridge university press ; New Delhi, 2015 ISBN : 9781107476417

S. No.	Title of Book	Author	Publication
9	Engineering Chemistry	Dara, S. S.; Umare S.S.	S.Chand and Co. Publication, New Delhi, 201, ISBN: 8121997658
10	Engineering Chemistry	Jain & Jain	Dhanpat Rai and sons; New Delhi, 2015. ISBN : 9352160002
11	Engineering Chemistry	Vairam, S.	Wiley India Pvt. Ltd. New Delhi, 2013, ISBN: 9788126543342
10	Chemistry for engineers	Agnihotri, Rajesh	Wiley India Pvt.Ltd. New Delhi, 2014. ISBN: 9788126550784

14. SOFTWARE/LEARNING WEBSITES

a. http://nptel.ac.in/course.php?disciplineId=115
b. http://nptel.ac.in/course.php?disciplineId=104
c. http://hperphysics.phy-astr.gsu.edu/hbase/hph.html
d. www.physicsclassroom.com
e. www.fearofphysics.com
f. www.sciencejoywagon.com/physicszone
g. www.science.howstuffworks.com
h. https://phet.colorado.edu
i. www.chemistryteaching.com
j. www.visionlearning.com
k. www.chem1.com
l. www.onlinelibrary.wiley.com
m. www.rsc.org
n. www.chemcollective.org
o. www.wqa.org
p. www.em-ea.org

Program Name : **Mechanical, Civil Chemical and Fabrication Technology and Erection Engineering Program Group**

Program Code : **AE/CE/CH/FG/ME/PT/PG**

Semester : **Second**

Course Title : **Applied Mechanics**

Course Code : **22203**

1. RATIONALE

In day-to-day working we come across different types of structures created for different purposes and functions. While designing the structures, analysis of forces and stresses' is an important and prerequisite step. Correct analysis is possible only when one knows the types and effects of forces acting on the structures. This course provides the scope to understand fundamental concepts of laws of mechanics and their applications to different engineering problems. This course is designed to provide basic understanding about the different types of forces, moments and their effects on structural elements, which will analysing different structural systems.

2. 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 applied mechanics to solve broad-based engineering related problems.**

3. COURSE OUTCOMES (COs)

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

a. Identify the force systems for given conditions by applying the basics of mechanics.
b. Select the relevant simple lifting machine(s) for given purposes.
c. Determine unknown force(s) of different engineering systems.
d. Check the stability of various force systems.
e. Apply the principles of friction in various conditions for useful purposes.
f. Find the centroid and centre of gravity of various components in engineering systems.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory						Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	1	2	6	3	70	28	30*	00	100	40	25@	10	25	10	50	20

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.

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

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

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

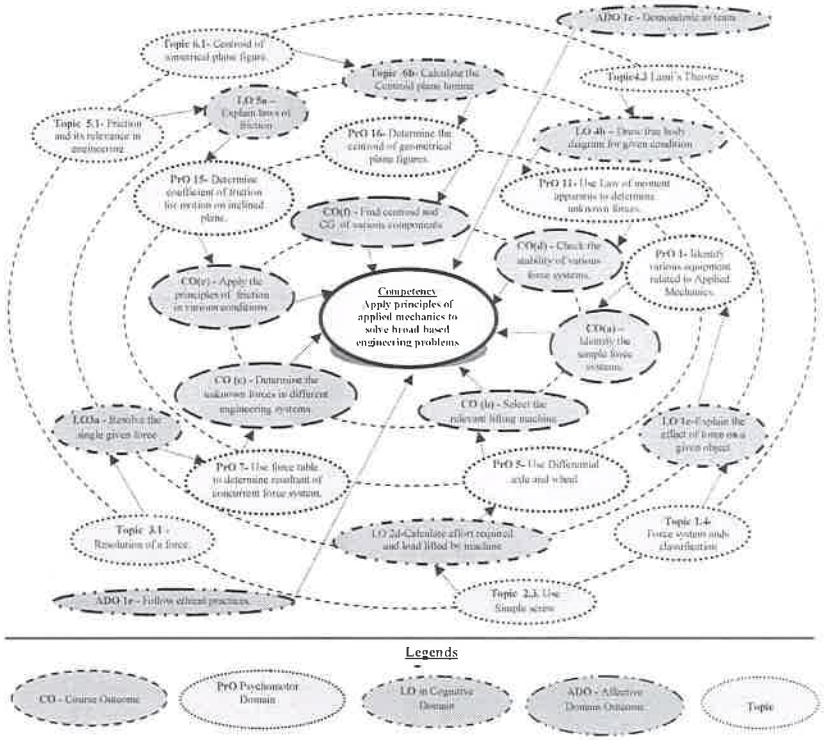

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

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

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Identify various equipment related to Applied Mechanics.	I to VI	02
2	Use Differential axle and wheel.	II	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
3	Use Simple screw jack.	II	02
4	Use worm and worm wheel.	II	02
5	Use single or double purchase crab.	II	02
6	Use Weston's differential or wormed geared pulley block.	II	02
7	Use force table to determine resultant of concurrent force system applying Law of Polygon of forces. (Part-I)	III	02*
8	Use force table to determine resultant of concurrent force system applying Law of Polygon of forces. (Part-II)	III	02*
9	Graphically determine resultant of concurrent force system.	III	02
10	Graphically determine resultant of parallel force system.	III	02
11	Use Law of moment apparatus to determine unknown forces.	IV	02*
12	Apply Lami's theorem to determine unknown force.	IV	02
13	Determine support reactions for simply supported beam.	IV	02
14	Determine coefficient of friction for motion on horizontal plane.	V	02*
15	Determine coefficient of friction for motion on inclined plane.	V	02
16	Determine centroid of geometrical plane figures.	VI	02
	Total		**32**

Note

i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

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

S.No.	Performance Indicators	Weightage in %
1	Preparation of experimental set up	20
2	Setting and operation	20
3	Safety measures	10
4	Observations and Recording	10
5	Interpretation of result and Conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
	Total	**100**

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

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical practices.

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

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Exp. No.
1	Differential axle and wheel (wall mounted unit with the wheel of 40 cm diameter and axles are insteps of 20 cm and 10 cm reducing diameter.	2
2	Simple screw Jack (Table mounted metallic body, screw with a pitch of 5 mm carrying a double flanged turn table of 20 cm diameter.	3
3	Worm and worm wheel (wall mounted unit with threaded spindle, load drum, effort wheel; with necessary slotted weights, hanger and thread)	4
4	Single Purchase Crab winch (Table mounted heavy cast iron body. The effort wheel is of C.I. material of 25 cm diameter mounted on a shaft of about 40mm dia. On the same shaft a geared wheel of 15 cm dia.	5
5	Double Purchase Crab winch (Having assembly same as above but with double set of gearing arrangement.)	5
6	Weston's Differential pulley block (consisting of two pulleys; one bigger and other smaller.	6
7	Weston's Differential worm geared pulley block (Consists of a metallic (preferably steel) cogged wheel of about 20 cm along with a protruded load drum of 10 cm dia to suspend the weights of 10 kg, 20 kg-2 weights and a 50 kg weights)	6
8	Universal Force Table (Consists of a circular 40 cm dia. Aluminum disc, graduated into 360 degrees.) with all accessories..	7, 10
9	Law of moments apparatus consisting of a stainless steel graduated beam 12.5 mm square in section, 1m long, pivoted at centre.	9
10	Beam Reaction apparatus (The apparatus is with two circular dial type 10 kg.	11
11	Friction apparatus for motion along horizontal and inclined plane (base to which a sector with graduated arc and vertical scale is provided. The plane may be clamped at any angle up to 45 degrees. pan. Two weight boxes (each of 5 gm,10 gm, 2-20 gm, 2-50 gm, 2-100 gm weight).	12
12	Models of geometrical figures.	13

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Mechanics and force system	1a. Explain concepts of the given terms. 1b. Use the relevant units of various quantities in the given situations. 1c. Explain effects of a force on the given object. 1d. Identify the force system for the given situation.	1.1. Significance and relevance: Mechanics, applied mechanics, statics, dynamics. 1.2. Space, time, mass, particle, body, rigid body. 1.3. Scalar and vector quantity, Units of measurement (SI units)- Fundamental units and derived units. 1.4. Force – unit, representation as a vector and by Bow's notation, characteristics and effects of a force, Principle of transmissibility of force, Force system and its classification.
Unit – II Simple lifting machine	2a. Describe the components of the given lifting machine. 2b. Differentiate the working principle of the given two types of simple lifting machines. 2c. Determine velocity ratio, efficiency and law of the given simple lifting machine. 2d. Calculate effort required and load lifted by the given simple lifting machine. 2e. Interpret the graphs after drawing them with the given data. 2f. Select the relevant simple lifting machine required for the given purpose with justification.	2.1 Simple lifting machine, load, effort, mechanical advantage, applications and advantages, Velocity ratio, efficiency of machines, law of machine. 2.2 Ideal machine, friction in machine, maximum Mechanical advantage and efficiency, reversible and non-reversible machines, condition for reversibility 2.3 Velocity ratios of Simple axle and wheel, Differential axle and wheel, Worm and worm wheel, Single purchase and double purchase crab winch, Simple screw jack, Weston's differential pulley block, geared pulley block. 2.4 Graphs of Load verses Effort, Load verses ideal Effort, Load verses Effort lost in friction, Load verses MA, Load verses Efficiency.
Unit- III Resolution and composition	3a. Resolve the given single force. 3b. Calculate the resultant of the given force system analytically. 3c. Determine graphically the resultant of the given force system. 3d. Find the resultant of the given force system using	3.1 Resolution of a force - Orthogonal and Non Orthogonal components of a force, moment of a force, Varignon's Theorem, 3.2 Composition of forces – Resultant, analytical method of determination of resultant for concurrent, non concurrent and parallel co-planar force systems – Law of triangle, parallelogram and polygon of forces. 3.3 Graphic statics, graphical representation

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	law of triangle and law of parallelogram.	of force, Space diagram, force diagram, polar diagram and funicular polygon, Graphical method of determination of resultant for concurrent and parallel co-planar force systems.
Unit– IV Equilibrium	4a. Draw the free body diagram for the given condition. 4b. Determine unknown force in the given situation using Lami's theorem. 4c. Identify the types of beams required for the given situation. 4d. Determine reactions in the given type of beam analytically and graphically.	4.1 Equilibrium and Equilibrant, Free body and Free body diagram, Analytical and graphical conditions of equilibrium, 4.2 Equilibrium of force systems analytically 4.3 Lami's Theorem, 4.4 Types of beam, supports (simple, hinged, roller and fixed) and loads acting on beam (vertical and inclined point load, UD load, couple), span of beam. 4.5 Beam reaction for cantilever, simply supported beam with or without overhang – subjected to combination of Point load and UD load or Vertical Point load and couple. 4.6 Beam reaction graphically for simply supported beam subjected to vertical loads only.
Unit– V Friction	5a. Determine force of friction and coefficient of friction for the given condition. 5b. Describe the conditions for friction for the give situation. 5c. Determine friction force in the given situation. 5d. Identify the various forces acting on a ladder for the given conditions using free body diagram.	5.1 Friction and its relevance in engineering, types and laws of friction, limiting equilibrium, limiting friction, co-efficient of friction, angle of friction, angle of repose, relation between co-efficient of friction and angle of friction. 5.2 Equilibrium of bodies on level surface subjected to force parallel and inclined to plane. 5.3 Equilibrium of bodies on inclined plane subjected to force parallel to the plane only. 5.4 FBD of ladder in friction
Unit– VI Centroid and centre of gravity	6a. Determine the centroid of geometrical plane figures and centre of gravity of the given simple solid. 6b. Calculate centroid of the given composite plane lamina 6c. Determine centre of gravity of the given solids. 6d. Determine centre of gravity of the given composite solid.	6.1 Centroid of geometrical plane figures (square, rectangle, triangle, circle, semi-circle, quarter circle) 6.2 Centroid of composite figures composed of not more than three geometrical figures 6.3 Centre of Gravity of simple solids (Cube, cuboid, cone, cylinder, sphere, hemisphere) 6.4 Centre of Gravity of composite solids composed of not more than two simple solids.

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

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Mechanics and Force System	04	02	02	02	06
II	Simple Lifting Machines	08	02	04	06	12
III	Resolution and Composition	10	02	04	08	14
IV	Equilibrium	10	02	02	10	14
V	Friction	08	02	04	06	12
VI	Centroid and Centre of Gravity	08	02	02	08	12
Total		**48**	**12**	**18**	**40**	**70**

Legends: *R=Remember. U=Understand, A=Apply and above (Bloom's Revised taxonomy)*

Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

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:

a. Collect five different photographs indicating concurrent, parallel, general force system in equilibrium.
b. Prepare a table of type of machine and relevant industrial application.
c. Collect five different situations where law of moment plays an important role.
d. Prepare models representing various types of supports (hinged, roller and fixed)
e. Illustrate situations wherein friction is essential and not essential.
f. Prepare models in the form of geometrical figures and solids and locate centroid and centre of gravity of them.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
a. Guide student(s) in undertaking micro-projects.

12. SUGGESTED MICRO-PROJECTS

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

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

a. **Types of Forces**: Prepare chart showing real-life examples indicating various types of forces
b. **Lifting Machine**: Collect photographs of specific simple lifting machine and relate these machines with the machines being studied and prepare models of simple lifting machines using tools in "MECHANO" and "MECHANIX"
c. **Types of support:** Prepare chart showing actual and corresponding schematic diagram of various type of support
d. **Beams:** Prepare models of beam subjected to point loads, uniformly distributed loads, simply supported, overhang and cantilever type beam.
e. **Friction:** Prepare chart regarding type of friction in various field conditions and collect data regarding coefficient of friction by referring books, Determine coefficient of friction for three different types of surfaces
f. **Centre of Gravity:** Prepare a chart of situations wherein concept of Centre of Gravity is vital.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Applied Mechanics	Khurmi, R.S.	S.Chand & Co. New Delhi 2014 ISBN: 9788121916431
2	Engineering Mechanics	Ramamrutham, S.	S Chand & Co. New Delhi 2008 ISBN:9788187433514
3	Foundations and Applications of Applied Mechanics	Ram, H. D.; Chauhan, A. K.	Cambridge University Press, Thomson Press India Ltd., New Delhi, 2015, ISBN: 9781107499836
4	Engineering Mechanics-Statics, Vol. I	Meriam, J. L.; Kraige, L.G.	Wiley Publication, New Delhi, ISBN: 978-81-265-4396

14. SOFTWARE/LEARNING WEBSITES

a. http://www.asnu.com.au
b. www.youtube.com for videos regarding machines and applications, friction
c. www.nptel.ac.in
d. www.discoveryforengineers.com

Program Name : **Civil Engineering Program Group**
Program Code : **CE/CR/CS**
Semester : **Second**
Course Title : **Construction Materials**
Course Code : **22204**

1. RATIONALE

Construction material is the key element in the construction project. A diploma civil engineer (also called technologist) has to constantly deal with selection of materials for various engineering project of constructions such as residential/ commercial buildings, roads, metro railways, bridges, dams, tunnels, and fly-over. The development of advance technology generates the necessity of new engineering materials. It is a challenging job for the civil engineer to select relevant material which is durable, economical and eco-friendly. New materials are introduced every day in the market. Modern techniques are developed to handle and use materials for economic and safer designs of engineering structure. At diploma level, students are expected to study about these aspects so as to develop their understanding, performance oriented abilities in order to apply their knowledge in construction industry

2. COMPETENCY

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

- **Select relevant building material to fulfill construction requirements.**

3. COURSE OUTCOMES (COs)

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

a. Identify relevant construction materials.
b. Identify relevant natural construction materials.
c. Select relevant artificial construction materials.
d. Select relevant special type of construction materials.
e. Select relevant finishing materials for construction.
f. Identify processed construction materials.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory							Practical				
				Paper	ESE		PA		Total		ESE		PA		Total	
L	T	P		Hrs.	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.

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

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

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

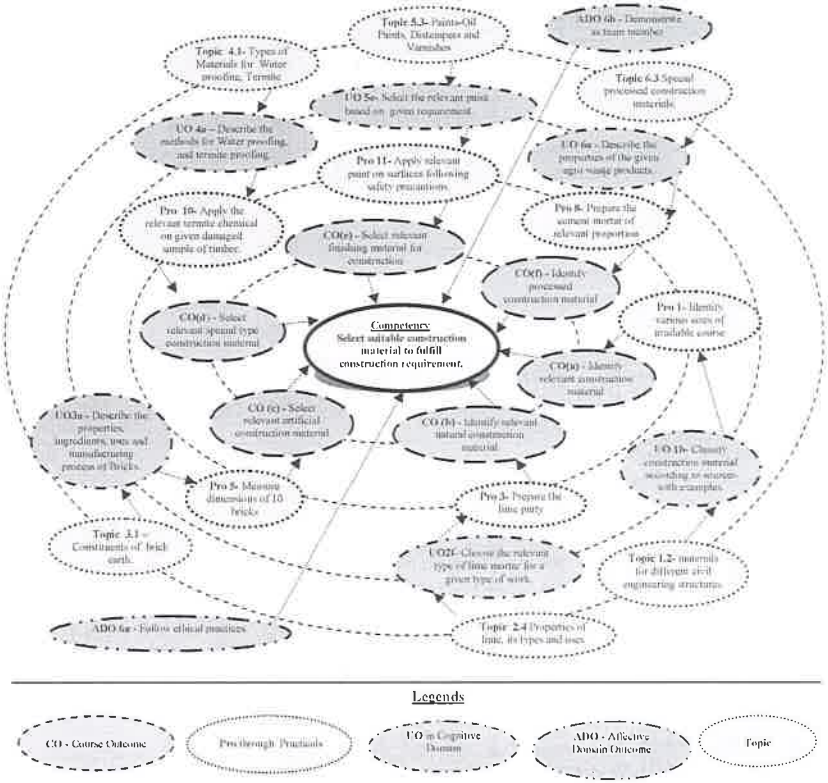

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

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

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Identify the various sizes of available coarse aggregates from sample of 10 kg in laboratory and prepare report (80, 40, 20,10	I	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
	mm)		
2	Identify the available construction materials in the laboratory on the basis of their sources.	I	02
3	Identify the grain distribution pattern in given sample of teak wood in the laboratory and draw the various patterns. (along and perpendicular to the grains)	II	02*
4	Prepare the lime putty by mixing lime (1 kg) with water in appropriate proportion and prepare report on slaking of lime.	II	02
5	Identify various layers and types of soil in foundation pit by visiting at least 3 construction sites in different locations of city and prepare report consisting photographs and samples. Part I	II	02
6	Identify various layers and types of soil in foundation pit by visiting at least 3 construction sites in different locations of city and prepare report consisting photographs and samples. Part I	II	02
7	Select first class, second class and third-class bricks from the stake of bricks and prepare report on the basis of its properties.	III	02*
8	Measure dimensions of 10 bricks and find average dimension and weight. Perform field tests - dropping, striking and scratching by nail and correlate the results obtained.	III	02*
9	Measure dimensions of 10 bricks and find average dimension and weight. Perform field tests - dropping, striking and scratching by nail and correlate the results obtained.	III	02
10	Identify different types of flooring tiles such as vitrified tiles, ceramic tiles, glazed tiles, mosaic tiles, anti- skid tiles, chequered tiles, paving blocks and prepare report about the specifications. Part I	III	02*
11	Identify different types of flooring tiles such as vitrified tiles, ceramic tiles, glazed tiles, mosaic tiles, anti- skid tiles, chequered tiles, paving blocks and prepare report about the specifications. Part II	III	02
12	Apply the relevant termite chemical on given damaged sample of timber. Part I	IV	02*
13	Apply the relevant termite chemical on given damaged sample of timber. Part II	IV	02
14	Prepare the finished piece of glass of given dimension from broken and damaged pieces of glass and asbestos using standard cutting and filing tools with safe practices. Part I	IV	02
15	Prepare the finished piece of glass of given dimension from broken and damaged pieces of glass and asbestos using standard cutting and filing tools with safe practices. Part II	IV	02
16	Apply two or more coats of selected paint on the prepared base of a given wall surface for the area of 1m x 1m using suitable brush/rollers adopting safe practices. Part I	V	02*
17	Apply two or more coats of selected paint on the prepared base of a given wall surface for the area of 1m x 1m using suitable brush/rollers adopting safe practices. Part II	V	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
18	Apply two or more coats of selected paint on the prepared base of a given wall surface for the area of 1m x 1m using suitable brush/rollers adopting safe practices. Part I	V	02
19	Apply two or more coats of selected paint on the prepared base of a given wall surface for the area of 1m x 1m using suitable brush/rollers adopting safe practices. Part II	V	02
20	Prepare the cement mortar of proportion 1:3 or 1:6 using artificial sand as a special processed construction material.	VI	02*
21	Prepare mortar using cement and Fly ash or Granite/marble polishing waste in the proportion 1:6 or 1:3.	VI	02
	Total		**42**

Note

i. *A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical LOs/tutorials need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. *Hence, the 'Process' and 'Product' related skills associated with each PrO of the laboratory/workshop/field work are to be assessed according to a suggested sample given below:*

S. No.	Performance Indicators	Weightage in %
1	Preparation of experimental set up	20
2	Setting and operation	20
3	Safety measures	10
4	Observations and Recording	10
5	Interpretation of result and Conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
	Total	**100**

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

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical practices.

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

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Exp. No.
1	Weighing balance	2 to 5
2	Pan, spade	2 to 6
3	Steel Tape	5 to 6
4	Saw of different types (Rip saw having 4 to 6 mm pitch, cross cut saw with tooth pitch 2 to 3 mm, panel saw)	2
5	Painting brushes of different size for oil, acrylic painting and rollers of different size for smooth finishing work.	11
6	Manual Glass cutter with diamond tip at end	13
7	Trowels (Brick, Buttering, Pointing) , triangular, ranging in size up to about 11 inches (279.40 mm) long and from 101.6 mm to 203.2 mm wide i.e. (4 to 8 inches wide).	1,3,7,8, 12
8	Portable Hammer , Spade, Pans (Ghamela), Thread, lime	1,3,4,7, 8,12
9	Square, mason's level, and straightedge 28.57 mm to 38.10 mm and the middle portion of the top edge from 152.40 mm to 254 mm wide	3,5,12
10	Ordinary Portland Cement	8
11	Bricks of standard size 230 mm x 115 mm x 75 mm,	4,5
12	Fly ash or Granite/marble polishing waste	12
13	Paints-OBD, acrylic, plastic emulsion.	11
14	Broken pieces of Glass	13

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Overview of Construction Materials	1a. Describe the civil engineering applications in the given field of civil engineering. 1b. Classify the given construction material according to sources with examples. 1c. Describe the criteria to select the construction materials for the given situation. 1d. Suggest the construction material in the given situation with justification.	1.1 Scope of construction materials in Building Construction, Transportation Engineering, Environmental Engineering, Irrigation Engineering (applications only). 1.2 Selection of materials for different civil engineering structures on the basis of strength, durability, Eco friendly and economy. 1.3 Broad classification of materials – Sources of materials, Natural, Artificial- special, finishing and recycled.
Unit – II Natural Construction Materials	2a. Describe the properties and structure of the given natural construction material. 2b. Explain the given type of defect(s) in timber. 2c. Explain the procedure of preservation of timber in the given situation. 2d. Select the natural construction material for the given situation with justification. 2e. Choose the relevant type of lime mortar for the given type of construction work with justification.	2.1 Requirements of good building stone; general characteristics of stone; quarrying and dressing methods and tools for stone. 2.2 Structure of timber, general properties of good timber, seasoning, preservation and defects in timber and uses, use of bamboo in construction. 2.3 Asphalt, bitumen and tar used in construction, properties and their uses. 2.4 Properties of lime, its types and uses. 2.5 Types of soil and its suitability in construction. 2.6 Properties of sand and uses. 2.7 Classification of coarse aggregate according to sizes and its uses.
Unit- III Artificial Construction Materials	3a. Describe the properties, ingredients, uses and manufacturing process of the given type of brick. 3b. Classify the given artificial construction materials. Classify different artificial construction material 3c. Select relevant type of artificial	3.1 Constituents of Brick earth, Conventional / Traditional bricks, Modular and Standard bricks, Characteristics of good brick, Classification of burnt clay bricks and their suitability, Special bricks. Common Field tests on Bricks, Manufacturing process of burnt clay brick.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	material for the given type of construction work with justification. 3d. Select the type of precast concrete products for the given civil structure with justification. 3e. Select relevant type of ferrous metal for the given type of construction work with justification. 3f. Select relevant type of non-ferrous metal for the given type of construction work with justification.	3.2 Flooring tiles – Types, uses 3.3 Manufacturing process of Cement - dry and wet (only flow chart), types of cement and its uses. 3.4 Pre-cast concrete blocks- hollow, solid, pavement blocks, balustrades, and their uses. 3.5 Plywood, particle board, Veneers, laminated board and their uses. 3.6 Types of glass: soda lime glass, lead glass and borosilicate glass and their uses. 3.7 Ferrous and non-ferrous metals and their uses.
Unit– IV Special Construction Materials	4a. Describe the method used for water proofing, termite proofing, thermal and sound insulation in the given situation. 4b. Select the relevant material required for the given operations with justification. 4c. Describe the fibers required for the given construction material. 4d. Select features of the given fiber which can be used as construction material with justification. 4e. Describe the features of the given type of geopolymer cement.	4.1 Types of material and suitability in construction works of following materials: Water proofing, Termite proofing; Thermal and sound insulating materials. 4.2 Fibers – Types –Jute, Glass, Plastic Asbestos Fibers, (only uses). 4.3 Geopolymer cement : Geo-cement: properties, uses and applications
Unit– V Finishing Materials	5a. Choose the relevant proportion adopted in mortars for the given type of construction work with justification 5b. Select the relevant type of POP board for the given type of work with justification. 5c. Describe properties of the given type of paint. 5d. Select the relevant type of paint to be used for the given situation with justification. 5e. Choose the relevant type of finishing material for the given situation with justification.	5.1 Lime Mortar, Cement Mortar, Special Mortars and their uses as plastering material. 5.2 Constituents and uses of POP (Plaster of Paris), POP finishing boards, sizes and uses. 5.3 Paints-Oil Paints, Distempers and Varnishes with their uses (situations where used).
Unit– VI Processed	6a. Describe the properties of the given industrial or agro waste	6.1 Industrial waste materials- Fly ash, Blast furnace slag, Granite and

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Construction Materials	products used for the given type of work. 6b. Describe the salient properties of the given modern construction material. 6c. Describe the salient properties of the given special construction material. 6d. Select the relevant processed construction material for the given situation with justification.	marble polishing waste and their uses. 6.2 Agro waste materials - Rice husk, Bagasse, coir fibres and their uses. 6.3 Special processed construction materials; Geosynthetic, Ferrocrete, Artificial timber, Artificial sand and their uses

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

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Overview of Construction Materials	04	04	04	--	08
II	Natural Construction Materials	12	04	08	04	16
III	Artificial Construction Materials	14	06	08	04	18
IV	Special Construction Materials	06	00	04	04	08
V	Finishing Materials	06	02	04	04	10
VI	Processed Construction Materials	06	02	04	04	10
Total		**48**	**18**	**32**	**20**	**70**

***Legends**: R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note**: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

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:

a. Undertake a market survey of different construction materials and compare the following points.
   i. Structure
   ii. Properties
   iii. Applications.
b. Prepare journals consisting of sketches of construction materials.
c. Undertake a market survey from local dealers for procurement of civil engineering material.
d. Inspect the various activities related to Construction material at sites of different civil structures.
e. Teacher guided self-learning activities

f. Course/ library /internet based mini-projects.
g. Literature survey of available at institute library regarding construction material used for different purposes and situations.
h. Develop Power point presentation or animation for demonstrating laying and fixing the construction materials.
i. Seminar on any relevant topic related to construction materials.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.
f. Procure various materials required for practical exercises.
g. Arrange visit to nearby industries and workshops for understanding various construction materials.
h. Use video/animation films to explain various processes like Manufacturing of construction materials, concrete mixing, and base preparation for painting, mortar laying, carpentry work, false ceiling.
i. Use different instructional strategies in classroom teaching.
j. Demonstrate different samples of various construction materials like Stone, aggregate of different sizes, timber, lime, bitumen, Bricks, tiles, precast concrete products, Water proofing material, Termite proofing material, Thermal insulating material, plaster of Paris, paints, distemper, and varnishes.
k. Display various technical brochures of recent building materials.

12. SUGGESTED MICRO-PROJECTS

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

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

a. Collect the market rates for following construction materials from various dealers/suppliers of local market for different brands.

i. Bricks.
ii. Stone / aggregate (20 mm, 40 mm and 80 mm)
iii. Teak wood.
iv. Flooring tiles.
v. Ordinary Portland Cement
vi. Oil paint
vii. Cement Paint
viii. Plaster of Paris
ix. Plastic paints
x. Recent types of paint.

b. Download the IS 456 and IS 800 and attach the printout for following materials.
   i. Steel section (I-section and ISA)
   ii. Mortar of proportion 1:6 and 1:4
   iii. Cement concrete mix of 1:2:4, 1:3:6 and 1:4:8.
c. Collect the technical brochures of following construction materials.
   i. Ordinary Portland Cement
   ii. Vitrified flooring tiles.
   iii. Particle boards used for aluminum partitions.
   iv. Paints.
d. Undertake a market survey for the cost and technical specification of different brands of following construction Materials and prepare comparison chart.
   i. Cement
   ii. Tiles
   iii. Glass
   iv. Paints.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Construction Materials	Ghose, D. N.	Tata McGraw Hill, New Delhi, 2014 ISBN: 9780074516478
2	Building Materials	Varghese, P.C.	PHI learning, New Delhi, 2014 ISBN: 8120328485
3	Engineering Materials	Rangwalla, S.C.	Charator publisher, Ahemdabad, 2015, ISBN: 9789385039171
4	Civil Engineering Materials	Somayaji, Shan	Pearson education, New Delhi, 2015 ISBN: 9788131766316
5	Engineering Materials	Rajput, R.K	S. Chand and Co., New Delhi, 2015 ISBN 8121919606
6	Engineering Materials	Sharma	PHI Learning, New Delhi, 2015 ISBN: 812032448X
7	Building Materials	Duggal, S. K.	New International, New Delhi, 2014 ISBN: 8122414354

14. SOFTWARE/LEARNING WEBSITES

a. https://www.quora.com/What-is-geocement
b. http://apis-cor.com/en/about/blog/geocement-new-generation-hightech-material
c. http://www.nbmcw.com/concrete/10827-geopolymer-concrete-a-new-eco-friendly-material-of-construction.html

d. https://www.youtube.com/watch?v=1fc4NVP9wXk
e. https://www.youtube.com/watch?v=m8U76Bm8kDY
f. https://www.youtube.com/watch?v=lORIZ1shR1M
g. https://www.youtube.com/watch?v=Xf89KDibIFE

Program Name	**: Civil Engineering Program Group**
Program Code	**: CE/CR/CS**
Semester	**: Second**
Course Title	**: Basic Surveying**
Course Code	**: 22205**

1. RATIONALE

Development and planning process for any civil engineering project needs survey of that area to be carried out and various types of survey maps are to be prepared. These maps and drawing are used for taking various decisions regarding the planning, designing, estimation, execution and construction process. The diploma pass outs/technicians should therefore know the various methods and instruments required for surveying. They should also have the skill and information to handle and operate the needed survey instruments. This course is therefore one of the core courses required for civil, mining, environmental and transportation engineers. Students are advised to master the desired skills which are expected from them for survey related works.

2. COMPETENCY

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

- **Undertake civil engineering surveys.**

3. COURSE OUTCOMES (COs)

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

a. Select the type of survey required for given situation.
b. Compute area of open field using chain, tape and cross staff.
c. Conduct traversing in the field using chain and compass.
d. Use leveling instruments to determine reduced level of ground points.
e. Draw/interpret contour maps of an area collecting field data.
f. Use digital planimeter to calculate the areas.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory						Practical					
L	T	P		Paper Hrs.	ESE Max	ESE Min	PA Max	PA Min	Total Max	Total Min	ESE Max	ESE Min	PA Max	PA Min	Total Max	Total Min
3	--	4	7	3	70	28	30*	00	100	40	50#	20	50	20	100	40

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain LOs required for the attainment of the COs.

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

5. COURSE MAP (with sample COs, Learning Outcomes i.e.LOs and topics)

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

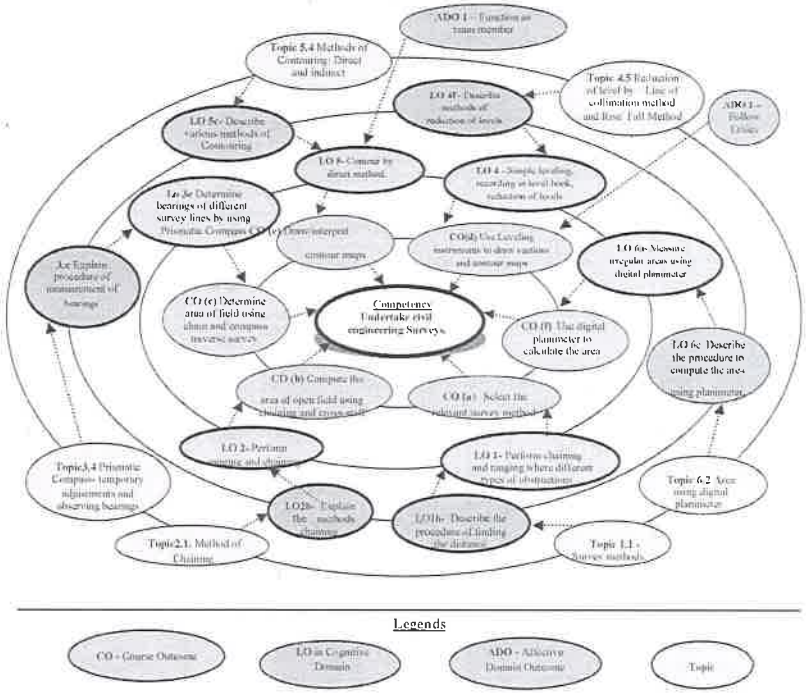

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals/exercises/tutorials in this section are psychomotor domain LOs (i.e.sub-components of the COs), to be developed and assessed in the student to lead to the attainment of the competency.

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. Required
1	Study & use of Metric Chain, Tapes, Ranging rods, Arrows	II	02
2	Measure distance between two survey stations using chain, tape and ranging rods to when two stations are inter visible. Part I	II	02*

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. Required
3	Undertake reciprocal ranging and measure the distance between two stations. Part I	II	02*
4	Undertake reciprocal ranging and measure the distance between two stations. Part II	II	02
5	Determine area of open field using chain and cross staff survey. Part I	II	02*
6	Determine area of open field using chain and cross staff survey. Part II	II	02
7	Determine area of open field using chain and cross staff survey. Part III	II	02
8	Measure Fore Bearing and Back Bearing of survey lines of open traverse using Prismatic Compass. Part I	III	02*
9	Measure Fore Bearing and Back Bearing of survey lines of open traverse using Prismatic Compass. Part II	III	02
10	Measure Fore Bearing and Back Bearing of survey lines of open traverse using Prismatic Compass. Part III	III	02
11	Measure Fore Bearing and back bearing of a closed traverse of 5or 6 sides and correct the bearings and included angles for the local attraction. Part I	III	02*
12	Measure Fore Bearing and back bearing of a closed traverse of 5or 6 sides and correct the bearings and included angles for the local attraction. Part II	III	02
13	Measure Fore Bearing and back bearing of a closed traverse of 5or 6 sides and correct the bearings and included angles for the local attraction. Part III	III	02
14	Measure Fore Bearing and back bearing of a closed traverse of 5or 6 sides and correct the bearings and included angles for the local attraction. Part IV	III	02
15	Undertake **Survey Project** with chain and compass for closed traverse for minimum 5 sides around a building.**(Compulsory)**	III	1* Full Day
16	Plot the traverse on A1 size imperial drawing sheet for data collected in Survey Project mentioned at practical No.15 . Part I	III	02
17	Plot the traverse on A1 size imperial drawing sheet for data collected in Survey Project mentioned at practical No.15 . Part II	III	02
18	Undertake simple leveling using dumpy level/ Auto level and leveling staff. Part I	IV	02*
19	Undertake simple leveling using dumpy level/ Auto level and leveling staff. Part II	IV	02
20	Undertake differential leveling and determine Reduced Levels by Height of instrument method and Rise and fall method using dumpy level/Auto Level and leveling staff. Part I	IV	02*
21	Undertake differential leveling and determine Reduced Levels by Height of instrument method and Rise and fall method using dumpy level/Auto Level and leveling staff. Part II	IV	02
22	Undertake differential leveling and determine Reduced Levels by Height of instrument method and Rise and fall method using	IV	02

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. Required
	dumpy level/Auto Level and leveling staff. Part III		
23	Undertake fly leveling with double check using dumpy level/ Auto level and leveling staff. Part I	IV	02
24	Undertake fly leveling with double check using dumpy level/ Auto level and leveling staff. Part II	IV	02
25	Undertake *Survey Project* with Leveling instrument for Profile leveling and cross-sectioning for a road length of 500 m with cross-section at 30 m interval. ***(Compulsory)***	IV	1* Full Day
26	Plot the L-section with minimum 3 cross-sections on A1 size imperial sheet for data collected in *Survey Project* mentioned at practical No.25. Part I	V	02*
27	Plot the L-section with minimum 3 cross-sections on A1 size imperial sheet for data collected in *Survey Project* mentioned at practical No.25. Part II	V	02
28	Conduct block contouring for the area of 40m x 40m to draw its contour plan. Part I	V	02
29	Conduct block contouring for the area of 40m x 40m to draw its contour plan. Part II	V	02
30	Undertake *Survey Project* for plotting contour map using block contouring method for a block of 150m x 150m with grid of 10m x 10m. ***(Compulsory)***	V	1* Full Day
31	Plot the contours on A1 size imperial drawing sheet for data collected in *Survey Project* mentioned at practical No.30. Part I	V	02
32	Plot the contours on A1 size imperial drawing sheet for data collected in *Survey Project* mentioned at practical No.30. Part II	V	02
33	Plot the contours on A1 size imperial drawing sheet for data collected in *Survey Project* mentioned at practical No.30. Part III	V	02
34	Measure area of irregular figure using Digital planimeter. Part I	VI	02*
35	Measure area of irregular figure using Digital planimeter. Part II	VI	02
	Total		**82**

Note

i. A suggestive list of practical LOs is given in the above table, more such practical LOs can be added to attain the COs and competency. A judicial mix of minimum 24 or more practical LOs/tutorials need to be performed, out of which, the practicals marked as '' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. Hence, the 'Process' and 'Product' related skills associated with each LO of the laboratory/workshop/field work are to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
1	Preparation of experimental set up	10
2	Setting and operation	20
3	Safety measures	10
4	Observations and Recording	20
5	Interpretation of result and Conclusion	20

S. No.	Performance Indicators	Weightage in %
6	Answer to sample questions	10
7	Submission of report in time	10
	Total	**100**

Additionally, the following affective domain LOs (social skills/attitudes), are also important constituents of the competency which can be best developed through the above mentioned laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical practices.

The development of the attitude related LOs of Krathwohl's 'Affective Domain Taxonomy', the achievement level may reach:

- 'Valuing Level' in 1st year
- 'Organizing Level' in 2nd year
- 'Characterizing Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Exp. S. No.
1	Metric Chain made from galvanized mild steel wires 4mm in dia, brass handles with swivel joints, brass tallies provided at every 5 m length of chain - 20 and 30m. Metallic tape-, Steel tape, Invar, Fiber glass tape satisfying IS 1269 (Part 1 and Part 2) : 1997 specifications	1 to 6,11,13 and 14
2	Pegs of length 400 mm and c/s area of 50 mm x 50 mm, Arrows 400 mm long and made up of good quality hardened and tempered steel wire of 4 mm in diameter.	1 to 6,11, 13 and 14
3	Metallic Ranging rods of 2 m length, circular or octagonal in cross section of 30 mm diameter, Lower shoe of 150 mm long. Painted in black, white and red stripes of 200 mm each.	1 to 6, 11,13 and 14
4	Optical square confirming to IS: 7999 – 1973specifications and open cross staff consisting of 4 metal arms with vertical slits for sighting through.	1 to 6, 11,13 and 14
5	Prismatic compass confirming to IS 1957-1961 with stand, made in Gun metal material having diameter of 85-110 mm and the least count of 30 minutes.	4 ,5 and 6
6	Dumpy level and automatic levels confirming to IS: 9613 – 1986 with stand and internal focusing telescope of standard make.	8 to 11, 13 and 14
7	Leveling staves- 2 m and 4 m ,telescopic type confirming to IS 11961 -1986 or Folding type confirming to IS 1779 (1961), 5 mm least count	8 to 11, 13 and 14
8	Digital planimeter of standard make with Ni Cd batteries and AC adapters	16

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Overview and Classification of Survey	1a. Classify given type of survey based on purpose, instruments used and nature of field and place. 1b. Explain the given basic principles of surveying. 1c. Describe given type of scale. 1d. Select the type of survey for given situation. 1e. Select the type of scale for given situation.	1.1 Survey- Purpose and Use, Principles of Survey 1.2 Types of surveying- Primary and Secondary classification, Plane, Geodetic, Cadastral, Hydrographic, Photogrammetry Aerial, Layout survey, Control survey, Topographical survey, Route survey, Reconnaissance survey. 1.3 Scales: Engineer's scale, RF and Diagonal scale.
Unit– II Chain and cross staff Survey	2a. Describe the procedure of finding the distance between two given inter-visible and not inter-visible survey stations. 2b. Explain the methods of ranging and measuring the length of the given survey line with examples. 2c. Explain the corrections in measurement of distance with chain in given situation. 2d. Compute the area of given field using principle of triangulation. 2e. Compute area of given open field by using chain and cross staff. 2f. Select type of chaining for given situation.	2.1 Chain survey Instruments: Metric Chain, Tapes, Arrow, Ranging rod, Open cross staff, Optical square (No questions to be asked for exams) 2.2 Chain survey Station, Base line, Check line, Tie line, Offset, Tie station, obstacles in chaining; Types of offsets: Perpendicular and Oblique 2.3 Ranging: Direct and Indirect Ranging. (No questions to be asked for exams) 2.4 Errors in length: Instrumental error, personal error, error due to natural cause, random error 2.5 Principle of triangulation 2.6 Location Sketch of survey station and running measurements of building. 2.7 Conventional Signs, Recording of measurements in a field book. 2.8 Area Calculations (Numerical problems)
Unit– III Chain and Compass traverse Survey	3a. Carry out the traversing in given situation by using compass and chain. 3b. Convert given whole circle bearing to reduced bearing and vice versa to find included angle with examples. 3c. Explain construction and functions of given parts of the given type of compass. 3d. Determine correct bearings from the given observed	3.1 Compass Traversing: open, closed. 3.2 Technical Terms: Geographic/True Magnetic and Arbitrary Meridians and Bearings, Meridian and Bearing, Whole Circle Bearing System (Azimuth) and Reduced (Quadrantal) Bearing System and examples on conversion of given bearing to another bearing (from one form to another), Fore Bearing and Back Bearing, Calculation of internal and external angles from bearings at a station. Dip of Magnetic needle, Magnetic Declination.(Numerical problems)

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	bearings. 3e. Explain the methods used to plot a traverse in the given situation. 3f. Adjust the closing error of the traverse for the given data.	3.3 Components of Prismatic Compass and their Functions(No sketch)Method of using Prismatic Compass- Temporary adjustments and observing bearings 3.4 Local attraction, Methods of correction of observed bearings-Correction at station and correction to included angles, 3.5 Methods of plotting a traverse and closing error, Graphical adjustment of closing error.
Unit– IV Levelling	4a. Explain the given terms related to leveling. 4b. Describe construction and use of the given leveling instrument. 4c. Explain the given temporary adjustments of a typical dumpy level. 4d. Describe methods of reduction of levels by height of collimation and rise and fall method in the given situation. 4e. Select type of leveling for the given work with examples and justification. 4f. Compute the missing readings from the given observed readings.	4.1 Terminologies: Level surfaces, level line, Horizontal and vertical surfaces, Datum, Bench Marks- GTS, Permanent, Arbitrary and Temporary, Reduced Level, Rise, Fall, Line of collimation, Station, Back sight, Fore sight. intermediate sight, Change point, Height of instruments . 4.2 Types of levels: Dumpy, Tilting, Auto level, Digital level, Components of Dumpy Level and its fundamental axes. Temporary adjustments of Level. 4.3 Types of Leveling Staffs: Self-reading staff and Target staff. 4.4 Reduction of level by Line of collimation method and Rise/ Fall Method 4.5 Methods: To find the R. L. by H.I. method(Numerical problems) 4.6 To find R.L by Rise and Fall method with necessary checks. (Numerical problems) 4.7 Leveling Types: Simple, Differential, Fly, Profile and Reciprocal Leveling 4.8 Computation of missing readings, Errors in Leveling. (Numerical problems) 4.9 Comparison of different levels.
Unit– V Contouring	5a. Describe the importance of contour maps for the given type of topography. 5b. Explain characteristics of contours for the given terrain. 5c. Explain methods of plotting contours in the given situation. 5d. Explain factors affecting the selection of the given contour interval. 5e. Prepare contour map from the given RLs of grid points with examples.	5.1 Contour, contour interval, horizontal equivalent. 5.2 Contour maps: Characteristics and uses o 5.3 Methods of Contouring: Direct and indirect 5.4 Methods of interpolation of contours: approximate, arithmetic and graphical 5.5 Toposheets: Study.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit– VI Measurement of Area and Volume	6a. Explain the theory and use of digital planimeter in the given situation. 6b. Describe procedure for measuring the given area using digital planimeter 6c. Compute the area from the given contour map. 6d. Compute the volume of reservoir from the given contour map.	6.1 Digital planimeter: Components and uses 6.2 Measurement of area using digital planimeter.(No problems to be asked for Exams) 6.3 Measurement of volume of reservoir from contour map. (No problems to be asked for exams)

Note: To attain the COs and competency above listed Learning Outcomes (LOs) need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'

9. 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 and Classification of Survey	04	2	4	-	06
II	Chain and cross staff Survey	06	2	-	6	08
III	Chain and Compass traverse Survey	12	4	4	8	16
IV	Levelling	16	6	6	12	24
V	Contouring	06	2	4	4	10
VI	Measurement of Area and Volume	04	2	4	-	06
Total		**48**	**18**	**22**	**30**	70

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*

Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of LOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

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

a. Construct a plain scale 1 cm = 3 m to read up to a meter and represent 27 m on the scale.
b. Draw a neat labeled sketch of a 20m chain and show its salient features.
c. Explain one method each to measure the distance between points on either side of obstacles in case of following: River, Lake, Building.
d. Explain different obstacles encountered in chain survey.
e. Explain the relation between the whole circle bearing and reduced bearing with the help of neat sketches and covert the given set of five WC to RB and vice versa.
f. Measure the bearing of Sun at noon with compass and then magnetic bearing of any line AB to find the true bearing of that line.

g. Find the deflection angles at each vertex of a give traverse with internal angles.
h. Find the bearing of remaining lines when the bearing of any one line of a traverse and deflection angles at respective station are given.
i. Determine the reservoir capacity from a give contour map of reservoir.
j. Interpret the given contour maps.(minimum five situation).
k. Draw the representative contour maps for the following: Ridge of a mountain, Hillock, Valley, Pond/lake, Gentle slope, Very Steep Slope, Plain Surface.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

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

12. SUGGESTED MICRO-PROJECTS

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

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

a. Collect the information of survey instruments available in the market with specifications.
b. Carry out comparative study of following survey instruments of different make and brands : Auto level and Digital planimeter.
c. Calibrate the given chain with reference to standard gauge.
d. Collect the map of city /town and calculate the ward wise and total area using digital planimeter.
e. Determine the RLs of the existing structures like lintels, chajja, slab, and beam.

f. Download specifications for prismatic compass, dumpy level, auto level, digital planimeter.
g. Perform reconnaissance survey for alignment of road.
h. Collect and interpret contour maps of different terrains available with various authorities.
i. Construct and measure given length using Diagonal scale from a given map.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Surveying and Levelling volume I	Kanetkar, T. P.; Kulkarni, S. V.	Pune Vidyarthi Gruh Prakashan, Pune; ISBN:978-81-858-2511-3
2	Surveying and Levelling	Basak, N. N.	McGraw Hill Education, New Delhi ISBN 93-3290-153-8
3	Surveying	Saikia, M D.; Das. B.M.; Das, M.M.	PHI Learning, New Delhi ISBN: 978-81-203-3985-9
4	Fundamentals of Surveying and Levelling	Subramanian, R.	Oxford University Press, New Delhi, ISBN: 0-19-945472-8
5	Survey I	Duggal, S. K.	McGraw Hill Education, New Delhi, ISBN: 978-00-701-5137-6
6	Textbook of Surveying	Rao, P. Venugopala Akella, Vijayalakshmi	PHI Learning, New Delhi ISBN: 978-81-203-4991-9
7	Surveying I	Punmia, B.C, Jain, Ashok Kumar Jain, Arun Kumar	Laxmi Publications., New Delhi, ISBN: 8-17-008853-4
8	Surveying and Levelling, Volume 1	Bhavikatti, S. S.	I. K. International, New Delhi ISBN: 978-81-906-9420-9
9	Textbook of Surveying	Venkatramaiah, C	Universities Press.New Delhi ISBN: 978-81-737-1021-6

14. SOFTWARE/LEARNING WEBSITES

a. www.asnu.com.au
b. www.oupinheonline.com
c. www.mtu.edu/technology/undergrad
d. www.wb.psu.edu/Academics/Degrees
e. www.tjc.edu/info/2004134/profess
f. www.pstcc.edu/catalog/12-13/cerp
g. https://youtu.be/e_yabRh5GY
h. https://youtu.be/Z4yYHHX8N0
i. https://youtu.be/2hL4wWUUSFc
j. https://youtu.be/j8poe2vvD2Q
k. https://youtu.be/chhuq_t40rY
l. https://youtu.be/L54T4uvpMTg
m. https://youtu.be/NdNEy-HBsoA
n. https://youtu.be/7dN3Iku0Bns
o. https://youtu.be/S8exEaGMi9c

Program Name : **Civil Engineering Program Group**

Program Code : **CE/CR/CS**

Semester : **Second**

Course Title : **Civil Engineering Workshop and Practice**

Course Code : **22008**

1. RATIONALE

General Civil Engineering Practices is a basic engineering course. The knowledge of basics of civil Engineering operations like masonry, mixing, concreting, finishing works is essential for technician to perform his/her duties in industries. Therefore, an opportunity is created through this course to develop basic skills with the safety aspects required for the same. Students should be able to supervise construction activities and use quality control techniques and maintain tools and equipments with safety to self, co-workers and the constructed components of the building. Working in field develops the attitude of team working and safety awareness. This course provides the unique experience of field work

2. COMPETENCY

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

- **Perform basic civil engineering jobs using relevant tools.**

3. COURSE OUTCOMES (COs)

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

a. Identify the various construction activities at site.
b. Perform masonry job activities.
c. Perform plumbing job activities.
d. Identify finishing jobs related to building construction.
e. Identify the various components of typical civil structures like road, culvert/bridges.

4. TEACHING AND EXAMINATION SCHEME

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

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

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

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

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

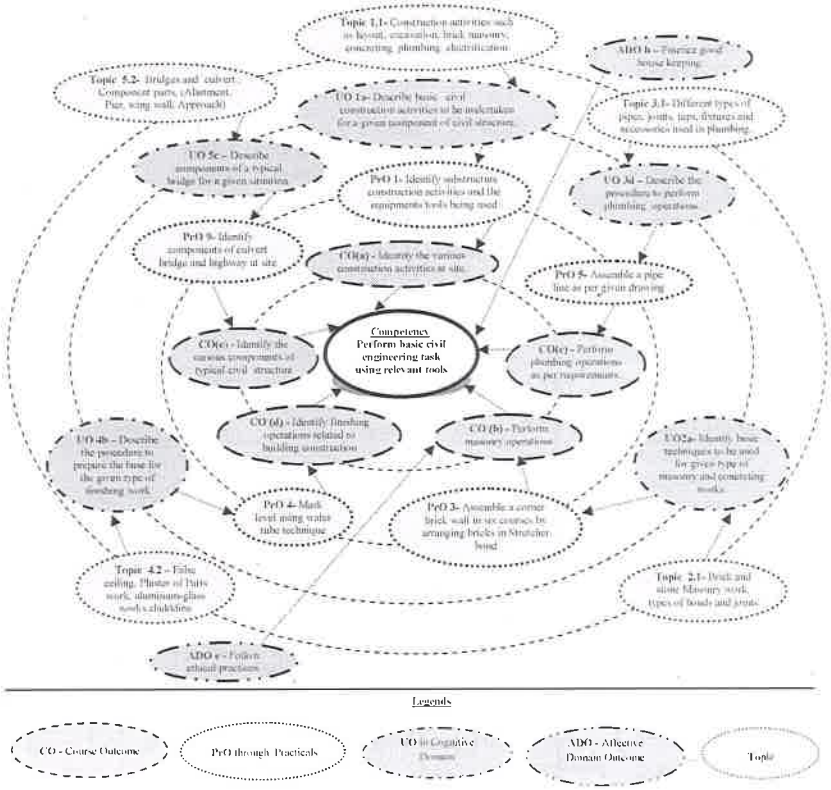

Figure 1 - Course Map

6. SUGGESTED PRACTICAL LEARNING OUTCOMES/TUTORIALS

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

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Identify the substructure construction activities and the equipments/tools being used at site during the visit. Part I	I, II	02*
2	Identify the substructure construction activities and the equipments/tools being used at site during the visit. Part II	I, II	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
3	Identify the substructure construction activities and the equipments/tools being used at site during the visit. Part III	I, II	02
4	Identify the substructure construction activities and the equipments/tools being used at site during the visit. Part IV	I, II	02
5	Assemble a corner brick wall in six courses by arranging bricks in Stretcher bond. Ensure that wall is in line, plumb and at right angle to a existing wall (Group of 10 students)	II	02*
6	Assemble a corner brick wall in six courses by arranging bricks in Stretcher bond. Ensure that wall is in line, plumb and at right angle to a existing wall (Group of 10 students). Part I	II	02
7	Assemble a corner brick wall in six courses by arranging bricks in Stretcher bond. Ensure that wall is in line, plumb and at right angle to a existing wall (Group of 10 students). Part II	II	02
8	Assemble a corner brick wall in six courses by arranging bricks in Stretcher bond. Ensure that wall is in line, plumb and at right angle to a existing wall (Group of 10 students). Part III	II	02
9	Assemble a corner brick wall in six courses by arranging bricks in Stretcher bond. Ensure that wall is in line, plumb and at right angle to a existing wall (Group of 10 students) Part IV	II	02
10	Identify the superstructure construction activities and the equipments/tools being used at site during the visit Part I	III, IV	02*
11	Identify the superstructure construction activities and the equipments/tools being used at site during the visit Part II	III, IV	02
12	Identify the superstructure construction activities and the equipments/tools being used at site during the visit Part III	III, IV	02
13	Identify the superstructure construction activities and the equipments/tools being used at site during the visit Part IV	III, IV	02
14	Mark level of given height from ground level at different locations in the specified location using water pipe technique. Part I (Group of 10 students)	II, IV	02*
15	Mark level of given height from ground level at different locations in the specified location using water pipe technique. Part II (Group of 10 students)	II, IV	02
16	Mark level of given height from ground level at different locations in the specified location using water pipe technique. Part III (Group of 10 students)	II, IV	02
17	Mark level of given height from ground level at different locations in the specified location using water pipe technique. Part IV (Group of 10 students)	II, IV	02
18	Assemble a pipe line as per given drawing using pipes of one inch diameter, pipes of half inch diameter, nipple, reducer, union, valves T, elbow and then dissemble this pipe line. Part I	III	02*
19	Assemble a pipe line as per given drawing using pipes of one inch diameter, pipes of half inch diameter, nipple, reducer, union, valves T, elbow and then dissemble this pipe	III	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
	line. Part II		
20	Assemble a pipe line as per given drawing using pipes of one inch diameter, pipes of half inch diameter, nipple, reducer, union, valves T, elbow and then dissemble this pipe line. Part III	III	02
21	Assemble a pipe line as per given drawing using pipes of one inch diameter, pipes of half inch diameter, nipple, reducer, union, valves T, elbow and then dissemble this pipe line. Part IV	III	02
22	Test the quality of cement on site/Laboratory. Part I	IV	02*
23	Test the quality of cement on site/Laboratory. Part II	IV	02
24	Test the quality of cement on site/Laboratory. Part III	IV	02
25	Identify types of bent up bar and stirrups at site during the field visit for the reinforcement for beams, column and slab. Part I	IV	02*
26	Identify types of bent up bar and stirrups at site during the field visit for the reinforcement for beams, column and slab. Part II	IV	02
27	Carry out field test on bricks at site. Part I	IV	02*
28	Carry out field test on bricks at site. Part II	IV	02
29	Carry out field test on bricks at site. Part III	IV	02
30	Identify the various components of the culvert at site	V	08*
31	Identify the various components of the bridge at site	V	08
32	Identify the various components of the highways at site	V	08
	Total		**64**

Note

*i. A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 24 or more practical LOs/tutorials need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. Hence, the 'Process' and 'Product' related skills associated with each PrO of the laboratory/workshop/field work are to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
1	Preparation of experimental set up	20
2	Setting and operation	20
3	Safety measures	10
4	Observations and Recording	10
5	Interpretation of result and Conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
	Total	**100**

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

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical practices.

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

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Exp. No.
1	Raw material such as bricks of standard size 230 mm x 115 mm x 75 mm,	3,8
2	Trowels (Brick, Buttering, Pointing) , triangular, ranging in size up to about 11 inches (279.40 mm) long and from 101.6 mm to 203.2 mm wide i.e. (4 to 8 inches wide).	3
3	Portable Hammer , Spade, Pans (ghamela), Thread, lime	3
4	Square, mason's level, and straightedge 28.57 mm to 38.10 mm and the middle portion of the top edge from 152.40 mm to 254 mm wide	3
5	Levels and mason's line, brushes.	3
6	String, Level / Water tube, Plumb bob, Right Angle	4
7	The mason's level to establish "plumb" and "level" lines	4
8	Plumbing materials such as pipes and accessories for different sizes and materials, pipe wrench	5
9	Pipe Bending Machine	5
10	Pipe Vice – 100 mm	5
11	Pipe Cutter- 50 mm	5
12	Ordinary Portland Cement	3.6
13	Reinforcement bar,10 mm dia. , binding wire and bending tool	7
14	Bricks of standard size 230 mm x 115 mm x 75 mm.	3.8

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Overview of Construction activities	1a. Describe basic construction activities to be undertaken for the given component of civil structure. 1b. Identify the construction activities at the given site. 1c. Identify the tools used for the given type of foundation layout. 1d. Describe different safety precautions to be taken at the given construction site.	1.1. Construction activities such as layout, excavation, brick masonry, concreting, plumbing, electrification, Interdependency of various activities 1.2. Workmanship and Safety precautions
Unit – II Masonry and Concreting	2a. Identify the basic techniques to be used for the given type of masonry and concreting works with justification. 2b. Identify the relevant quality control measures to be adopted in operations related to the given type of masonry and concreting with justification. 2c. Describe the methods of plastering and pointing to be undertaken in the given situation. 2d. Describe the methods of the formwork for the given type of building. 2e. Identify type of bonds in the given type of brickwork.	2.1 Brick and stone Masonry work, Types of bonds and joints (vertical and horizontal). 2.2 Line dori, plumb bob, right angle and water level tube. 2.3 Plastering, Pointing. 2.4 Proper mixing of concrete, concrete laying. 2.5 Use of concrete Mixtures and Vibrators, different types of Vibrators. 2.6 Formwork, Scaffolding. 2.7 Centring and Shuttering.
Unit- III Plumbing Services	3a Identify the plumbing tools and fixtures in the given situation with justification. 3b Select the pipe fittings, hand tools and machinery for the given type of work with justification. 3c Select the type of plumbing tools and machinery for the given situation with justification. 3d Describe the procedure to perform plumbing operations for the given condition. 3e Describe the safety precautions to be undertaken for the given site.	3.1 Different types of pipes, joints, taps, fixtures and accessories used in plumbing. 3.2 Components (pipes, valves, bends,) used in water supply/sanitary/sewerage lines.
Unit– IV Finishing Works	4a. Describe the operations to be undertaken related to the given situation of false ceiling, aluminum partitions, plastering work. 4b. Describe the procedure to prepare the	4.1 Flooring, skirting and dado. 4.2 False ceiling, Plaster of Paris (POP) work, aluminum – glass works, cladding. 4.3 Whitewash and painting:

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	base for the given type of finishing /painting work. 4c. Choose the relevant aluminum section for the given type of work with justification. 4d. Describe whitewashing and Painting procedure for the given type of walls/steel frames/wooden structure.	Tools required, brush, roller and spray painting, preparation of surface for timber and steel members for painting.
Unit– V Construction of Road, culverts/ bridges	5a. Identify relevant materials for the given type of road construction with justification. 5b. Describe the types and components of road for the given situation. 5c. Describe the components of typical bridge for the given situation. 5d. Describe the components of a typical Culvert in the given situation. 5e. Identify relevant materials for construction of given type of bridge/culvert.	5.1 Types of road, components of road, (carriage way, shoulder, camber, gradient). 5.2 Bridges and Culvert, component parts, (Abutment, Pier, Wing wall, Approach).

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

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

- Not applicable -

10. SUGGESTED STUDENT ACTIVITIES

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

b. Undertake a market survey of local dealers for procurement of civil engineering materials, plumbing materials and finishing items
c. Organize a visit to Construction sites of different types such as simple residential buildings, malls, multistoried buildings. Observe the course/topic based practices on the field.
d. Teacher guided self-learning activities
e. Course/ library /internet based mini-projects.
f. Develop Power point presentation or animation for activities seen during field visit.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.

c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
a. Guide student(s) in undertaking micro-projects.
b. Arrange visit to nearby construction sites for understanding various construction stages and construction activities.
c. Show video/animation films to explain various processes like, excavation, foundation, brickwork, plastering, laying water supply and sewer pipe line.
d. Prepare construction activity chart for various civil engineering stages.

12. SUGGESTED MICRO-PROJECTS

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

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

a. **Bill Preparation** (Group of 4-5 students) – Prepare bill of materials for given pipeline layout
b. ***Masonry and concreting*** - Each student will collect the information regarding the IS provisions for the construction materials like cement, bricks, reinforcement and sand.
a. ***Finishing Work*** – Collect the information from local market regarding the types, thickness, manufacturer, cost of various brands and make of aluminum extruded sections along with its specifications laid in IS code.(Individual activity)
b. ***Plumbing*** – Download the specifications for plumbing tools such as bench vice, hammers, pipe wrench and pipe accessories.
c. ***Masonry and concreting*** – Undertake a market survey of cement aggregate and sand of various specifications from local dealers (Group of five students)
d. ***Plumbing*** – Collect the technical information for various plumbing accessories such as GI/PVC pipes, bend, union, couplings of various dimensions and write a brief reports.(Individual activity)
e. ***Masonry and concreting*** *(Individual activity)* –
   i. Collect five samples of bricks from different suppliers and test them in field to assess its quality and write a report on it with reference to its constituents and process of manufacturing.
   ii. Prepare a mud /cement mortar of various proportions 1:3 and apply plaster on a plain wall of 120 mm X 90 mm and observe the line, level and plumb
   iii. Prepare a cement concrete of proportion 1:2:4, 1:3:6 and 1:4:8 and prepare a cubical block of it to determine its strength. (Individual activity)

iv. Masonry and concreting –Collect the list of available brand of flooring tiles with their IS specifications and make a report of it.

f. ***Masonry and concreting*** (Group of five students) – Undertake the local survey for various shuttering material along with its specifications.

g. ***Masonry and concreting*** .(Group of ten students) – Assemble and dissemble the shuttering material for a beam of given dimension using appropriate material as directed by concern teacher

h. **Finishing Work** (Individual activity) - Undertake the survey for different brands of paint, painting tools and prepare a report with reference to the following points:
   i. Constituents of paint material
   ii. Coverage area of finishing surface.
   iii. Cost.
   iv. Durability and aesthetic features.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	PWD- Standard Data Book for Building Work	PWD	PWD, Government of Maharashtra, Mumbai.
2	CPWD Specifications (Vol.-I and II)	CPWD	CPWD, Govt. of India, New Delhi.
3	The Practical design of Structural Elements in Timber	Bull, J.W.	Gower Press, London, 1989, ISBN: 9780566090288
4	Basic Plumbing With Illustrations	Massey, Howard C.	Craftsman Book Co; California, ISBN: 9780934041997
5	Modern Plumbing	Baker, E.Keith Blanken	Goodheart-Willcox Co. ISBN: 978-1590703502
6	District Schedule of rates, (DSR)	PWD	PWD, Government of Maharashtra, Mumbai.
7	A To Z Of Practical Building Construction & its Management	Mantri Sandeep	Satya Prakashan, New Delhi; 2015; ISBN : 9788176842051

14. SOFTWARE/LEARNING WEBSITES

a. http://www.asnu.com.au
b. http://www.iamcivilengineer.com/ -building-design-and.html
c. www.mahapwd.com/
d. cpwd.gov.in/
e. https://wrd.maharashtra.gov.in/

Program Name: All Branches of Diploma in Engineering and Technology.

Program Code: CE/CR/CS/CH/PS/CM/CO/IF/CW/DE/EJ/EN/EQ/ET/EX/IE/MU/EE/ EP/EU/IS/IC/AE /FG/ME/PG/PT/DC/TX/TC

Semester : Second

Course Title : Business Communication Using Computers

Course Code : 22009

1. RATIONALE

Communication is the key factor for smooth and efficient functioning of any industry or business activity. Effective business communication is the lifeblood of any organization and is required to maintain quality and progress. The efficacy of business communication skills are essential for engineering professionals for instructing, guiding and motivating subordinates to achieve desired goals at work place. It is very crucial for an entrepreneur to run organization successfully by communicating effectively and skillfully with employees, customers and investors. Thus this course has been designed to enhance the skills to '*Communicate effectively and skillfully at workplace.*'

2. COMPETENCY

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

- **Communicate effectively and skillfully at workplace.**

3. COURSE OUTCOMES (COs)

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

a. Communicate effectively by avoiding barriers in various formal and informal situations.
b. Communicate skillfully using non-verbal methods of communication.
c. Give presentations by using audio- visual aids.
d. Write reports using correct guidelines.
e. Compose e-mail and formal business letters.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory						Practical					
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
L	T	P			Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
--	--	2	2	--	--	--	--	--	--	--	35@^	14	15~	06	50	20

(~[1]): For only practical courses, the PA (15 marks) has two components under practical marks i.e. the assessment of practical has a weightage of 60% (i.e.09 marks) and micro-project assessment has a weightage of 40% (i.e.06 marks). This is designed to facilitate attainment of COs holistically, as there is no theory ESE.

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

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

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

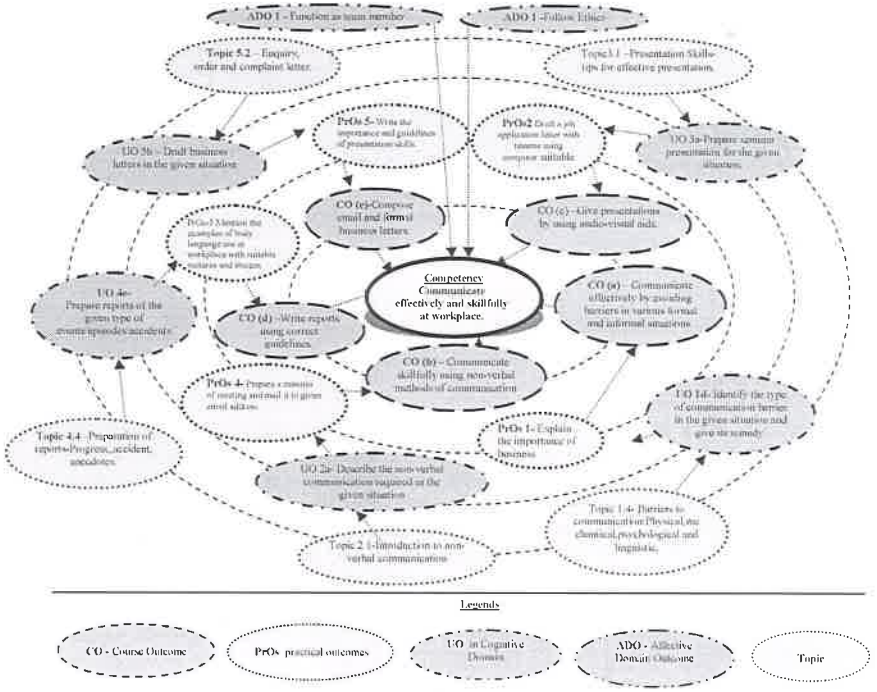

Figure 1 - Course Map

6. SUGGESTED PRACTICALS ACTIVITIES / EXERCISES (Integrate the theory in the laboratory when conducting practical)

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.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Explain the importance of business communication for an organization using case study	I	2*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
2	Draft a job application letter with resume using computer.	V	2*
3	Mention the examples of body language use at workplace with suitable pictures and images.	II	2*
4	Prepare a minutes of meeting and mail it to given email address	VI	2
5	Write the importance and guidelines of presentation skills.	III	2*
6	Draft a detailed Progress Report.	IV	2*
7	Organize a debate on types of communication.	I & III	2
8	Summarize an industry report using techniques of summarizing.	IV	2
9	Draft a complaint letter on given topic.	V	2
10	Design PowerPoint presentation on any technical topic.	III	2*
11	Explain the eight principles of effective communication.	I	2*
12	Explain various non-verbal codes with examples.	II	2
13	Explain the importance of personal appearance stating tips of grooming for a professional.	II	2*
14	Draft a memo on given topic.	V	2
15	Present any Two barriers to communication using case study.	I	2*
16	Present a technical paper using IEEE format.	III	2*
			32

Note

i. A suggestive list of practical LOs is given in the above table, more such practical LOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical LOs/tutorials need to be performed, out of which, the practicals marked as '' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry. The size of batch for the practical should not exceed more than 21 students strictly for the maximum attainment of COs and PrOs.*

ii. Hence, the 'Process' and 'Product' related skills associated with each LO of the laboratory/workshop/field work are to be assessed according to a suggested sample given below:

7. MAJOR EQUIPMENTS / INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Exp. S.No.
1	LCD Projector	All
2	Smart Board with networking	All
3	Language lab with internet	All
4	Printer	Wherever Applicable

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Unit Outcomes (UOs) (in cognitive domain)		Topics and Sub-topics
	Writing Skills	Speaking Skills	
Unit – I Introduction to Business Communication	1a. Describe the importance of the business communication in the given situation. 1b. Identify the missing element in the given communication process. 1c. Identify the type of communication in the given situation. 1d. Identify the type of communication barrier in the given situation and its remedy.	1e. Use different types of verbal and non–verbal communication for the given situation.	1.1 Introduction to Communication- Elements, Importance, Functions. 1.2 Types (meaning and importance) –Verbal (Oral-Written), Formal, Informal, Vertical, Horizontal and Diagonal communication. 1.3 Principles of effective communication. 1.4 Barriers to communication - Physical, mechanical, psychological and linguistic. 1.5 Business communication: Meaning, characteristics and importance.
Unit– II Non-Verbal Communication	2a. Describe the non-verbal communication required in the given situation. 2b. Describe personal appearance required in the given communication situation. 2c. Describe the given facial expressions.	2d. Use relevant facial expressions in the given situation. 2e. Answer questions after listening to presentations.	2.1 Introduction to Non-Verbal communication (Meaning and importance) 2.2 Body Language: Aspects of body language: gestures, eye contact, posture, facial expressions, personal appearance (dressing and grooming) vocalics. 2.3 Body language - positive and negative body language.
Unit– III Presentation skills	3a. Prepare seminar presentation for the given situation. 3b. Prepare debate points 'for' and 'against' the given topic. 3c. Prepare the points for computer presentation	3d. Make seminar presentation 3e. Participate in debate speaking 'for' or 'against' the given topic. 3f. Make effective	3.1 Presentation skills- tips for effective presentation. 3.2 Guidelines for developing power point presentation. 3.3 Presenting Technical papers.

Unit	Unit Outcomes (UOs) (in cognitive domain)		Topics and Sub-topics
	Writing Skills	Speaking Skills	
	for the given topic.	computer presentations	
Unit– IV Office Drafting	4a. Draft the given notice using the relevant format. 4b. Draft the given memorandum using the relevant format. 4c. Prepare agenda for the given type of meetings. 4d. Prepare minutes of the given type of meetings. 4e. Prepare reports of the given type of events/episodes/ accidents	4f. Read the agenda of the given meeting. 4g. Read the report of the given event. 4h. Initiate telephone calls for given situation. 4i. Answer official phone calls for given situation.	4.1. Office drafting: Formats and Guidelines. 4.2. Formulating notices and memoranda. 4.3. Preparation of agenda and writing minutes of meetings. 4.4. Preparation of reports- progress reports, Accident reports, case study. 4.5. Summarizing techniques.
Unit-V Business Correspondence	5a. Respond to given job advertisements by writing your CV/ Resume. 5b. Draft business letters in the given situations. 5c. Draft complaint letters for the given situations. 5d. Compose E- mails with relevant for the given situation.		5.1 Business correspondence. 5.2 Enquiry, order and complaint letters. 5.3 E-mails- netiquettes. 5.4 Difference –Curriculum Vitae, Bio-data and Resume. 5.5 Job application and resume writing

Note: To attain the COs and competency, above listed Learning Outcomes (UOs) need to be undertaken to achieve the 'Application Level' of Blooms's 'Cognitive Domain Taxonomy' Theory related topic should be covered during practical hours using multimedia.

9. SUGGESTED SPECIFICATION TABLE FOR INTERNAL END SEMISTER EXAMINATION

Unit No.	Unit Title	Distribution of practical Marks			
		R Level	U Level	A Level	Total Marks
I	Introduction to Business Communication	02	02	01	05
II	Non-verbal Communication	02	01	02	05
III	Presentation Skills	02	01	02	05
IV	Office Drafting	02	04	04	10
V	Business Correspondence	02	04	04	10
	Total	**10**	**12**	**13**	**35**

***Legends**: R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note**: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of PrOs and UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10. SUGGESTED GUIDELINES FOR ASSESSMENT TOOL TO CONDUCT INTERNAL END SEMETER EXAM (ESE) .

Weightage (20 Marks) A	Weightage (15 Marks) B	Total
Assessment based on PrOs, practicals conducted during semester Based on computer and written skill. (Minimum four questions each five marks) Sample questions: Eg. I Draft an email to The manager regarding the shortage of raw material at production department. Note-submit the printout of mail. (Computer based) **Eg. II Write job application with resume. (written)**	**Oral examination based on UOs Topics mentioned in syllabus. (Minimum five questions each two marks to be asked) Eg. I Explain the importance of communication in professional life. II. State any four guidelines of presentation skills.**	**(35 Marks) A+B** **Duration: 2 hours**

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:

a. Collect good articles from newspapers and magazines and read them with correct intonation.
b. Listen to Business news on TV and radio.
c. Watch videos of effective presentations on television and open learning sources for presentation skills and body language.
d. Undertake micro-projects.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

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

b. *'L' in item No. 4* does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About *15-20% of the topics/sub-topics* which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
a. Arrange various communication activities using functional grammar.
b. Show video/animation films to develop listening skills and enhance vocabulary.
c. Use real life situations for explanation.
d. Prepare and give oral presentations.
e. Guide micro-projects in groups as well as individually.

12. SUGGESTED TITLES OF MICRO-PROJECTS

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

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

a. Study the personal appearance and grooming of employees visiting sales store, shopping mall in the vicinity.
b. Comparative study of Bio-data, Resume and Curriculum vitae.
c. A detailed study of guidelines required for presentation skills.
d. Summarize technical content using English newspaper, magazines or online resources.
e. Prepare a booklet on aspects of body language in pictorial form.
f. A detailed study of the importance, of technical paper of technical paper presentation.
g. Case study on the importance of Business communication in an organization.
h. Report on various formal/business activities.
i. Study of oral presentation of famous business leader.
j. Detailed study of business etiquettes observed in organization.
k. Summarize the business article with the help of English newspapers/magazines and other sources.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Effective Communication Skills	M Ashraf Rizvi	Tata McGraw-Hill

S. No.	Title of Book	Author	Publication
2	Communication Skills	Sanjay Kumar and Pushp Lata	Oxford University Press
3	Personality Development and Soft Skills	Barun K. Mitra	Oxford University Press

14. SOFTWARE/LEARNING WEBSITES

a. https://www.britishcouncil.in/english/learn-online
b. http://learnenglish.britishcouncil.org/en/content
c. http://www.talkenglish.com/
d. languagelabsystem.com
e. www.wordsworthelt.com
f. www.notesdesk.com
g. http://www.tutorialspoint.com
h. www.studylecturenotes.com
i. totalcommunicator.com
j. www.speaking-tips.com

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION (MSBTE)

I – Scheme
II – Semester Course Curriculum

Course Title: **Applied Mechanics** (AE, CE, CH, FG, ME, PT)
(Course Code: ..... **)**

Diploma programme in which this course is offered	Semester in which offered
Automobile, Civil, Mechanical, Chemical Fabrication Technology and Erection Engineering and Production Technology	Second

1. RATIONALE

In day-to-day working we come across different types of structures created for different purposes and functions. While designing ~~of~~ the structures, analysis of forces and stresses' is an important and prerequisite step. Correct analysis is possible only when one knows the types and effects of forces acting on the structures. This course ~~also~~ provides the scope to understand fundamental concepts of laws of mechanics and their applications to different engineering problems. This course is designed to provide basic understanding about the different types of forces, moments and their effects on structural elements, which will analysing different structural systems.

2. 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 applied mechanics to solve broad-based engineering related problems.**

3. COURSE OUTCOMES (COs)

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

a. Identify the force systems for given conditions by applying the basics of mechanics.
b. Select the relevant simple lifting machine(s) for given purposes.
c. Determine unknown force(s) of different engineering systems.
d. Check the stability of various force systems.
e. Apply the principles of friction in various conditions for useful purposes.
f. Find the centroid and centre of gravity of various components in engineering systems.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
3	2	2	7	70	30*	25	25	150

***(*):** Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken*

during the semester for the assessment of the cognitive domain LOs required for the attainment of the COs.
***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment.*

5. COURSE MAP (with sample COs, Learning Outcomes i.e. LOs and topics)

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

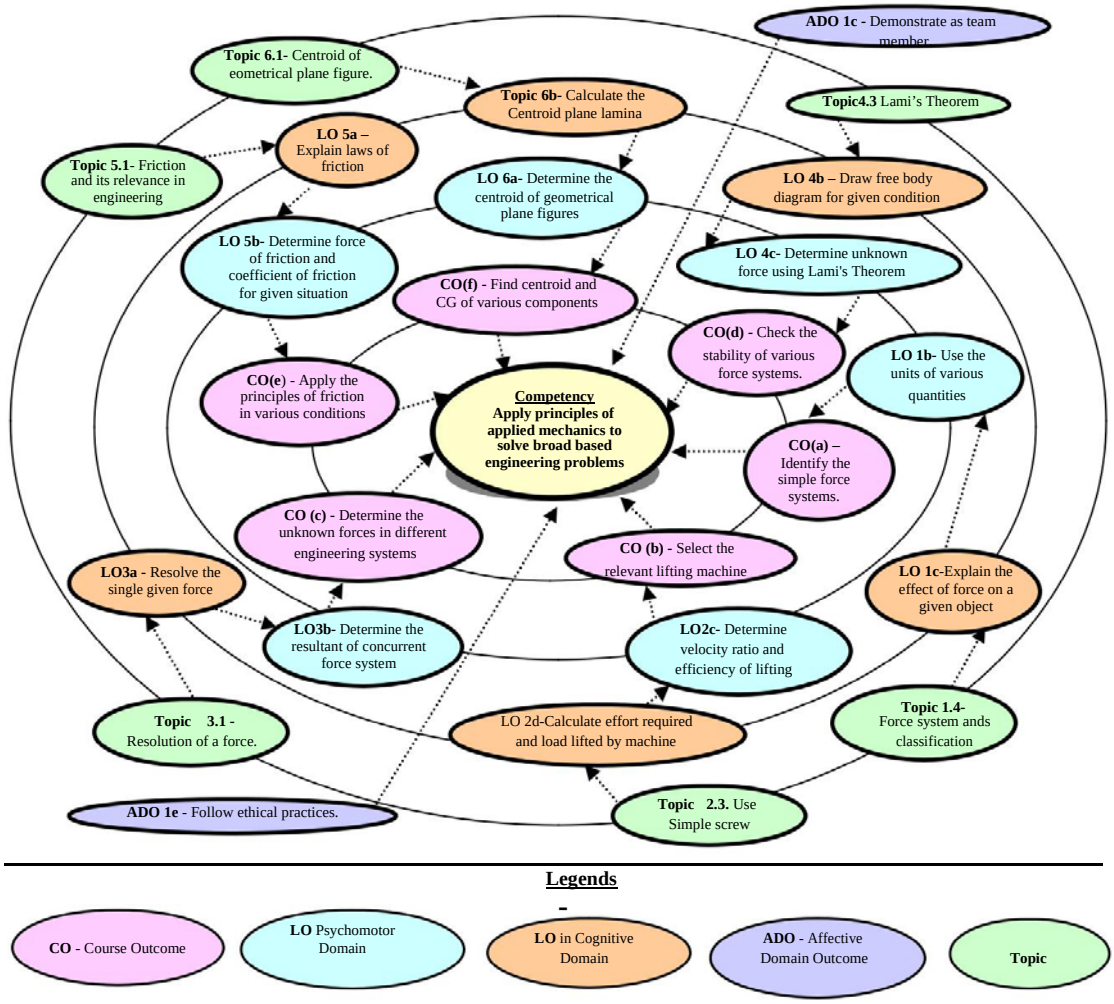

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals/exercises/tutorials in this section are psychomotor domain LOs (i.e.sub-components of the COs), to be developed and assessed in the student to lead to the attainment of the competency.

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
1	Identify various equipment related to Applied Mechanics.	II to VI	02
2	Use Differential axle and wheel.	II	02*
3	Use Simple screw jack.	II	02
4	Use worm and worm wheel.	II	02
5	Use single or double purchase crab.	II	02
6	Use Weston's differential or wormed geared pulley block.	II	02
7	Use force table to determine resultant of concurrent force system applying Law of Polygon of forces.	III	02*
8	Use force table to determine resultant of concurrent force system applying Law of Polygon of forces.	III	02*
9	Graphically determine resultant of concurrent force system.	III	02
10	Graphically determine resultant of parallel force system.	III	02
11	Use Law of moment apparatus to determine unknown forces.	IV	02*
12	Apply Lami's theorem to determine unknown force.	IV	02
13	Determine support reactions for simply supported beam.	IV	02
14	Determine coefficient of friction for motion on horizontal plane.	V	02*
15	Determine coefficient of friction for motion on inclined plane.	V	02
16	Determine centroid of geometrical plane figures.	VI	02
	Total		**32**

Note

i. A suggestive list of practical LOs is given in the above table, more such practical LOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical LOs/tutorials need to be performed, out of which, the practicals marked as '' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. Hence, the 'Process' and 'Product' related skills associated with each LO of the laboratory/workshop/field work are to be assessed according to a suggested sample given below:

S.No.	Performance Indicators	Weightage in %
1	Preparation of experimental set up	20
2	Setting and operation	20
3	Safety measures	10
4	Observations and Recording	10
5	Interpretation of result and Conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
Total		**100**

Additionally, the following affective domain LOs (social skills/attitudes), are also important constituents of the competency which can be best developed through the above mentioned laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.

d. Maintain tools and equipment.
e. Follow ethical practices.

The development of the attitude related LOs of Krathwohl's 'Affective Domain Taxonomy', the achievement level may reach:

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Exp. No.
1	Differential axle and wheel (wall mounted unit with the wheel of 40 cm diameter and axles are insteps of 20 cm and 10 cm reducing diameter .	2
2	Simple screw Jack (Table mounted metallic body , screw with a pitch of 5 mm carrying a double flanged turn table of 20 cm diameter.	3
3	Worm and worm wheel (wall mounted unit with threaded spindle, load drum, effort wheel; with necessary slotted weights, hanger and thread)	4
4	Single Purchase Crab winch (Table mounted heavy cast iron body. The effort wheel is of C.I. material of 25 cm diameter mounted on a shaft of about 40mm dia. On the same shaft a geared wheel of 15 cm dia.	5
5	Double Purchase Crab winch (Having assembly same as above but with double set of gearing arrangement.)	5
6	Weston's Differential pulley block (consisting of two pulleys; one bigger and other smaller.	6
7	Weston's Differential worm geared pulley block (Consists of a metallic (preferably steel) cogged wheel of about 20 cm along with a protruded load drum of 10 cm dia to suspend the weights of 10 kg, 20 kg-2 weights and a 50 kg weights)	6
8	Universal Force Table (Consists of a circular 40 cm dia. Aluminum disc, graduated into 360 degrees.) with all accessories..	7, 10
9	Law of moments apparatus consisting of a stainless steel graduated beam 12.5 mm square in section, 1m long, pivoted at centre.	9
10	Beam Reaction apparatus (The apparatus is with two circular dial type 10 kg.	11
11	Friction apparatus for motion along horizontal and inclined plane (base to which a sector with graduated arc and vertical scale is provided. The plane may be clamped at any angle up to 45 degrees. pan. Two weight boxes (each of 5 gm,10 gm, 2-20 gm, 2-50 gm, 2-100 gm weight),	12
12	Models of geometrical figures.	13

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Mechanics and force system	1a. Explain concepts of the given terms. 1b. Use the relevant units of various quantities in the given situations. 1c. Explain effects of a force on the given object. 1d. Identify the force system for the given situation.	1.1. Significance and relevance: Mechanics, applied mechanics, statics, dynamics. 1.2. Space, time, mass, particle, body, rigid body. 1.3. Scalar and vector quantity, Units of measurement (SI units)- Fundamental units and derived units. 1.4. Force – unit, representation as a vector and by Bow's notation, characteristics and effects of a force, Principle of transmissibility of force, Force system and its classification.
Unit – II Simple lifting machine	2a. Describe the components of the given lifting machine. 2b. Differentiate the working principle of the given two types of simple lifting machines. 2c. Determine velocity ratio, efficiency and law of the given simple lifting machine. 2d. Calculate effort required and load lifted by the given simple lifting machine. 2e. Interpret the graphs after drawing them with the given data. 2f. Select the relevant simple lifting machine required for the given purpose with justification.	2.1 Simple lifting machine, load, effort, mechanical advantage, applications and advantages. Velocity ratio, efficiency of machines, law of machine. 2.2 Ideal machine, friction in machine, maximum Mechanical advantage and efficiency, reversible and non-reversible machines, condition for reversibility 2.3 Velocity ratios of Simple axle and wheel, Differential axle and wheel, Worm and worm wheel, Single purchase and double purchase crab winch, Simple screw jack, Weston's differential pulley block, geared pulley block. 2.4 Graphs of Load verses Effort, Load verses ideal Effort, Load verses Effort lost in friction, Load verses MA, Load verses Efficiency.
Unit- III Resolution and compositio n	3a. Resolve the given single force. 3b. Calculate the resultant of the given force system analytically. 3c. Determine graphically the resultant of the given force system. 3d. Find the resultant of the given force system using	3.1 Resolution of a force - Orthogonal and Non Orthogonal components of a force, moment of a force, Varignon's Theorem, 3.2 Composition of forces – Resultant, analytical method of determination of resultant for concurrent, non concurrent and parallel co-planar force systems – Law of triangle, parallelogram and polygon of forces. 3.3 Graphic statics, graphical representation

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	law of triangle and law of parallelogram.	of force, Space diagram, force diagram, polar diagram and funicular polygon, Graphical method of determination of resultant for concurrent and parallel co-planar force systems.
Unit– IV Equilibrium	4a. Draw the free body diagram for the given condition. 4b. Determine unknown force in the given situation using Lami's theorem. 4c. Identify the types of beams required for the given situation. 4d. Determine reactions in the given type of beam analytically and graphically.	4.1 Equilibrium and Equilibrant, Free body and Free body diagram, Analytical and graphical conditions of equilibrium, 4.2 Equilibrium of force systems analytically 4.3 Lami's Theorem, 4.4 Types of beam, supports (simple, hinged, roller and fixed) and loads acting on beam (vertical and inclined point load, UD load, couple), span of beam. 4.5 Beam reaction for cantilever, simply supported beam with or without overhang – subjected to combination of Point load and UD load or Vertical Point load and couple. 4.6 Beam reaction graphically for simply supported beam subjected to vertical loads only.
Unit– V Friction	5a. Determine force of friction and coefficient of friction for the given condition. 5b. Describe the conditions for friction for the give situation. 5c. Determine friction force in the given situation. 5d. Identify the various forces acting on a ladder for the given conditions using free body diagram.	5.1 Friction and its relevance in engineering, types and laws of friction, limiting equilibrium, limiting friction, co-efficient of friction, angle of friction, angle of repose, relation between co-efficient of friction and angle of friction. 5.2 Equilibrium of bodies on level surface subjected to force parallel and inclined to plane. 5.3 Equilibrium of bodies on inclined plane subjected to force parallel to the plane only. 5.4 FBD of ladder in friction
Unit– VI Centroid and centre of gravity	6a. Determine the centroid of geometrical plane figures and centre of gravity of the given simple solid. 6b. Calculate centroid of the given composite plane lamina 6c. Determine centre of gravity of the given solids. 6d. Determine centre of gravity	6.1 Centroid of geometrical plane figures (square, rectangle, triangle, circle, semi-circle, quarter circle) 6.2 Centroid of composite figures composed of not more than three geometrical figures 6.3 Centre of Gravity of simple solids (Cube, cuboid, cone, cylinder, sphere, hemisphere) 6.4 Centre of Gravity of composite solids composed of not more than two simple

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	of the given composite solid.	solids.

***Note**: To attain the COs and competency, above listed Learning Outcomes (LOs) need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.*

9. 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	Mechanics and Force System	04	02	02	02	06
II	Simple Lifting Machines.	08	02	04	06	12
III	Resolution and Composition	10	02	04	08	14
IV	Equilibrium	10	02	02	10	14
V	Friction	08	02	04	06	12
VI	Centroid and Centre of Gravity	08	02	02	08	12
Total		**48**	**12**	**18**	**40**	**70**

***Legends:** R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note**: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of LOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

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:

a. Collect five different photographs indicating concurrent, parallel, general force system in equilibrium.
b. Prepare a table of type of machine and relevant industrial application.
c. Collect five different situations where law of moment plays an important role.
d. Prepare models representing various types of supports (hinged, roller and fixed)
e. Illustrate situations wherein friction is essential and not essential.
f. Prepare models in the form of geometrical figures and solids and locate centroid and centre of gravity of them.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the LOs/COs through classroom presentations (see implementation guideline for details).

d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
a. Guide student(s) in undertaking micro-projects.

12. SUGGESTED MICRO-PROJECTS

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

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

a. **Types of Forces**: Prepare chart showing real-life examples indicating various types of forces
b. **Lifting Machine**: Collect photographs of specific simple lifting machine and relate these machines with the machines being studied and prepare models of simple lifting machines using tools in “MECHANO” and “MECHANIX”
c. **Types of support:** Prepare chart showing actual and corresponding schematic diagram of various type of support
d. **Beams:** Prepare models of beam subjected to point loads, uniformly distributed loads, simply supported, overhang and cantilever type beam.
e. **Friction:** Prepare chart regarding type of friction in various field conditions and collect data regarding coefficient of friction by referring books, Determine coefficient of friction for three different types of surfaces
f. **Centre of Gravity:** Prepare a chart of situations wherein concept of Centre of Gravity is vital**.**

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Applied Mechanics	Khurmi, R.S.	S.Chand & Co. New Delhi 2014 ISBN: 9788121916431
2	Engineering Mechanics	Ramamrutham, S.	S Chand & Co. New Delhi 2008 ISBN:9788187433514
3	Foundations and Applications of Applied Mechanics	Ram, H. D.; Chauhan, A. K.	Cambridge University Press, Thomson Press India Ltd., New Delhi, 2015, ISBN: 9781107499836
4	Engineering Mechanics-Statics, Vol. I	Meriam, J. L.; Kraige, L.G.	Wiley Publication, New Delhi, ISBN: 978-81-265-4396

14. SOFTWARE/LEARNING WEBSITES

a. http://www.asnu.com.au

b. www.youtube.com for videos regarding machines and applications, friction
c. www.nptel.ac.in
d. www.discoveryforengineers.com

Maharashtra State Board of Technical Education (MSBTE)

I - Scheme
II – Semester Course Curriculum

Course Title: **Applied Science** (AE, CE, FG, ME, PT)
(Course Code: .....)

Diploma Programme in which this course is offered	Semester in which offered
Automobile, Mechanical, Production, Civil, Fabrication Technology and Erection Engineering	Second

1. RATIONALE

Diploma engineers have to deal with various materials and machines. The study of concepts and principles of science like elasticity, viscosity, surface tension, motion, thermo couples, photo-sensors, LASERs, X-Rays, metals, alloys, cement, lime, refractory materials water treatment and analysis, fuel and combustion will help the student to select and use relevant materials and methods which will be economical and eco-friendly.

2. COMPETENCY

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

- **Solve broad-based engineering problems using principles of advanced physics and chemistry.**

3. COURSE OUTCOMES (COs)

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

a. Select relevant material in industry by analyzing its physical properties.
b. Apply laws of motion in various applications.
c. Use LASERs, X-Rays and photo electric sensors..
d. Select the relevant metallurgical process related to industrial applications.
e. Use relevant water treatment process to solve industrial problems.
f. Use relevant fuel in relevant applications.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)				Examination Scheme				
							Theory Marks		Practical Marks		Total Marks
L	T	P	C				ESE	PA	ESE	PA	
4	-	2	Applied	Physics	2	2	35	15*	15	10	
			Science	Chemistry	2		35	15*	15	10	150

***(*):** Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment (5 marks each for Physics and Chemistry) to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain LOs required for the attainment of the COs.*

Legends: ***L****-Lecture;* ***T*** *– Tutorial/Teacher Guided Theory Practice;* ***P*** *- Practical;* ***C*** *– Credit,* ***ESE*** *- End Semester Examination;* ***PA*** *- Progressive Assessment*
Note: *Practical of Chemistry and Physics will be conducted in alternate weeks for each batch.*

5. COURSE MAP (with sample COs, Learning outcomes i.e. LOs and topics)

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

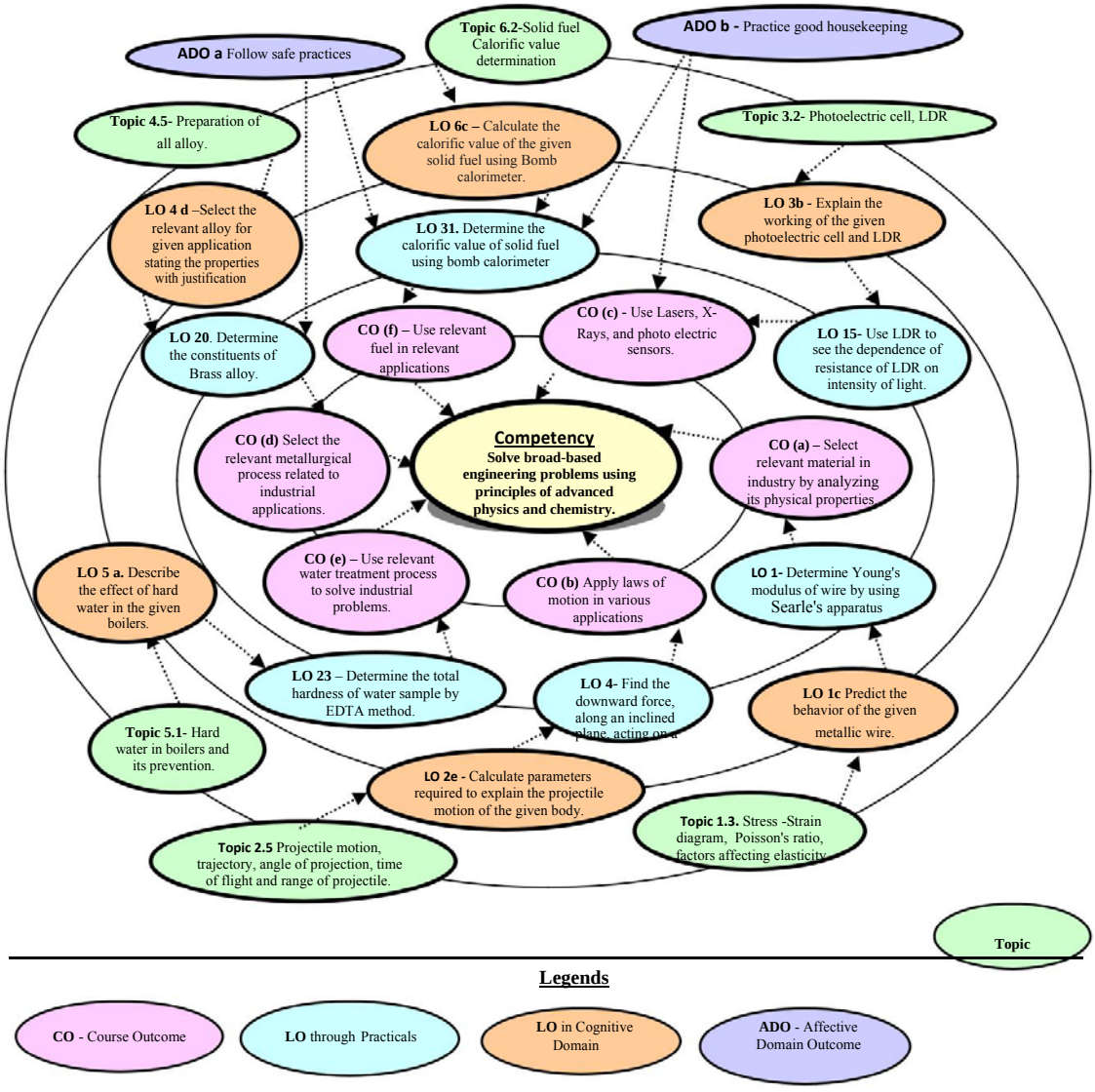

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals/exercises/tutorials in this section are psychomotor domain LOs (i.e.sub-components of the COs), to be developed and assessed in the student to lead to the attainment of the competency.

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. Required
	Physics		
1	Use Searle's method to determine the Young's modulus of given wire	I	02*
2	Apply Archimedes' principle to determine the buoyancy force on a solid immersed in liquid.	I	02
3	Determine the coefficient of viscosity of given liquid by Stoke's method.	I	02
4	Find the downward force, along an inclined plane, acting on a roller due to gravity and its relationship with the angle of inclination.	I	02
5	Predict the range of the projectile from the initial launch speed and angle.	II	02*
6	i) Find the dependence of the stopping potential on the frequency of light source in photo electric effect experiment. ii) Find the dependence of the stopping potential on the intensity of light source in photo electric effect experiment.	III	02
7	Determine the I-V characteristics of photoelectric cell and LDR.	III	02*
8	Determine the divergence of laser beam.	III	02
	Chemistry		
9	Standardization of $KMnO_4$ solution using standard oxalic acid and Determine the percentage of iron present in given Hematite ore by $KMnO_4$ solution.	IV	02*
10	Determine the percentage of copper in given copper ore .	IV	02
11	Determine total hardness, temporary hardness and permanent hardness of water sample by EDTA method.	V	02*
12	Determine the alkalinity of given water sample.	V	02
13	Determine the turbidity of given water sample by Nephelometric method.	V	02
14	Determine the moisture and ash content in given coal sample using proximate analysis.	VI	02
15	Determine the calorific value of given solid fuel using Bomb calorimeter.	VI	02*
16	Determine the percentage of Sulphur in given coal sample by ultimate analysis.(Gravimetric analysis)	VI	02
	Total		**32**

Note

i. *A suggestive list of practical LOs is given in the above table, more such practical LOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical LOs/tutorials need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. *Hence, the 'Process' and 'Product' related skills associated with each LO of the laboratory/workshop/field work are to be assessed according to a suggested sample given below:*

S. No.	Performance Indicators	Weightage in %
1	Preparation of experimental set up	20
2	Setting and operation	20
3	Safety measures	10
4	Observations and Recording	10
5	Interpretation of result and Conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
Total		**100**

Additionally, the following affective domain LOs (social skills/attitudes), are also important constituents of the competency which can be best developed through the above mentioned laboratory/field based experiences:

a. Follow safe practices.
b. Practice good housekeeping.
c. Practice energy conservation.
d. Demonstrate working as a leader/a team member.
e. Follow ethical Practices.

The development of the attitude related LOs of Krathwohl's 'Affective Domain Taxonomy', the achievement level may reach:

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Exp. No.
1	Searle's apparatus(with slotted mass of 0.5 kg each)	1
2	Liquid container	2
3	Solid body (different size and materials)	3,4
4	Stoke's apparatus (glass tube, viscous liquid, spherical balls of varying sizes)	3
5	Stop watch	4,5
6	Photo transducer	4
7	Timer	4
8	Projectile motion detector	5
9	Photo electric effect apparatus	6
10	Experimental setup for characteristics of photoelectric cell	7
11	Experimental setup for characteristics of LDR	7
12	Laser Source (He Ne, diode laser)	8
13	Electronic balance, with the scale range of 0.001g to 500g. pan size 100 mm; response time 3-5 sec.; power requirement 90-250 V, 10 watt.	All
18	Electric oven inner size 18''x18''x18''; temperature range 100 to 250^0 C with the capacity of 40 lt.	14,16
19	Bomb calorimeter	15

S. No.	Equipment Name with Broad Specifications	Exp. No.
20	Muffle furnace, Temperature up to 900^{0}C,digital temperature controller with an accuracy of +/- 3^{0}C	14,16
21	Nephelometer ; Auto-ranging from 20-200 NTU,+/- 2% of reading plus 0.1 NTU, power 220 Volts +/- 10% AC 50 Hz	13

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	Physics	
Unit – I Properties of matter and Non-Destructive Testing	1a. Explain concept of elasticity and plasticity for the given material. 1b. Establish relation between given types of modulii of elasticity. 1c. Predict the behavior of the given metallic wire.	1.1 Deforming Force and Restoring Force, Elasticity, Plasticity, Rigidity 1.2 Stress and Strain and their types, Elastic limit and Hooke's law, types of moduli of elasticity 1.3 Stress -Strain diagram, Poisson's ratio, factors affecting elasticity
	1d. Explain pressure-depth relation for the given law. 1e. Explain Newton's law of viscosity for the given liquid. 1f. Explain Stokes' law for the free fall of the body through the given viscous medium.	1.4 Fluid friction, pressure, pressure- depth relation, Pascal's law, Archimedes' principle 1.5 Viscosity, velocity gradient, Newton's law of viscosity. 1.6 Free fall of spherical body through viscous medium and Stokes' law, derivation of coefficient of viscosity 'η' by Stokes' method, effect of temperature and adulteration on viscosity of liquids.
	1g. Describe the salient features of the given NDT method.	1.7 Non-destructive testing (NDT),Various NDT methods used, Criteria for the selection of NDT method, merits and demerits of NDT
Unit– II Types of Motion	2a. Explain the equations of motion for the given body moving in the given type of path. 2b. Calculate the angular velocity of the given body. 2c. Explain the relevant Newton's laws of motion for the given moving object. 2d. Calculate the work/power/ energy for the given situation. 2e. Calculate the given	2.1 Displacement, velocity, acceleration and retardation, equations of motion, equations of motion under gravity. 2.2 Angular displacement, angular velocity, angular acceleration, three equations of angular motion 2.3 Momentum, impulse, impulsive force, Newton's laws of motion and their Applications 2.4 Work, power and energy: potential energy, kinetic energy, work -energy principle.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	parameters for the given projectile in motion.	2.5 Projectile motion, trajectory, angle of projection, time of flight and range of projectile with formulae.
Unit– III Photoelectricity, X-Rays and LASERs	3a. Explain the concept of the given parameters of the given material. 3b. Explain the working of the given photoelectric device.	3.1 Planck's hypothesis, properties of photons, Photo electric effect: threshold frequency, threshold wavelength, stopping potential, Work function, characteristics of photoelectric effect, Einstein's photoelectric equation. 3.2 Photoelectric cell and LDR: principle, working and applications.
	3c. Explain the production of X-Rays of the given material with properties and applications.	3.3 Production of X-rays by modern Coolidge tube, properties and applications.
	3d. Differentiate between LASER and given colour of light 3e. Explain the given terms with examples.	3.4 Laser: properties, absorption, spontaneous and stimulated emission, applications of Laser 3.5 Population inversion, active medium, optical pumping, three energy level system, He-Ne Laser.
Chemistry		
Unit-IV Metals, alloys, Cement, and Refractory materials	4a. Describe construction and working of the given type of furnace. 4b. Describe the extraction process of the given ore with chemical reaction. 4c. Explain purposes and preparation methods of making the given alloy. 4d. Select the relevant alloy for the given application stating the properties with justification. 4e. Describe the constituents, hardening and setting process of the given type of cement. 4f. Select the relevant refractory for given application stating the properties with justification.	4.1 Metallurgy: Mineral, ore, gangue, flux, slag. 4.2 Types of furnace: Muffle furnace, Blast furnace. 4.3 Extraction processes of Haematite, copper pyrite ores: Crushing, concentration, reduction, refining. 4.4 Properties of iron and copper: Hardness, tensile strength, toughness, malleability, ductility, refractoriness, fatigue resistance. specific gravity, specific heat, brazing, castability, stiffness. 4.5 Preparation of alloys (Fusion and compression method). 4.6 Ferrous alloys: Low carbon, medium carbon, high carbon steels. 4.7 Non-ferrous alloy: Brass, Bronze, Duralumin, Tinman Solder, Woods metal. 4.8 Cement: Types; Biocement and Portland cement; constituents, setting and hardening, applications 4.9 Lime: classification, constituents, setting and hardening, applications.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
		4.10 Refractory material: Types, properties.
Unit –V Water treatment	5a. Describe the given terminologies related to hard water and their effects 5b. Describe the given process for softening of the given water sample. 5c. Describe with sketches the purification of the given type of water. 5d. Describe the given type of of waste water treatment.	5.1 Hardness; Classification 5.2 Hard water in boilers and prevention: Boiler corrosion, caustic embrittlement, priming and foaming, scales and sludges. 5.3 Water softening: lime soda process (hot lime soda and cold lime soda process), zeolite process, ion exchange process (cation exchange and anion exchange). 5.4 Potable water treatment: Sedimentation, coagulation, filtration and sterilization. 5.5 Waste water treatment: sewage treatment, BOD and COD of sewage water; Reverse Osmosis, recycling of waste water.
Unit-VI Fuels and Combustion	6a. Describe salient properties of the given type of fuel. 6b. Explain the given type of analysis of the given type of coal. 6c. Calculate the calorific value of the given solid fuel using Bomb calorimeter. 6d. Describe composition, properties of given gaseous fuel with their applications. 6e. Calculate the mass and volume of air required for complete combustion of the given fuel.	6.1 Fuel: Calorific value and ignition temperature, classification. 6.2 Solid fuels: Coal, Classification and composition , proximate analysis, Ultimate analysis, Bomb calorimeter. Carbonization of coke by Otto Hofmann's oven. 6.3 Liquid fuels: Fractional distillation of crude petroleum, boiling range, composition, properties. Knocking, cracking, octane number and cetane number. 6.4 Gaseous fuels: Biogas, LPG, and CNG. Combustion equation of gaseous fuels, mass and volume of air required for complete combustion.

***Note**: To attain the COs and competency, above listed Learning Outcomes (LOs) need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.*

9. 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
	Physics					
I	Properties of matter and NDT	14	03	05	06	14
II	Types of motion	09	02	02	06	10
III	Photoelectricity, X-Ray and LASER,	09	03	04	04	11
	Chemistry					

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
IV	Metals, alloys, cement, refractory materials	12	02	04	06	12
V	Water treatment	10	02	03	06	11
VI	Fuels and combustion.	10	03	04	05	12
Total		**64**	**15**	**22**	**33**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note: *This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess with respect to attainment of LOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

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:

a. Seminar on any relevant topic.
b. Library survey regarding engineering material used in different industries.
c. Prepare power point presentation or animation for showing applications of lasers.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the LOs/COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.

12. SUGGESTED MICRO-PROJECTS

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

In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every

student to become problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty:

a. **Elasticity:** Prepare working model to demonstrate the stress – strain behavior of different wires of different thickness and material.
b. **Viscosity:** Collect 3 to 5 liquids and prepare a working model to differentiate liquids on the basis of viscosity and demonstrate their applications.
c. **Motion:** Prepare model of ball rolling down on inclined plane to demonstrate the conservation of energy and motion of an object in inclined plane.
d. **Photo Sensors**: Prepare simple photo sensor using LDR.
e. **Properties of Laser**: Use Key chain laser to differentiate laser with ordinary light.
f. **Water analysis**: Collect water samples from different water sources and find the characteristics like acidity, conductivity, dissolved solids, suspended particles.
g. **Water treatment:** Collect 3 to 5 water samples to find the dosage of bleaching powder required for its sterilization.
h. **Water analysis:** Prepare model to find the soap foaming capacity of bore water on addition of soda ash.
i. **Fuels:** Prepare chart showing different types of liquid fuels showing their calorific values and uses.
j. **Cement:** Collect different samples of cement and find their initial and final setting time**.**
k. **Refractory materials**: Prepare chart showing properties of refractory materials.
l. **Metal properties:** Prepare chart showing different industrial application of metal and relate it with required property or properties using internet.
m. **Alloy steel:** Find the effect of alloying elements like Mn, Cr, Ni, W, V, Co on properties of steel. Prepare chart of showing percentage composition, properties and industrial applications of different types of steel based on above alloying elements using internet.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Physics Textbook Part I and Part - Class XI	Narlikar, J. V.; Joshi, A. W.; Mathur, Anuradha; *et al*	National Council of Education Research and Training, New Delhi, 2010, ISBN : 8174505083
2	Physics Textbook Part I and part II - Class XII	Narlikar, J.V.; Joshi, A. W.; Ghatak A.K. *et al*	National Council of Education Research and Training, New Delhi, 2013, ISBN : 8174506314
3	Engineering Physics	Bhattacharya, D. K.; Tandon Poonam	Oxford Publishing, New Delhi, ISBN:0199452814
4	Principles of Engineering Physics -I	Md. Nazoor Khan and Simanchala Panigrahi	Cambridge university press; New Delhi, 2016 ISBN : 9781316635643
5	Engineering Physics	Palanisamy, P. K.	SCITECH Publications, Chennai, ISBN: 9788183711012
6	Principles of Physics	Walker, J.; Halliday, D; Resnick, R	Wiley Publications, New Delhi, 10th edition ISBN: 9788126552566
7	Textbook of Engineering Physics	Avadhanulu, M. N.; Kshirsagar, P. G.	S. Chand and Co., New Delhi, 2015 ISBN: 9788121908177
8	Engineering Chemistry	Agarwal, Shikha	Cambridge university press ; New Delhi, 2015 ISBN : 9781107476417

S. No.	Title of Book	Author	Publication
9	Engineering Chemistry	Dara, S. S.; Umare S.S.	S.Chand and Co. Publication, New Delhi, 201, ISBN: 8121997658
10	Engineering Chemistry	Jain & Jain	Dhanpat Rai and sons; New Delhi, 2015, ISBN : 9352160002
11	Engineering Chemistry	Vairam, S.	Wiley India Pvt. Ltd. New Delhi, 2013, ISBN: 9788126543342
10	Chemistry for engineers	Agnihotri, Rajesh	Wiley India Pvt.Ltd. New Delhi, 2014, ISBN: 9788126550784

14. SOFTWARE/LEARNING WEBSITES

a. http://nptel.ac.in/course.php?disciplineId=115
b. http://nptel.ac.in/course.php?disciplineId=104
c. http://hperphysics.phy-astr.gsu.edu/hbase/hph.html
d. www.physicsclassroom.com
e. www.fearofphysics.com
f. www.sciencejoywagon.com/physicszone
g. www.science.howstuffworks.com
h. https://phet.colorado.edu
i. www.chemistryteaching.com
j. www.visionlearning.com
k. www.chem1.com
l. www.onlinelibrary.wiley.com
m. www.rsc.org
n. www.chemcollective.org
o. www.wqa.org
p. www.em-ea.org

Maharashtra State Board of Technical Education (MSBTE)

I – Scheme
II – Semester Course Curriculum

CourseTitle: **Applied Mathematics** (CE)
(Course Code: .....)

Diploma programme in which this course is offered	Semester in which offered
Civil Engineering	Second

1. RATIONALE

This course is an extension of Basic Mathematics of first semester namely Applied Mathematics which is designed for its applications in engineering and technology using the techniques of calculus, differentiation, integration, differential equations and in particular numerical integration. Derivatives are useful to find slope of the curve, maxima and minima of the function, radius of curvature. Integral calculus helps in finding the area. Differential equation is used in finding the curve and its related applications for various engineering models. Numerical integration is used to find the area of the functions especially whose integration cannot be evaluated easily with routine methods. This course further develops the skills and understanding of mathematical concepts which underpin the investigative tools used in engineering.

2. COMPETENCY

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

- **Solve civil engineering related broad-based problems using the principles of applied mathematics**.

3. COURSE OUTCOMES (COs)

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

a. Calculate the equation of tangent, maxima, minima, radius of curvature by differentiation.
b. Solve the given problems of integration using suitable methods.
c. Apply the concept of integration to find area and volume.
d. Solve the differential equation of first order and first degree using suitable methods.
e. Apply the concept of numerical integration to investigate the area.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
4	2	-	6	70	30*	-	-	100

(*): *Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken*

during the semester for the assessment of the cognitive domain LOs required for the attainment of the COs.
Legends: ***L****-Lecture;* ***T*** *– Tutorial/Teacher Guided Theory Practice;* ***P*** *-Practical;* ***C*** *– Credit,* ***ESE*** *-End Semester Examination;* ***PA*** *- Progressive Assessment*

5. COURSE MAP (with sample COs, Learning Outcomes i.e. LOs and topics)

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

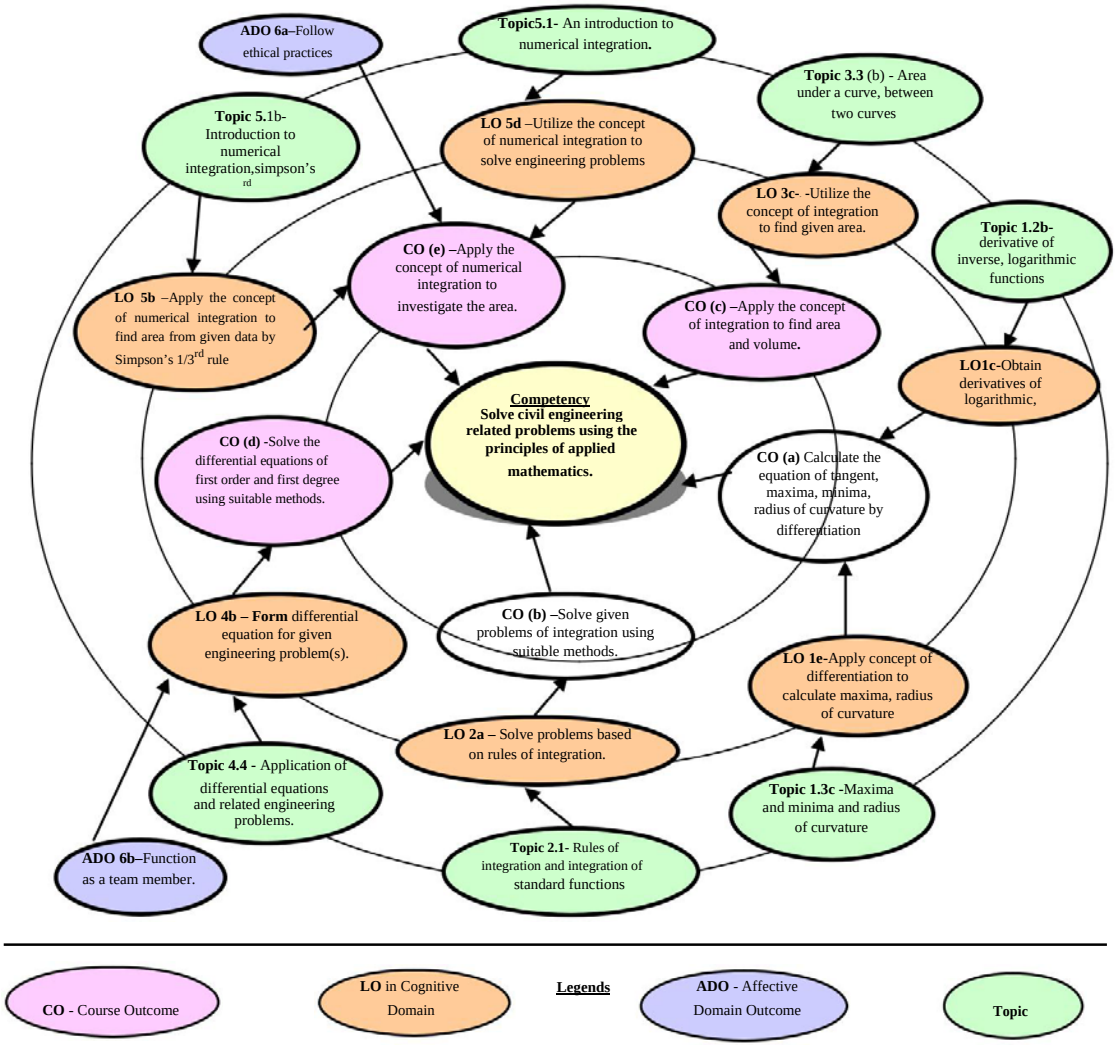

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The tutorials in this section are LOs (i.e.sub- components of the COs) to be developed and assessed in the student to lead to the attainment of the competency**.**

S. No.	Tutorials	Unit No.	Approx. Hrs. Required

S. No.	Tutorials	Unit No.	Approx. Hrs. Required
1	Solve problems based on finding value of the function at different points.	I	2
2	Solve problems to find derivatives of implicit function and parametric function	I	2
3	Solve problems to find derivative of logarithmic and exponential functions.	I	2
4	Solve problems based on finding equation of tangent and normal.	I	2
5	Solveproblems based on finding maxima, minima of function and radius of curvature at a given point.	I	2
6	Solve the problems based on standard formulae of integration.	II	2
7	Solve problems based on methods of integration, substitution, partial fractions.	II	2
8	Solve problems based on integration by parts.	II	2
9	Solve practice problems based on properties of definite integration.	III	2
10	Solve practice problems based on finding area under curve, area between two curves and volume of revolutions.	III	2
11	Solve the problems based on formation, order and degree of differential equations.	IV	2
12	Develop a model using variable separable method to related engineering problem.	IV	2
13	Develop a model using the concept of linear differential equation to related engineering problem.	IV	2
14	Solve problems based on Trapezoidal rule	V	2
15	Solve problems based on Simpson's $1/3^{rd}$ rule and Simpson's $3/8^{th}$ rule.	V	2
16	Make use of concept of numerical integration to solve related civil engineering problems.	V	2
Total			32

Note: *The above tutorial sessions are for guideline only. The remaining tutorial hours are for revision and practice.*

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED:

- Not applicable -

7. UNDERPINNING THEORY COMPONENTS

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

Unit	Major Cognitive Domain Learning Outcomes	Topics and Sub-topics
Unit – I Differential Calculus	1a. Solve the given simple problems based on functions. 1b. Solve the given simple problems based on rules of differentiation.	1.1 Functions and Limits : a) Concept of function and simple examples b) Concept of limits without

Unit	Major Cognitive Domain Learning Outcomes	Topics and Sub-topics
	1c. Obtain the derivatives of logarithmic, exponential functions. 1d. Apply the concept of differentiation to find given equation of tangent and normal 1e. Apply the concept of differentiation to calculate maxima and minima and radius of curvature for given function.	examples. 1.2 Derivatives : a) Rules of derivatives such as sum, product, quotient of functions. b) Derivative of composite functions (chain Rule), implicit and parametric functions. c) Derivatives of inverse, logarithmic and exponential functions. 1.3 Applications of derivative : a) Second order derivative without examples. b) Equation of tangent and normal c) Maxima and minima d) Radius of curvature
Unit– II Integral Calculus	2a. Solve the given simple problem(s) based on rules of integration. 2b. Obtain the given simple integral(s) using substitution method. 2c. Integrate given simple functions using the integration by parts. 2d. Evaluate the given simple integral by partial fractions.	2.1 Simple Integration: Rules of integration and integration of standard functions. 2.2 Methods of Integration: a) Integration by substitution. b) Integration by parts c) Integration by partial fractions.
Unit– III Applications of Definite Integration	3a. Solve given simple problems based on properties of definite integration. 3b. Apply the concept of definite integration to find the area under the given curve(s). 3c. Utilize the concept of definite integration to find area between given two curves. 3d. Invoke the concept of definite integration to find the volume of revolution of given surface.	3.1 Definite Integration: a) Simple examples b) Properties of definite integral (without proof) and simple examples. 3.2 Applications of integration : a) Area under the curve. b) Area between two curves. c) Volume of revolution.
Unit-IV First Order First Degree Differential Equations	4a. Find the order and degree of given differential equations. 4b. Form simple differential equations for given simple engineering problem(s). 4c. Solve given differential equations using the method of variable separable. 4d. Solve the given simple problems	4.1 Concept of differential equation 4.2 Order, degree and formation of differential equation. 4.3 Solution of differential equation a. Variable separable form. b. Linear differential equation. 4.4 Application of differential equations and related engineering problems.

Unit	Major Cognitive Domain Learning Outcomes	Topics and Sub-topics
	based on linear differential equations.	
Unit –V Numerical Integration	5a. Apply the concept of numerical integration to find area from given data by Trapezoidal rule. 5b. Apply the concept of numerical integration to find area from given data by Simpson's $1/3^{rd}$ rule. 5c. Apply the concept of numerical integration to find area from given data by Simpson's $3/8^{th}$ rule. 5d. Utilize the concept of numerical integration to solve related engineering problems.	5.1 An introduction to numerical integration. a. Trapezoidal rule. b. Simpson's $1/3^{rd}$ rule. c. Simpson's $3/8^{th}$ rule.

***Note**: To attain the COs and competency, above listed Learning Outcomes (LOs) need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.*

8. 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	Differential calculus	20	04	08	12	24
II	Integral calculus	14	02	06	08	16
III	Applications of Definite Integration.	10	02	02	04	08
IV	First Order First Degree Differential Equations	08	02	02	04	08
V	Numerical integration	12	02	05	07	14
Total		**64**	**12**	**23**	**35**	**70**

***Legends:** R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note:** This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of LOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

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:

a. Identify engineering problems based on real world problems and solve with the use of free tutorials available on the internet.
b. Use graphical software's: EXCEL, DPLOT, and GRAPH for related topics.
c. Use Mathcad as Mathematical Tools and solve the problems of Calculus.
d. Identify problems based on applications of differential equations and solve these problems.

e. Prepare models to explain different concepts of applied mathematics.
f. Prepare a seminar on any relevant topic based on applications of integration.
g. Prepare a seminar on any relevant topic based on applications of numerical integration to related engineering problems.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the LOs/COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.

11. SUGGESTED MICRO-PROJECTS

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

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

a. Prepare models using the concept of tangent and normal to bending of roads in case of sliding of a vehicle.
b. Prepare models using the concept of radius of curvature to bending of railway track.
c. Prepare charts displaying the area of irregular shapes using the concept of integration.
d. Prepare charts displaying volume of irregular shapes using concept of integration.
e. Prepare models using the concept of differential equations for mixing problem.
f. Prepare models using the concept of differential equations for radio carbon decay.
g. Prepare models using the concept of differential equations for population growth.
h. Prepare models using the concept of differential equations for thermal cooling.
i. Prepare charts displaying the area of irregular shapes using the concept of Simpson's $1/3^{rd}$ rule.
j. Prepare charts displaying the area of irregular shapes using the concept of Simpson's $3/8^{th}$ rule.

12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Higher Engineering Mathematics	Grewal, B.S.	Khanna publications, New Delhi , 2013 ISBN- 8174091955
2	A Text Book of Engineering Mathematics	Dutta, D.	New Age International Publications, New Delhi, 2006, ISBN: 978-81-224-1689-3
3	Advanced Engineering Mathematics	Krezig, Ervin	Wiley Publications, New Delhi, 2016 ISBN:978-81-265-5423-2,
4	Advanced Engineering Mathematics	Das, H.K.	S. Chand Publications, New Delhi, 2008, ISBN: 9788121903455
5	Engineering Mathematics, Volume 1 (4^{th} edition)	Sastry, S.S.	PHI learning, New Delhi, 2014 ISBN-978-81-203-3616-2,
6	Comprehensive Basic Mathematics, Volume 2	Veena, G.R.	New Age International Publications, New Delhi, 2005 ISBN:978-81-224-1684-8
7	Getting Started with MATLAB-7	Pratap, Rudra	Oxford University Press, New Delhi, 2009 ISBN: 0199731241
8	Engineering Mathematics (3^{rd} edition).	Croft, Anthony.	Pearson Education, New Delhi,2010 ISBN: 978-81-317-2605-1

13. SOFTWARE/LEARNING WEBSITES

a. www.scilab.org/ - SCI Lab
b. www.mathworks.com/products/matlab/ - MATLAB
c. Spreadsheet applications
d. www.dplot.com/ - DPlot
e. www.allmathcad.com/ - MathCAD
f. www.wolfram.com/mathematica/ - Mathematica
g. http://fossee.in/
h. https://www.khanacademy.org/math?gclid=CNqHuabCys4CFdOJaAoddHoPig
i. www.easycalculation.com
j. www.math-magic.com

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION (MSBTE)

I – Scheme
II – Semester Course Curriculum

Course Title: **Basic Surveying**
(Course Code: .....)

Diploma programme in which this course is offered	Semester in which offered
Civil Engineering	Second

1. RATIONALE

Development and planning process for any civil engineering project needs survey of that area to be carried out and various types of survey maps are to be prepared. These maps and drawing are used for taking various decisions regarding the planning, designing, estimation, execution and construction process. The diploma pass outs/technicians should therefore know the various methods and instruments required for surveying. They should also have the skill and information to handle and operate the needed survey instruments. This course is therefore one of the core courses required for civil, mining, environmental and transportation engineers. Students are advised to master the desired skills which are expected from them for survey related works.

2. COMPETENCY

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

- **Undertake civil engineering surveys.**

3. COURSE OUTCOMES (COs)

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

a. Select the type of survey required for given situation.
b. Compute area of open field using chain, tape and cross staff.
c. Conduct traversing in the field using chain and compass.
d. Use leveling instruments to determine reduced level of ground points.
e. Draw/interpret contour maps of an area collecting field data.
f. Use digital planimeter to calculate the areas.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
3	-	4	7	70	30*	50	50	200

***(*):** Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain LOs required for the attainment of the COs.*

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

5. COURSE MAP (with sample COs, Learning Outcomes i.e.LOs and topics)

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

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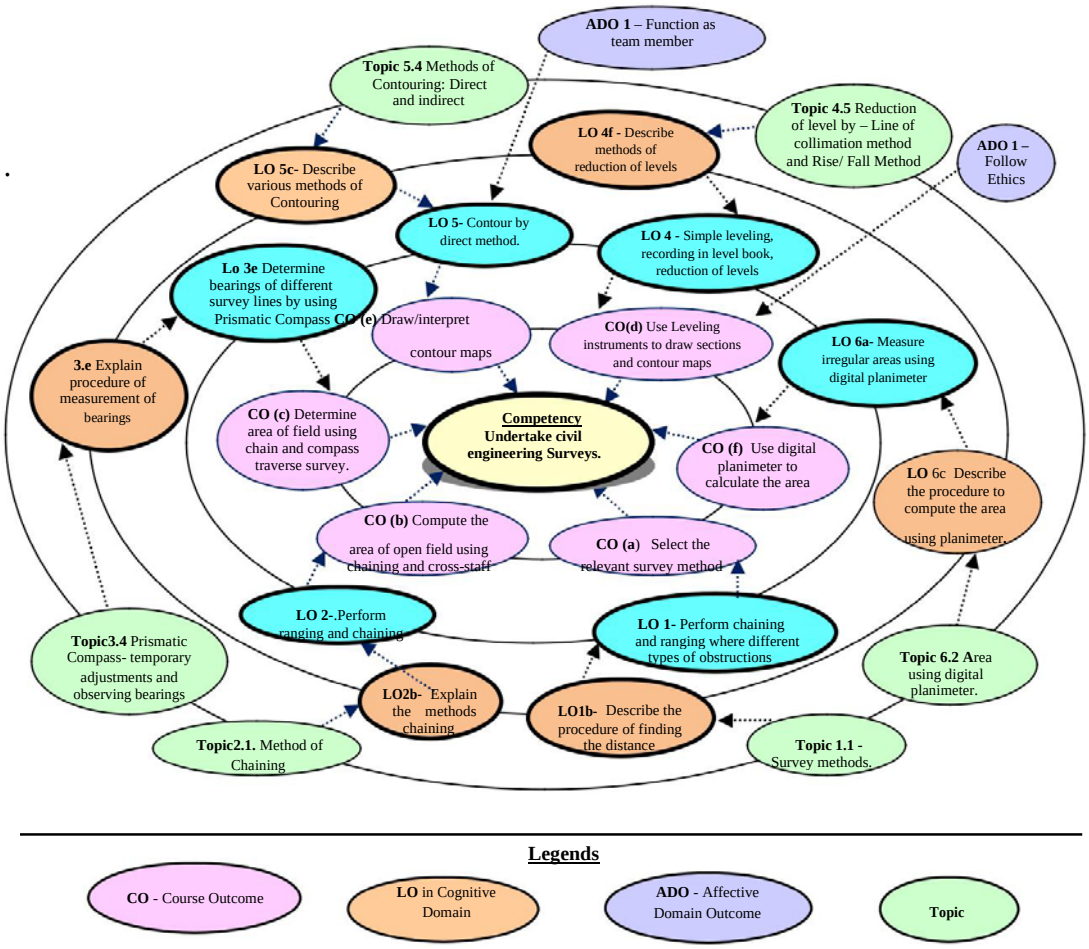

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals/exercises/tutorials in this section are psychomotor domain LOs (i.e.sub-components of the COs), to be developed and assessed in the student to lead to the attainment of the competency**.**

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. Required
1	Measure distance between two survey stations using chain, tape and ranging rods to when two stations are inter visible. Part I	II	02*
2	Measure distance between two survey stations using chain, tape and ranging rods to when two stations are inter visible. Part II	II	02

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. Required
3	Undertake reciprocal ranging and measure the distance between two stations. Part I	II	02*
4	Undertake reciprocal ranging and measure the distance between two stations. Part II	II	02
5	Determine area of open field using chain and cross staff survey. Part I	II	02*
6	Determine area of open field using chain and cross staff survey. Part II	II	02
7	Determine area of open field using chain and cross staff survey. Part III	II	02
8	Measure Fore Bearing and Back Bearing of survey lines of open traverse using Prismatic Compass. Part I	III	02*
9	Measure Fore Bearing and Back Bearing of survey lines of open traverse using Prismatic Compass. Part II	III	02
10	Measure Fore Bearing and Back Bearing of survey lines of open traverse using Prismatic Compass. Part III	III	02
11	Measure Fore Bearing and back bearing of a closed traverse of 5or 6 sides and correct the bearings and included angles for the local attraction. Part I	III	02*
12	Measure Fore Bearing and back bearing of a closed traverse of 5or 6 sides and correct the bearings and included angles for the local attraction. Part II	III	02
13	Measure Fore Bearing and back bearing of a closed traverse of 5or 6 sides and correct the bearings and included angles for the local attraction. Part III	III	02
14	Measure Fore Bearing and back bearing of a closed traverse of 5or 6 sides and correct the bearings and included angles for the local attraction. Part IV	III	02
15	Undertake **Survey Project** with chain and compass for closed traverse for minimum 5 sides around a building**.(Compulsory)**	III	1* Full Day
16	Plot the traverse on A1 size imperial drawing sheet for data collected in Survey Project mentioned at practical No.15 . Part I	III	02
17	Plot the traverse on A1 size imperial drawing sheet for data collected in Survey Project mentioned at practical No.15 . Part II	III	02
18	Undertake simple leveling using dumpy level/ Auto level and leveling staff. Part I	IV	02*
19	Undertake simple leveling using dumpy level/ Auto level and leveling staff. Part II	IV	02
20	Undertake differential leveling and determine Reduced Levels by Height of instrument method and Rise and fall method using dumpy level/Auto Level and leveling staff. Part I	IV	02*
21	Undertake differential leveling and determine Reduced Levels by Height of instrument method and Rise and fall method using dumpy level/Auto Level and leveling staff. Part II	IV	02
22	Undertake differential leveling and determine Reduced Levels by Height of instrument method and Rise and fall method using	IV	02

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. Required
	dumpy level/Auto Level and leveling staff. Part III		
23	Undertake fly leveling with double check using dumpy level/ Auto level and leveling staff. Part I	IV	02
24	Undertake fly leveling with double check using dumpy level/ Auto level and leveling staff. Part II	IV	02
25	Undertake *Survey Project* with Leveling instrument for Profile leveling and cross-sectioning for a road length of 500 m with cross-section at 30 m interval***. (Compulsory)***.	IV	1* Full Day
26	Plot the L-section with minimum 3 cross-sections on A1 size imperial sheet for data collected in *Survey Project* mentioned at practical No.25. Part I	V	02*
27	Plot the L-section with minimum 3 cross-sections on A1 size imperial sheet for data collected in *Survey Project* mentioned at practical No.25. Part II	V	02
28	Conduct block contouring for the area of 40m x 40m to draw its contour plan. Part I	V	02
29	Conduct block contouring for the area of 40m x 40m to draw its contour plan. Part II	V	02
30	Undertake *Survey Project* for plotting contour map using block contouring method for a block of 150m x 150m with grid of 10m x 10m***. (Compulsory)***	V	1* Full Day
31	Plot the contours on A1 size imperial drawing sheet for data collected in *Survey Project* mentioned at practical No.30. Part I	V	02
32	Plot the contours on A1 size imperial drawing sheet for data collected in *Survey Project* mentioned at practical No.30. Part II	V	02
33	Plot the contours on A1 size imperial drawing sheet for data collected in *Survey Project* mentioned at practical No.30. Part III	V	02
34	Measure area of irregular figure using Digital planimeter. Part I	VI	02*
35	Measure area of irregular figure using Digital planimeter. Part II	VI	02
	Total		**82**

Note

i. A suggestive list of practical LOs is given in the above table, more such practical LOs can be added to attain the COs and competency. A judicial mix of minimum 24 or more practical LOs/tutorials need to be performed, out of which, the practicals marked as '' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. Hence, the 'Process' and 'Product' related skills associated with each LO of the laboratory/workshop/field work are to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
1	Preparation of experimental set up	10
2	Setting and operation	20
3	Safety measures	10
4	Observations and Recording	20
5	Interpretation of result and Conclusion	20

S. No.	Performance Indicators	Weightage in %
6	Answer to sample questions	10
7	Submission of report in time	10
Total		**100**

Additionally, the following affective domain LOs (social skills/attitudes), are also important constituents of the competency which can be best developed through the above mentioned laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical practices.

The development of the attitude related LOs of Krathwohl's 'Affective Domain Taxonomy', the achievement level may reach:

- 'Valuing Level' in 1st year
- 'Organizing Level' in 2nd year
- 'Characterizing Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Exp. S. No.
1	Engineers Chain made from galvanized mild steel wires 4mm in dia, brass handles with swivel joints, brass tallies provided at every 5 m length of chain - 20 and 30m. Metallic tape-, Steel tape, Invar, Fiber glass tape satisfying IS 1269 (Part 1 and Part 2) : 1997 specifications	1 to 6,11,13 and 14
2	Pegs of length 400 mm and c/s area of 50 mm x 50 mm, Arrows 400 mm long and made up of good quality hardened and tempered steel wire of 4 mm in diameter.	1 to 6,11, 13 and 14
3	Metallic Ranging rods of 2 m length, circular or octagonal in cross section of 30 mm diameter, Lower shoe of 150 mm long. Painted in black, white and red stripes of 200 mm each.	1 to 6, 11,13 and 14
4	Line ranger, optical square confirming to IS: 7999 – 1973specifications and open cross staff consisting of 4 metal arms with vertical slits for sighting through.	1 to 6, 11,13 and 14
5	Prismatic compass confirming to IS 1957-1961 with stand, made in Gun metal material having diameter of 85-110 mm and the least count of 30 minutes.	4 ,5 and 6
6	Dumpy level and automatic levels confirming to IS: 9613 – 1986 with stand and internal focusing telescope of standard make.	8 to 11, 13 and 14
7	Leveling staves- 2 m and 4 m ,telescopic type confirming to IS 11961 -1986 or Folding type confirming to IS 1779 (1961), 5 mm least count	8 to 11, 13 and 14
8	Digital planimeter of standard make with Ni Cd batteries and AC adapters	16

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Overview and Classification of Survey	1a. Classify given type of survey based on purpose, instruments used and nature of field and place. 1b. Explain the given basic principles of surveying. 1c. Describe given type of scale. 1d. Select the type of survey for given situation. 1e. Select the type of scale for given situation.	1.1 Survey- Purpose and Use, Principles of Survey 1.2 Types of surveying- Primary and Secondary classification Plane, geodetic, military, engineering cadastral, hydrographic, photogrammatry and areal surveying. 1.3 Scales: Engineer's scale, RF and diagonal scale.
Unit– II Chain and cross staff Survey	2a. Describe the procedure of finding the distance between two given inter-visible and not inter-visible survey stations. 2b. Explain the methods of ranging and measuring the length of the given survey line with examples. 2c. Explain the corrections in measurement of distance with chain in given situation. 2d. Compute the area of given field using principle of triangulation. 2e. Compute area of given open field by using chain and cross staff. 2f. Select type of chaining for given situation.	2.1 Chain survey Instruments: Metric Chain, Tapes, Arrow, Tapes, Ranging rod, Line ranger, Offset rod, Open cross staff, optical square 2.2 Chain survey Station, Base line, Check line, Tie line, Offset, Tie station, Method of Chaining, obstacles in chaining; Types of offsets: Perpendicular and Oblique 2.3 Ranging: Direct Ranging and Indirect Ranging 2.4 Errors in length: Instrumental error, personal error, error due to natural cause, random error 2.5 Principle of triangulation 2.6 Location Sketch of survey station and running measurements of building. 2.7 Conventional Signs Recording of measurements in a field book.
Unit– III Chain and Compass traverse Survey	3a. Carry out the traversing in given situation by using compass and chain. 3b. Convert given whole circle bearing to reduced bearing and vice versa to find included angle with examples. 3c. Explain construction and functions of given parts of the given type of compass. 3d. Determine correct bearings from the given observed	3.1 Compass Traversing: open, closed. 3.2 Technical Terms: Geographic/True Magnetic and Arbitrary Meridians and Bearings, Meridian and Bearing, Whole Circle Bearing System and Reduced Bearing System and examples on conversion of given bearing to another bearing (from one form to another), Fore Bearing and Back Bearing, Calculation of internal and external angles from bearings at a station. Dip of Magnetic needle, Magnetic Declination.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	bearings. 3e. Explain the methods used to plot a traverse in the given situation. 3f. Adjust the closing error of the traverse for the given data.	3.3 Components of Prismatic Compass and their Functions, Method of using Prismatic Compass- temporary adjustments and observing bearings 3.4 Local attraction, Methods of correction of observed bearings-Correction at station and correction to included angles, 3.5 Methods of plotting a traverse and closing error, Graphical adjustment of closing error.
Unit– IV Levelling	4a. Explain the given terms related to leveling. 4b. Describe construction and use of the given leveling instrument. 4c. Explain the given temporary adjustments of a typical dumpy level. 4d. Describe methods of reduction of levels by height of collimation and rise and fall method in the given situation. 4e. Select type of leveling for the given work with examples and justification. 4f. Compute the missing readings from the given observed readings.	4.1 Terminologies: Level surfaces, Horizontal and vertical surfaces, Datum, Bench Marks- GTS, Permanent, Arbitrary and Temporary, Reduced Level, Rise, Fall, Line of collimation, Station, Back sight, Fore sight, intermediate sight, Change point, Height of instruments . 4.2 Types of levels: Dumpy, Tilting, Auto level, Digital level, Components of Dumpy Level and its fundamental axes. Temporary adjustments of Level. 4.3 Types of Leveling Staffs: Self-reading staff and Target staff. 4.4 Reduction of level by Line of collimation method and Rise/ Fall Method 4.5 Methods to find the R. L. in Level Book by H.I. 4.6 Methods: Rise and Fall Methods with necessary checks. 4.7 Leveling Types: Simple, Differential, Fly, Profile and Reciprocal Leveling 4.8 Computation of missing readings, Errors in Leveling
Unit– V Contouring	5a. Describe the importance of contour maps for the given type of topography. 5b. Explain characteristics of contours for the given terrain. 5c. Explain methods of plotting contours in the given situation. 5d. Explain factors affecting the selection of the given contour interval. 5e. Prepare contour map from the given RLs of grid points with	5.1 Contour, contour interval, horizontal equivalent. 5.2 Contour maps: Characteristics and uses o 5.3 Methods of Contouring: Direct and indirect 5.4 Methods of interpolation of contours: approximate, arithmetic and graphical

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	examples.	
Unit– VI Measurement of Area and Volume	6a. Explain the theory and use of digital planimeter in the given situation. 6b. Describe procedure for measuring the given area using digital planimeter 6c. Compute the area from the given contour map. 6d. Compute the volume of reservoir from the given contour map.	6.1 Digital planimeter: Components and uses 6.2 Measurement of area using digital planimeter. 6.3 Measurement of volume of reservoir from contour map.

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

9. 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 and Classification of Survey	04	2	4	-	06
II	Chain and cross staff Survey	08	2	4	6	12
III	Chain and Compass traverse Survey	12	4	4	8	16
IV	Levelling	14	4	6	10	20
V	Contouring	06	2	4	4	10
VI	Measurement of Area and Volume	04	2	4	-	06
Total		**48**	**16**	**26**	**28**	**70**

***Legends:** R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note**: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of LOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

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

a. Construct a plain scale 1 cm = 3 m to read up to a meter and represent 27 m on the scale.
b. Draw a neat labeled sketch of a 20m chain and show its salient features.
c. Explain one method each to measure the distance between points on either side of obstacles in case of following: River, Lake, Building.
d. Explain different obstacles encountered in chain survey.
e. Explain the relation between the whole circle bearing and reduced bearing with the help of neat sketches and covert the given set of five WC to RB and vice versa.

f. Measure the bearing of Sun at noon with compass and then magnetic bearing of any line AB to find the true bearing of that line.
g. Find the deflection angles at each vertex of a give traverse with internal angles.
h. Find the bearing of remaining lines when the bearing of any one line of a traverse and deflection angles at respective station are given.
i. Determine the reservoir capacity from a give contour map of reservoir.
j. Interpret the given contour maps.(minimum five situation).
k. Draw the representative contour maps for the following: Ridge of a mountain, Hillock, Valley, Pond/lake, Gentle slope, Very Steep Slope, Plain Surface.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

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

12. SUGGESTED MICRO-PROJECTS

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

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

a. Collect the information of survey instruments available in the market with specifications.
b. Carry out comparative study of following survey instruments of different make and brands : Auto level and Digital planimeter.
c. Calibrate the given chain with reference to standard gauge.

d. Collect the map of city /town and calculate the ward wise and total area using digital planimeter.
e. Determine the RLs of the existing structures like lintels, chajja, slab, and beam.
f. Download specifications for prismatic compass, dumpy level, auto level, digital planimeter.
g. Perform reconnaissance survey for alignment of road.
h. Collect and interpret contour maps of different terrains available with various authorities.
i. Construct and measure given length using Diagonal scale from a given map.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Surveying and Levelling volume I	Kanetkar, T. P.; Kulkarni, S. V.	Pune Vidyarthi Gruh Prakashan, Pune; ISBN:978-81-858-2511-3
2	Surveying and Levelling	Basak, N. N.	McGraw Hill Education, New Delhi ISBN 93-3290-153-8
3	Surveying	Saikia, M D.; Das. B.M.; Das. M.M.	PHI Learning, New Delhi ISBN: 978-81-203-3985-9
4	Fundamentals of Surveying and Levelling	Subramanian, R.	Oxford University Press. New Delhi, ISBN: 0-19-945472-8
5	Survey I	Duggal, S. K.	McGraw Hill Education, New Delhi, ISBN: 978-00-701-5137-6
6	Textbook of Surveying	Rao, P. Venugopala Akella, Vijayalakshmi	PHI Learning, New Delhi ISBN: 978-81-203-4991-9
7	Surveying I	Punmia, B.C, Jain, Ashok Kumar Jain, Arun Kumar	Laxmi Publications., New Delhi. ISBN: 8-17-008853-4
8	Surveying and Levelling, Volume 1	Bhavikatti, S. S.	I. K. International, New Delhi ISBN: 978-81-906-9420-9
9	Textbook of Surveying	Venkatramaiah, C	Universities Press.New Delhi ISBN: 978-81-737-1021-6

14. SOFTWARE/LEARNING WEBSITES

a. www.asnu.com.au
b. www.oupinheonline.com
c. www.mtu.edu/technology/undergrad
d. www.wb.psu.edu/Academics/Degrees
e. www.tjc.edu/info/2004134/profess
f. www.pstcc.edu/catalog/12-13/cerp
g. https://youtu.be/e_yabRh5GY
h. https://youtu.be/Z4yYHHX8N0
i. https://youtu.be/2hL4wWUUSFc
j. https://youtu.be/j8poe2vvD2Q
k. https://youtu.be/chhuq_t40rY
l. https://youtu.be/L54T4uvpMTg
m. https://youtu.be/NdNEy-HBsoA
n. https://youtu.be/7dN3Iku0Bns

- https://youtu.be/S8exEaGMi9c

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION (MSBTE)

I – Scheme
II – Semester Course Curriculum

Course Title: **Civil Engineering Workshop and Practice**
(Course Code: ..... **)**

Diploma Programme in which this course is offered	Semester in which offered
Civil Engineering	Second

1. RATIONALE

General Civil Engineering Practices is a basic engineering course. The knowledge of basics of civil Engineering operations like masonry, mixing, concreting, finishing works is essential for technician to perform his/her duties in industries. Therefore, an opportunity is created through this course to develop basic skills with the safety aspects required for the same. Students should be able to supervise construction activities and use quality control techniques and maintain tools and equipments with safety to self, co-workers and the constructed components of the building. Working in field develops the attitude of team working and safety awareness. This course provides the unique experience of field work

2. COMPETENCY

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

- **Perform basic civil engineering jobs using relevant tools.**

3. COURSE OUTCOMES (COs)

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

a. Identify the various construction activities at site.
b. Perform masonry job activities.
c. Perform plumbing job activities.
d. Identify finishing jobs related to building construction.
e. Identify the various components of typical civil structures like road, culvert/bridges.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total liforn
L	T	P	C	ESE	PA	ESE	PA	
-	-	4	4	-	-	50	50~[2]	100

(~[2])*: For the* ***practical only courses,*** *the PA has two components under practical marks i.e. the assessment of practicals (seen in section 6) has a weightage of 60% (i.e.30 marks) and micro-project assessment (seen in section 12) has a weightage of 40% (i.e.20 marks). This is designed to facilitate attainment of COs holistically, as there is no theory ESE.*

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

5. COURSE MAP (with sample COs, Learning Outcomes i.e. LOs and topics)

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

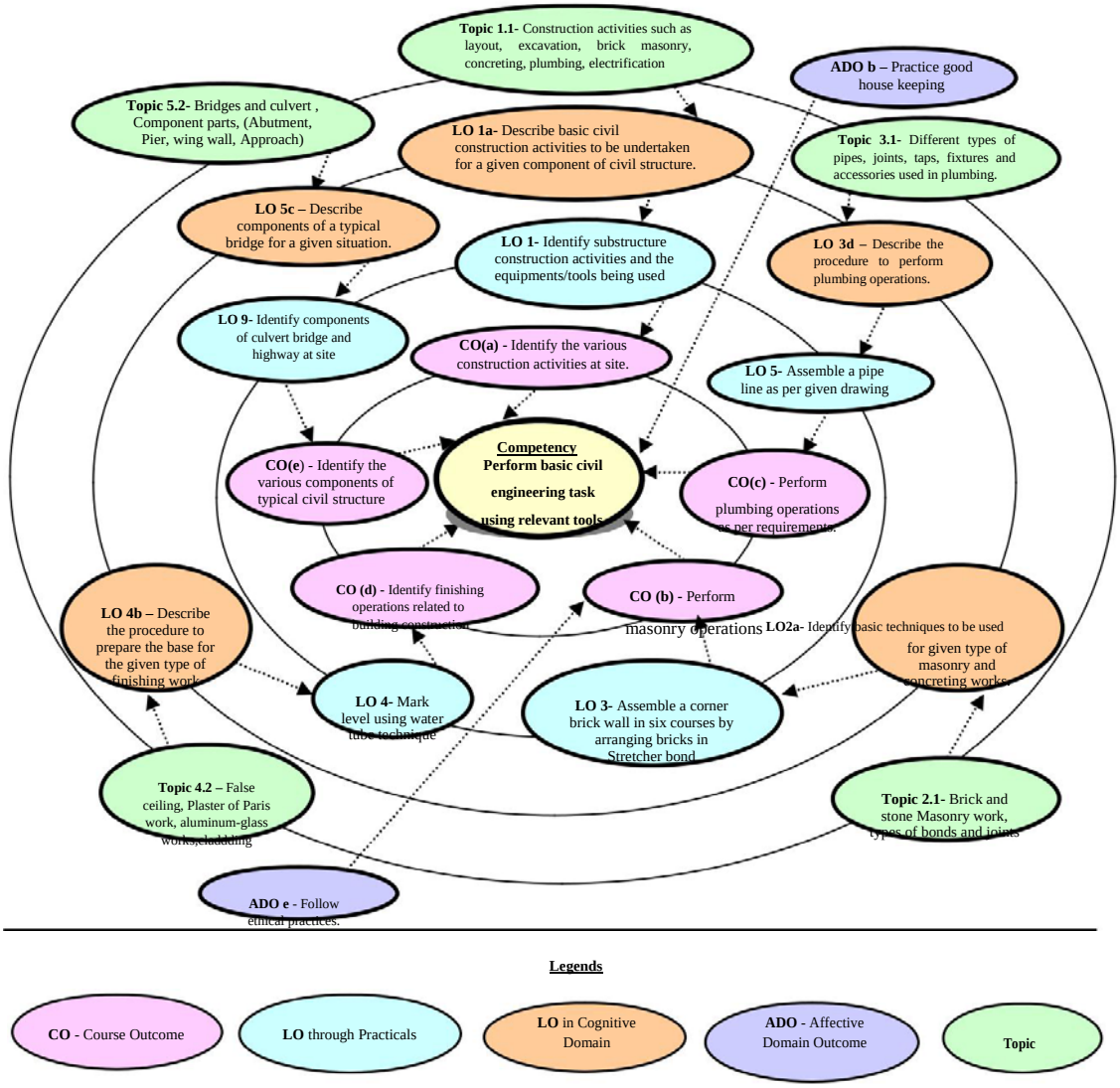

Figure 1 - Course Map

6. SUGGESTED PRACTICAL LEARNING OUTCOMES/TUTORIALS

The practical learning outcomes/tutorials in this section are psychomotor domain LOs (i.e. sub-components of the COs) are to be developed and assessed in the student to lead to the attainment of the competency.

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
1	Identify the substructure construction activities and the equipments/tools being used at site during the visit. Part I	I, II	02*
2	Identify the substructure construction activities and the	I, II	02

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
	equipments/tools being used at site during the visit. Part II		
3	Identify the substructure construction activities and the equipments/tools being used at site during the visit. Part III	I, II	02
4	Identify the substructure construction activities and the equipments/tools being used at site during the visit. Part IV	I, II	02
5	Assemble a corner brick wall in six courses by arranging bricks in Stretcher bond. Ensure that wall is in line, plumb and at right angle to a existing wall (Group of 10 students)	II	02*
6	Assemble a corner brick wall in six courses by arranging bricks in Stretcher bond. Ensure that wall is in line, plumb and at right angle to a existing wall (Group of 10 students). Part I	II	02
7	Assemble a corner brick wall in six courses by arranging bricks in Stretcher bond. Ensure that wall is in line, plumb and at right angle to a existing wall (Group of 10 students). Part II	II	02
8	Assemble a corner brick wall in six courses by arranging bricks in Stretcher bond. Ensure that wall is in line, plumb and at right angle to a existing wall (Group of 10 students). Part III	II	02
9	Assemble a corner brick wall in six courses by arranging bricks in Stretcher bond. Ensure that wall is in line, plumb and at right angle to a existing wall (Group of 10 students) Part IV	II	02
10	Identify the superstructure construction activities and the equipments/tools being used at site during the visit Part I	III, IV	02*
11	Identify the superstructure construction activities and the equipments/tools being used at site during the visit Part II	III, IV	02
12	Identify the superstructure construction activities and the equipments/tools being used at site during the visit Part III	III, IV	02
13	Identify the superstructure construction activities and the equipments/tools being used at site during the visit Part IV	III, IV	02
14	Mark level of given height from ground level at different locations in the specified location using water pipe technique. Part I (Group of 10 students)	II, IV	02*
15	Mark level of given height from ground level at different locations in the specified location using water pipe technique. Part II (Group of 10 students)	II, IV	02
16	Mark level of given height from ground level at different locations in the specified location using water pipe technique. Part III (Group of 10 students)	II, IV	02
17	Mark level of given height from ground level at different locations in the specified location using water pipe technique. Part IV (Group of 10 students)	II, IV	02
18	Assemble a pipe line as per given drawing using pipes of one inch diameter, pipes of half inch diameter, nipple, reducer, union, valves T, elbow and then dissemble this pipe line. Part I	III	02*
19	Assemble a pipe line as per given drawing using pipes of one inch diameter, pipes of half inch diameter, nipple,	III	02

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
	reducer, union, valves T, elbow and then dissemble this pipe line. Part II		
20	Assemble a pipe line as per given drawing using pipes of one inch diameter, pipes of half inch diameter, nipple, reducer, union, valves T, elbow and then dissemble this pipe line. Part III	III	02
21	Assemble a pipe line as per given drawing using pipes of one inch diameter, pipes of half inch diameter, nipple, reducer, union, valves T, elbow and then dissemble this pipe line. Part IV	III	02
22	Test the quality of cement on site/Laboratory. Part I	IV	02*
23	Test the quality of cement on site/Laboratory. Part II	IV	02
24	Test the quality of cement on site/Laboratory. Part III	IV	02
25	Identify types of bent up bar and stirrups at site during the field visit for the reinforcement for beams, column and slab. Part I	IV	02*
26	Identify types of bent up bar and stirrups at site during the field visit for the reinforcement for beams, column and slab. Part II	IV	02
27	Carry out field test on bricks at site. Part I	IV	02*
28	Carry out field test on bricks at site. Part II	IV	02
29	Carry out field test on bricks at site. Part III	IV	02
30	Identify the various components of the culvert at site	V	08*
31	Identify the various components of the bridge at site	V	08
32	Identify the various components of the highways at site	V	08
	Total		**64**

Note

i. A suggestive list of practical LOs is given in the above table, more such practical LOs can be added to attain the COs and competency. A judicial mix of minimum 24 or more practical LOs/tutorials need to be performed, out of which, the practicals marked as '' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. Hence, the 'Process' and 'Product' related skills associated with each LO of the laboratory/workshop/field work are to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
1	Preparation of experimental set up	20
2	Setting and operation	20
3	Safety measures	10
4	Observations and Recording	10
5	Interpretation of result and Conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
Total		**100**

Additionally, the following affective domain LOs (social skills/attitudes), are also important constituents of the competency which can be best developed through the above mentioned laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical practices.

The development of the attitude related LOs of Krathwohl's 'Affective Domain Taxonomy', the achievement level may reach:

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Exp. No.
1	Raw material such as bricks of standard size 230 mm x 115 mm x 75 mm,	3,8
2	Trowels (Brick, Buttering, Pointing) , triangular, ranging in size up to about 11 inches (279.40 mm) long and from 101.6 mm to 203.2 mm wide i.e. (4 to 8 inches wide).	3
3	Portable Hammer , Spade, Pans (ghamela), Thread, lime	3
4	Square, mason's level, and straightedge 28.57 mm to 38.10 mm and the middle portion of the top edge from 152.40 mm to 254 mm wide	3
5	Levels and mason's line, brushes.	3
6	String, Level / Water tube, Plumb bob, Right Angle	4
7	The mason's level to establish "plumb" and "level" lines	4
8	Plumbing materials such as pipes and accessories for different sizes and materials, pipe wrench	5
9	Pipe Bending Machine	5
10	Pipe Vice – 100 mm	5
11	Pipe Cutter- 50 mm	5
12	Ordinary Portland Cement	3.6
13	Reinforcement bar,10 mm dia. , binding wire and bending tool	7
14	Bricks of standard size 230 mm x 115 mm x 75 mm,	3.8

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Overview of Construction activities	1a. Describe basic construction activities to be undertaken for the given component of civil structure. 1b. Identify the construction activities at the given site. 1c. Identify the tools used for the given type of foundation layout. 1d. Describe different safety precautions to be taken at the given construction site.	1.1. Construction activities such as layout, excavation, brick masonry, concreting, plumbing, electrification, Interdependency of various activities 1.2. Workmanship and Safety precautions
Unit – II Masonry and Concreting	2a. Identify the basic techniques to be used for the given type of masonry and concreting works with justification. 2b. Identify the relevant quality control measures to be adopted in operations related to the given type of masonry and concreting with justification. 2c. Describe the methods of plastering and pointing to be undertaken in the given situation. 2d. Describe the methods of the formwork for the given type of building. 2e. Identify type of bonds in the given type of brickwork.	2.1 Brick and stone Masonry work, Types of bonds and joints (vertical and horizontal). 2.2 Line dori, plumb bob, right angle and water level tube. 2.3 Plastering, Pointing. 2.4 Proper mixing of concrete, concrete laying. 2.5 Use of concrete Mixtures and Vibrators, different types of Vibrators. 2.6 Formwork, Scaffolding. 2.7 Centring and Shuttering.
Unit- III Plumbing Services	3a Identify the plumbing tools and fixtures in the given situation with justification. 3b Select the pipe fittings, hand tools and machinery for the given type of work with justification. 3c Select the type of plumbing tools and machinery for the given situation with justification. 3d Describe the procedure to perform plumbing operations for the given condition. 3e Describe the safety precautions to be undertaken for the given site.	3.1 Different types of pipes, joints, taps, fixtures and accessories used in plumbing. 3.2 Components (pipes, valves, bends,) used in water supply/sanitary/sewerage lines.
Unit– IV Finishing Works	4a. Describe the operations to be undertaken related to the given situation of false ceiling, aluminum partitions, plastering work. 4b. Describe the procedure to prepare the	4.1 Flooring, skirting and dado. 4.2 False ceiling, Plaster of Paris (POP) work, aluminum – glass works, cladding. 4.3 Whitewash and painting:

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	base for the given type of finishing /painting work. 4c. Choose the relevant aluminum section for the given type of work with justification. 4d. Describe whitewashing and Painting procedure for the given type of walls/steel frames/wooden structure.	Tools required, brush, roller and spray painting, preparation of surface for timber and steel members for painting.
Unit– V Construction of Road, culverts/ bridges	5a. Identify relevant materials for the given type of road construction with justification. 5b. Describe the types and components of road for the given situation. 5c. Describe the components of typical bridge for the given situation. 5d. Describe the components of a typical Culvert in the given situation. 5e. Identify relevant materials for construction of given type of bridge/culvert.	5.1 Types of road, components of road, (carriage way, shoulder, camber, gradient). 5.2 Bridges and Culvert, component parts, (Abutment, Pier, Wing wall, Approach).

***Note**: To attain the COs and competency, above listed Learning Outcomes (LOs) need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.*

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

- Not applicable -

10. SUGGESTED STUDENT ACTIVITIES

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

b. Undertake a market survey of local dealers for procurement of civil engineering materials, plumbing materials and finishing items
c. Organize a visit to Construction sites of different types such as simple residential buildings, malls, multistoried buildings. Observe the course/topic based practices on the field.
d. Teacher guided self-learning activities
e. Course/ library /internet based mini-projects.
f. Develop Power point presentation or animation for activities seen during field visit.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.

c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the LOs/COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
a. Guide student(s) in undertaking micro-projects.
b. Arrange visit to nearby construction sites for understanding various construction stages and construction activities.
c. Show video/animation films to explain various processes like, excavation, foundation, brickwork, plastering, laying water supply and sewer pipe line.
d. Prepare construction activity chart for various civil engineering stages..

12. SUGGESTED MICRO-PROJECTS

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

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

a. **Bill Preparation** (Group of 4-5 students) – Prepare bill of materials for given pipeline layout
b. ***Masonry and concreting*** - Each student will collect the information regarding the IS provisions for the construction materials like cement, bricks, reinforcement and sand.
a. ***Finishing Work*** – Collect the information from local market regarding the types, thickness, manufacturer, cost of various brands and make of aluminum extruded sections along with its specifications laid in IS code.(Individual activity)
b. ***Plumbing*** – Download the specifications for plumbing tools such as bench vice, hammers, pipe wrench and pipe accessories.
c. ***Masonry and concreting*** – Undertake a market survey of cement aggregate and sand of various specifications from local dealers (Group of five students)
d. ***Plumbing*** – Collect the technical information for various plumbing accessories such as GI/PVC pipes, bend, union, couplings of various dimensions and write a brief reports.(Individual activity)
e. ***Masonry and concreting*** *(Individual activity)* –
    i. Collect five samples of bricks from different suppliers and test them in field to assess its quality and write a report on it with reference to its constituents and process of manufacturing.
    ii. Prepare a mud /cement mortar of various proportions 1:3 and apply plaster on a plain wall of 120 mm X 90 mm and observe the line, level and plumb
    iii. Prepare a cement concrete of proportion 1:2:4, 1:3:6 and 1:4:8 and prepare a cubical block of it to determine its strength. (Individual activity)

iv. Masonry and concreting –Collect the list of available brand of flooring tiles with their IS specifications and make a report of it.

f. ***Masonry and concreting*** (Group of five students) – Undertake the local survey for various shuttering material along with its specifications.

g. ***Masonry and concreting*** .(Group of ten students) – Assemble and dissemble the shuttering material for a beam of given dimension using appropriate material as directed by concern teacher

h. **Finishing Work** (Individual activity) - Undertake the survey for different brands of paint, painting tools and prepare a report with reference to the following points:
   i. Constituents of paint material
   ii. Coverage area of finishing surface.
   iii. Cost.
   iv. Durability and aesthetic features.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	PWD- Standard Data Book for Building Work	PWD	PWD, Government of Maharashtra, Mumbai.
2	CPWD Specifications (Vol.-I and II)	CPWD	CPWD, Govt. of India, New Delhi.
3	The Practical design of Structural Elements in Timber	Bull, J.W.	Gower Press, London, 1989, ISBN: 9780566090288
4	Basic Plumbing With Illustrations	Massey, Howard C.	Craftsman Book Co; California, ISBN: 9780934041997
5	Modern Plumbing	Baker, E.Keith Blanken	Goodheart-Willcox Co ISBN: 978-1590703502
6	District Schedule of rates(DSR)	PWD	PWD, Government of Maharashtra, Mumbai.
7	A To Z Of Practical Building Construction & its Management	Mantri Sandeep	Satya Prakashan New Delhi, ISBN : 9788176842051

14. SOFTWARE/LEARNING WEBSITES

a. http://www.asnu.com.au
b. http://www.iamcivilengineer.com/ -building-design-and.html
c. www.mahapwd.com/
d. cpwd.gov.in/
e. https://wrd.maharashtra.gov.in/

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION (MSBTE)

I – Scheme
II – Semester Course Curriculum

Course Title: **Construction Materials**
(Course Code: ..... **)**

Diploma programme in which this course is offered	Semester in which offered
Civil Engineering	Second

1. RATIONALE

Construction material is the key element in the construction project. A diploma civil engineer (also called technologist) has to constantly deal with selection of materials for various engineering project of constructions such as residential/ commercial buildings, roads, metro railways, bridges, dams, tunnels, and fly-over. The development of advance technology generates the necessity of new engineering materials. It is a challenging job for the civil engineer to select relevant material which is durable, economical and eco-friendly. New materials are introduced every day in the market. Modern techniques are developed to handle and use materials for economic and safer designs of engineering structure. At diploma level, students are expected to study about these aspects so as to develop their understanding, performance oriented abilities in order to apply their knowledge in construction industry

2. COMPETENCY

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

- **Select relevant building material to fulfill construction requirements**.

3. COURSE OUTCOMES (COs)

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

a. Identify relevant construction materials.
b. Identify relevant natural construction materials.
c. Select relevant artificial construction materials.
d. Select relevant special type of construction materials.
e. Select relevant finishing materials for construction.
f. Identify processed construction materials.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
3	-	2	5	70	30*	25	25	150

***(*):** Under the theory PA, Out of 30 marks, 10 marks are for micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain LOs required for the attainment of the COs.*

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

5. COURSE MAP (with sample COs, Learning Outcomes i.e.LOs and topics)

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

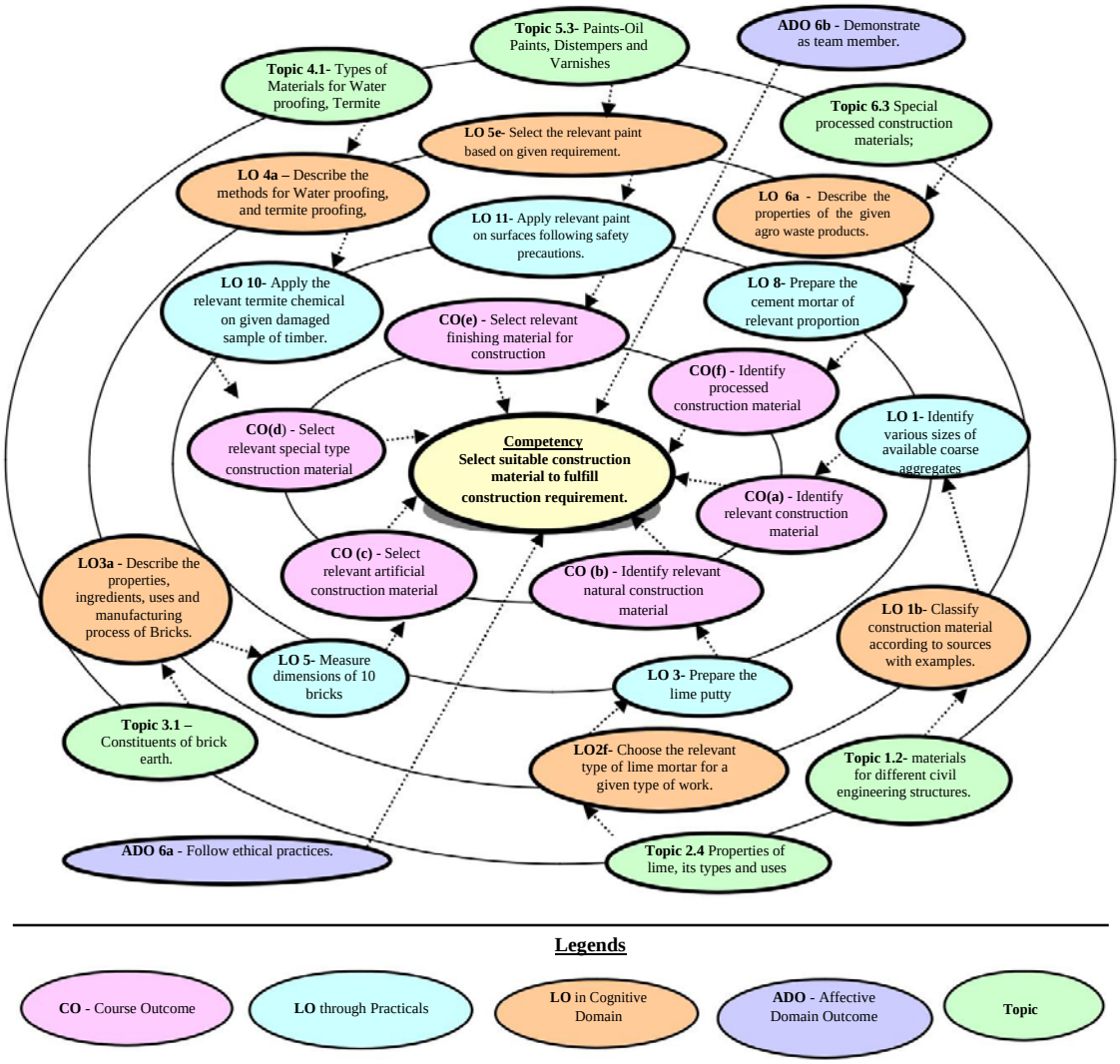

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals/exercises/tutorials in this section are psychomotor domain LOs (i.e.sub-components of the COs), to be developed and assessed in the student to lead to the attainment of the competency.

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
1	Identify the various sizes of available coarse aggregates from	I	02*

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
	sample of 10 kg in laboratory and prepare report (80, 40, 20,10 mm)		
2	Identify the available construction materials in the laboratory on the basis of their sources.	I	02
3	Identify the grain distribution pattern in given sample of teak wood in the laboratory and draw the various patterns. (along and perpendicular to the grains)	II	02*
4	Prepare the lime putty by mixing lime (1 kg) with water in appropriate proportion and prepare report on slaking of lime.	II	02
5	Identify various layers and types of soil in foundation pit by visiting at least 3 construction sites in different locations of city and prepare report consisting photographs and samples. Part I	II	02
6	Identify various layers and types of soil in foundation pit by visiting at least 3 construction sites in different locations of city and prepare report consisting photographs and samples. Part I	II	02
7	Select first class, second class and third-class bricks from the stake of bricks and prepare report on the basis of its properties.	III	02*
8	Measure dimensions of 10 bricks and find average dimension and weight. Perform field tests - dropping, striking and scratching by nail and correlate the results obtained.	III	02*
9	Measure dimensions of 10 bricks and find average dimension and weight. Perform field tests - dropping, striking and scratching by nail and correlate the results obtained.	III	02
10	Identify different types of flooring tiles such as vitrified tiles, ceramic tiles, glazed tiles, mosaic tiles, anti- skid tiles, chequered tiles, paving blocks and prepare report about the specifications. Part I	III	02*
11	Identify different types of flooring tiles such as vitrified tiles, ceramic tiles, glazed tiles, mosaic tiles, anti- skid tiles, chequered tiles, paving blocks and prepare report about the specifications. Part II	III	02
12	Apply the relevant termite chemical on given damaged sample of timber. Part I	IV	02*
13	Apply the relevant termite chemical on given damaged sample of timber. Part II	IV	02
14	Prepare the finished piece of glass of given dimension from broken and damaged pieces of glass and asbestos using standard cutting and filing tools with safe practices. Part I	IV	02
15	Prepare the finished piece of glass of given dimension from broken and damaged pieces of glass and asbestos using standard cutting and filing tools with safe practices. Part II	IV	02
16	Apply two or more coats of selected paint on the prepared base of a given wall surface for the area of 1m x 1m using suitable brush/rollers adopting safe practices. Part I	V	02*
17	Apply two or more coats of selected paint on the prepared base of a given wall surface for the area of 1m x 1m using suitable	V	02

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
	brush/rollers adopting safe practices. Part II		
18	Apply two or more coats of selected paint on the prepared base of a given wall surface for the area of 1m x 1m using suitable brush/rollers adopting safe practices. Part I	V	02
19	Apply two or more coats of selected paint on the prepared base of a given wall surface for the area of 1m x 1m using suitable brush/rollers adopting safe practices. Part II	V	02
20	Prepare the cement mortar of proportion 1:3 or 1:6 using artificial sand as a special processed construction material.	VI	02*
21	Prepare mortar using cement and Fly ash or Granite/marble polishing waste in the proportion 1:6 or 1:3.	VI	02
	Total		**42**

Note

i. A suggestive list of practical LOs is given in the above table, more such practical LOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical LOs/tutorials need to be performed, out of which, the practicals marked as '' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. Hence, the 'Process' and 'Product' related skills associated with each LO of the laboratory/workshop/field work are to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
1	Preparation of experimental set up	20
2	Setting and operation	20
3	Safety measures	10
4	Observations and Recording	10
5	Interpretation of result and Conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
Total		**100**

Additionally, the following affective domain LOs (social skills/attitudes), are also important constituents of the competency which can be best developed through the above mentioned laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical practices.

The development of the attitude related LOs of Krathwohl's 'Affective Domain Taxonomy', the achievement level may reach:

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Exp. No.
1	Weighing balance	2 to 5
2	Pan, spade	2 to 6
3	Steel Tape	5 to 6
4	Saw of different types (Rip saw having 4 to 6 mm pitch, cross cut saw with tooth pitch 2 to 3 mm, panel saw)	2
5	Painting brushes of different size for oil, acrylic painting and rollers of different size for smooth finishing work.	11
6	Manual Glass cutter with diamond tip at end	13
7	Trowels (Brick, Buttering, Pointing) , triangular, ranging in size up to about 11 inches (279.40 mm) long and from 101.6 mm to 203.2 mm wide i.e. (4 to 8 inches wide).	1,3,7,8, 12
8	Portable Hammer , Spade, Pans (Ghamela), Thread, lime	1,3,4,7, 8,12
9	Square, mason's level, and straightedge 28.57 mm to 38.10 mm and the middle portion of the top edge from 152.40 mm to 254 mm wide	3,5,12
10	Ordinary Portland Cement	8
11	Bricks of standard size 230 mm x 115 mm x 75 mm,	4,5
12	Fly ash or Granite/marble polishing waste	12
13	Paints-OBD, acrylic, plastic emulsion.	11
14	Broken pieces of Glass	13

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Overview of Construction Materials	1a. Describe the civil engineering applications in the given field of civil engineering. 1b. Classify the given construction material according to sources with examples. 1c. Describe the criteria to select the construction materials for the given situation. 1d. Suggest the construction material in the given situation with justification.	1.1 Scope of construction materials in Building Construction, Transportation Engineering, Environmental Engineering, Irrigation Engineering (applications only). 1.2 Selection of materials for different civil engineering structures on the basis of strength, durability, Eco friendly and economy. 1.3 Broad classification of materials – Sources of materials, Natural, Artificial- special, finishing and recycled.
Unit – II Natural Construction Materials	2a. Describe the properties and structure of the given natural construction material. 2b. Explain the given type of defect(s) in timber. 2c. Explain the procedure of preservation of timber in the given situation. 2d. Select the natural construction material for the given situation with justification. 2e. Choose the relevant type of lime mortar for the given type of construction work with justification.	2.1 Requirements of good building stone; general characteristics of stone; quarrying and dressing methods and tools for stone. 2.2 Structure of timber, general properties of good timber, seasoning, preservation and defects in timber and uses, use of bamboo in construction. 2.3 Asphalt, bitumen and tar used in construction, properties and their uses. 2.4 Properties of lime, its types and uses. 2.5 Types of soil and its suitability in construction. 2.6 Properties of sand and uses. 2.7 Classification of coarse aggregate according to sizes and its uses.
Unit- III Artificial Construction Materials	3a. Describe the properties, ingredients, uses and manufacturing process of the given type of brick. 3b. Classify the given artificial construction materials. Classify different artificial construction material 3c. Select relevant type of artificial	3.1 Constituents of Brick earth, Conventional / Traditional bricks, Modular and Standard bricks, Characteristics of good brick, Classification of burnt clay bricks and their suitability, Special bricks. Common Field tests on Bricks, Manufacturing process of burnt clay brick.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	material for the given type of construction work with justification. 3d. Select the type of precast concrete products for the given civil structure with justification. 3e. Select relevant type of ferrous metal for the given type of construction work with justification. 3f. Select relevant type of non-ferrous metal for the given type of construction work with justification.	3.2 Flooring tiles – Types, uses 3.3 Manufacturing process of Cement - dry and wet (only flow chart), types of cement and its uses. 3.4 Pre-cast concrete blocks- hollow, solid, pavement blocks, balustrades, and their uses. 3.5 Plywood, particle board, Veneers, laminated board and their uses. 3.6 Types of glass: soda lime glass, lead glass and borosilicate glass and their uses. 3.7 Ferrous and non-ferrous metals and their uses.
Unit– IV Special Construction Materials	4a. Describe the method used for water proofing, termite proofing, thermal and sound insulation in the given situation. 4b. Select the relevant material required for the given operations with justification. 4c. Describe the fibers required for the given construction material. 4d. Select features of the given fiber which can be used as construction material with justification. 4e. Describe the features of the given type of geopolymer cement.	4.1 Types of material and suitability in construction works of following materials: Water proofing, Termite proofing; Thermal and sound insulating materials. 4.2 Fibers – Types –Jute, Glass, Plastic Asbestos Fibers, (only uses). 4.3 Geopolymer cement : Geo-cement: properties, uses and applications
Unit– V Finishing Materials	5a. Choose the relevant proportion adopted in mortars for the given type of construction work with justification 5b. Select the relevant type of POP board for the given type of work with justification. 5c. Describe properties of the given type of paint. 5d. Select the relevant type of paint to be used for the given situation with justification. 5e. Choose the relevant type of finishing material for the given situation with justification.	5.1 Lime Mortar, Cement Mortar, Special Mortars and their uses as plastering material. 5.2 Constituents and uses of POP (Plaster of Paris), POP finishing boards, sizes and uses. 5.3 Paints-Oil Paints, Distempers and Varnishes with their uses (situations where used).
Unit– VI Processed	6a. Describe the properties of the given industrial or agro waste	6.1 Industrial waste materials- Fly ash, Blast furnace slag, Granite and

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Construction Materials	products used for the given type of work. 6b. Describe the salient properties of the given modern construction material. 6c. Describe the salient properties of the given special construction material. 6d. Select the relevant processed construction material for the given situation with justification.	marble polishing waste and their uses. 6.2 Agro waste materials - Rice husk, Bagasse, coir fibres and their uses. 6.3 Special processed construction materials; Geosynthetic, Ferrocrete, Artificial timber, Artificial sand and their uses.

***Note**: To attain the COs and competency, above listed Learning Outcomes (LOs) need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.*

9. 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 Construction Materials	04	04	04	--	08
II	Natural Construction Materials	12	04	08	04	16
III	Artificial Construction Materials	14	06	08	04	18
IV	Special Construction Materials	06	00	04	04	08
V	Finishing Materials	06	02	04	04	10
VI	Processed Construction Materials	06	02	04	04	10
Total		**48**	**18**	**32**	**20**	**70**

***Legends**: R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note**: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of LOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

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:

a. Undertake a market survey of different construction materials and compare the following points.
   i. Structure
   ii. Properties
   iii. Applications.
b. Prepare journals consisting of sketches of construction materials.
c. Undertake a market survey from local dealers for procurement of civil engineering material.
d. Inspect the various activities related to Construction material at sites of different civil structures.
e. Teacher guided self-learning activities

f. Course/ library /internet based mini-projects.
g. Literature survey of available at institute library regarding construction material used for different purposes and situations.
h. Develop Power point presentation or animation for demonstrating laying and fixing the construction materials.
i. Seminar on any relevant topic related to construction materials.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the LOs/COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.
f. Procure various materials required for practical exercises.
g. Arrange visit to nearby industries and workshops for understanding various construction materials.
h. Use video/animation films to explain various processes like Manufacturing of construction materials, concrete mixing, and base preparation for painting, mortar laying, carpentry work, false ceiling.
i. Use different instructional strategies in classroom teaching.
j. Demonstrate different samples of various construction materials like Stone, aggregate of different sizes, timber, lime, bitumen, Bricks, tiles, precast concrete products, Water proofing material, Termite proofing material, Thermal insulating material, plaster of Paris, paints, distemper, and varnishes.
k. Display various technical brochures of recent building materials.

12. SUGGESTED MICRO-PROJECTS

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

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

a. Collect the market rates for following construction materials from various dealers/suppliers of local market for different brands.
   i. Bricks.
   ii. Stone / aggregate (20 mm, 40 mm and 80 mm)
   iii. Teak wood.
   iv. Flooring tiles.
   v. Ordinary Portland Cement
   vi. Oil paint
   vii. Cement Paint
   viii. Plaster of Paris
   ix. Plastic paints
   x. Recent types of paint.

b. Download the IS 456 and IS 800 and attach the printout for following materials.
   i. Steel section (I-section and ISA)
   ii. Mortar of proportion 1:6 and 1:4
   iii. Cement concrete mix of 1:2:4, 1:3:6 and 1:4:8.

c. Collect the technical brochures of following construction materials.
   i. Ordinary Portland Cement
   ii. Vitrified flooring tiles.
   iii. Particle boards used for aluminum partitions.
   iv. Paints.

d. Undertake a market survey for the cost and technical specification of different brands of following construction Materials and prepare comparison chart.
   i. Cement
   ii. Tiles
   iii. Glass
   iv. Paints.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Construction Materials	Ghose, D. N.	Tata McGraw Hill, New Delhi, 2014 ISBN: 9780074516478
2	Building Materials	Varghese, P.C.	PHI learning, New Delhi, 2014 ISBN: 8120328485
3	Engineering Materials	Rangwalla, S.C.	Charator publisher, Ahemdabad, 2015, ISBN: 9789385039171
4	Civil Engineering Materials	Somayaji, Shan	Pearson education, New Delhi, 2015 ISBN: 9788131766316
5	Engineering Materials	Rajput, R.K	S. Chand and Co., New Delhi, 2015 ISBN 8121919606
6	Engineering Materials	Sharma	PHI Learning, New Delhi, 2015 ISBN: 812032448X
7	Building Materials	Duggal, S. K.	New International, New Delhi, 2014 ISBN: 8122414354

14. SOFTWARE/LEARNING WEBSITES

a. https://www.quora.com/What-is-geocement
b. http://apis-cor.com/en/about/blog/geocement-new-generation-hightech-material

c. http://www.nbmcw.com/concrete/10827-geopolymer-concrete-a-new-eco-friendly-material-of-construction.html
d. https://www.youtube.com/watch?v=1fc4NVP9wXk
e. https://www.youtube.com/watch?v=m8U76Bm8kDY
f. https://www.youtube.com/watch?v=lORIZ1shRIM
g. https://www.youtube.com/watch?v=Xf89KDibIFE

Maharashtra State Board of Technical Education (MSBTE)

I – Scheme
II – Semester Course Curriculum

Course Title: **Business Communication** (Common)
(Course Code: .....)

Diploma Programme in which this course is offered	Semester in which offered
Common to all programmes	Second

1. RATIONALE

The IT revolution and globalization have brought the concept of business communication to the forefront of academia and industry. Communication has become an integral part of business. It is essential to develop ethics and etiquettes of business communication as per industry requirements. The diploma engineers need to be equipped with these skills to face the challenges of industry. This course will develop the competency to 'communicate effectively to fulfill business requirements'.

2. COMPETENCY

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

- **Communicate effectively to fulfill business requirements.**

3. COURSE OUTCOMES (COs)

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

a. Avoid communication barriers for effective business communication.
b. Make the relevant use of body language to communicate.
c. Use audio – visual aids to communicate effectively and efficiently.
d. Develop notices, memoranda and reports in relevant formats.
e. Draft different types of business letters, E-mails using correct formats.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
2$	-		2	35$	15*			50

***(*):** Under the theory PA of 15 mark, 10 marks are for developing speaking skills and 5 marks for micro-projects for the assessment of the cognitive domain LOs required for the attainment of the COs.*

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

5. COURSE MAP (with sample COs, Learning Outcomes i.e. LOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the

course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map**.**

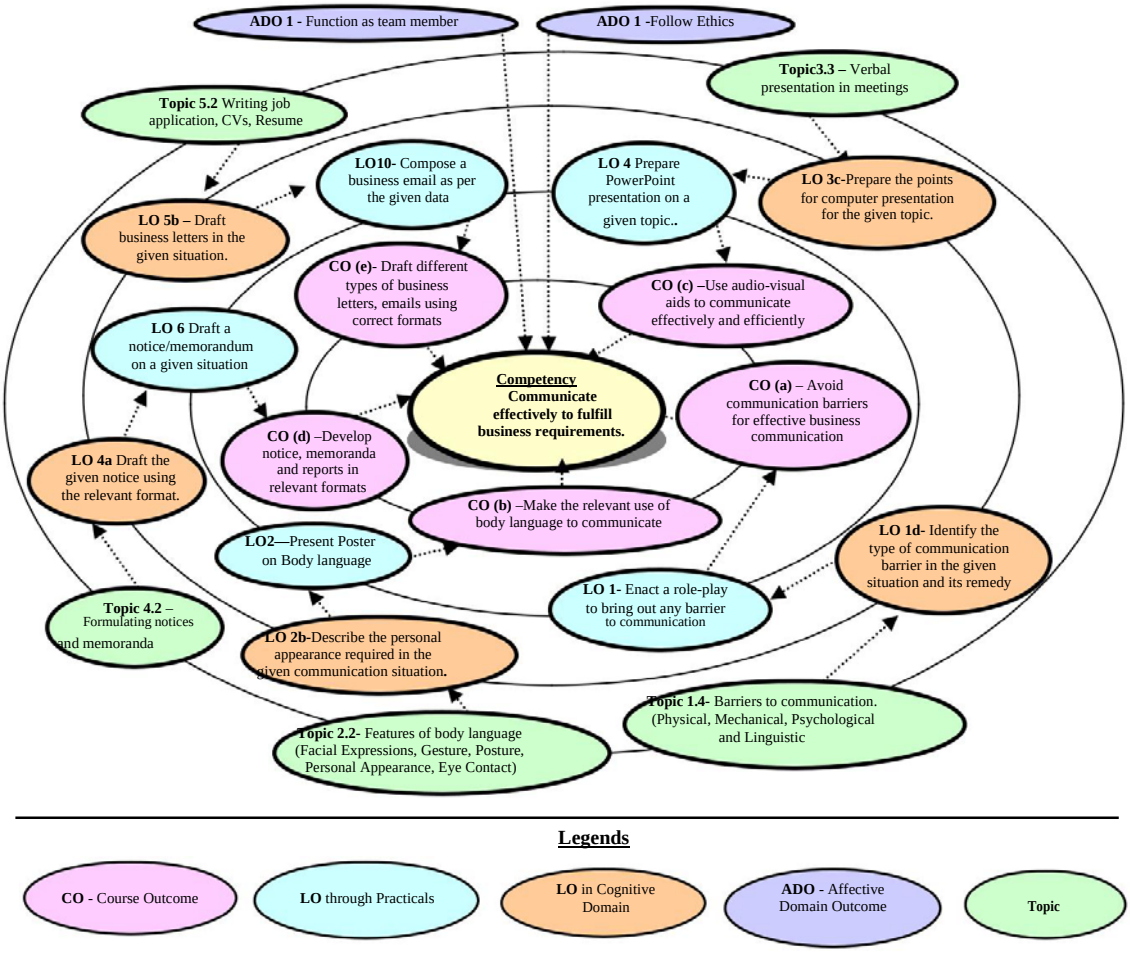

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals/exercises/tutorials in this section are psychomotor domain LOs (i.e.sub-components of the COs), to be developed and assessed in the student to lead to the attainment of the competency.

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
	Use 'language laboratory' for different practical tasks		
1	Enact role-play to bring out any barrier to communication.	I	2
2	Present Poster on Body language.	II	1
3	Use relevant body language during Oral Presentation.	II	2
4	Prepare PowerPoint presentation on a given topic.	III	2
5	Speak with correct voice modulation after listening to the given conversation	III	2
6	Draft a notice/memorandum on a given situation.	IV	1
7	Prepare a report on a student related issue.	IV	1
8	Prepare Resume with a cover letter.	V	1

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
9	Draft an enquiry or order letter on the given topic.	V	1
10	Compose a business email as per the given data.	V	1

Note

A suggestive list of practical LOs is given in the above table, more such practical LOs can be added to attain the COs and competency. A judicial mix of 10 or more practical LOs/tutorials needs to be performed.

S. No.	Performance Indicators	Weightage in %
a.	Setting up of language laboratory	10
b.	Using the language laboratory skillfully	30
c.	Follow Safety measures	10
d.	Work in teams	20
e.	Respond to given questions	10
f.	Self-learning	20
Total		**100**

Additionally, the following affective domain LOs (social skills/attitudes), are also important constituents of the competency which can be best developed through the above mentioned laboratory/field based experiences:

a. Maintain Cleanliness.
b. Demonstrate working as a leader/a team member.
c. Follow ethics.

The development of the attitude related LOs of Krathwohl's 'Affective Domain Taxonomy', the achievement level may reach:

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Exp. S.No.
1	Language Lab with relevant software and Computer system with all necessary components like; motherboard, random access memory (RAM), read-only memory (ROM), Graphics cards, sound cards, internal hard disk drives, DVD drive, network interface card	all
2	LCD Projector with document reader	all
3	Smart Board with networking	all

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Major Learning Outcomes (in cognitive domain)		Topics and Sub-topics
	Writing Skills	**Speaking Skills**	
Unit – I Introduction to Business Communication	1a. Describe the importance of the business communication in the given situation. 1b. Identify the missing element in the given communication process. 1c. Identify the type of communication in the given situation. 1d. Identify the type of communication barrier in the given situation and its remedy.	1e. Use different types of verbal and non–verbal communication for the given situation.	1.1 Business communication: meaning, importance, scope and characteristics. 1.2 Process of communication - encoding, decoding, message, channel and feedback. 1.3 Types - verbal, non-verbal, formal, informal, vertical, horizontal and diagonal communication 1.4 Barriers to communication - Physical, mechanical, psychological and linguistic
Unit– II Non-Verbal Communication and Body Language	2a. Describe the non-verbal communication required in the given situation. 2b. Describe the personal appearance required in the given communication situation. 2c. Describe the given facial expressions and emogies	2d. Use relevant facial expressions in the given situation. 2e. Answer questions after listening to presentations.	2.1 Role and importance of non-verbal communication. 2.2 Features of body language: gestures, eye contact, posture, facial expressions, emogies, personal appearance 2.3 Corporate body language [delete these words] 2.4 Ppositive and negative body language. 2.5 Listening skills.
Unit– III Presentation skills	3a. Prepare seminar presentation for the given situation. 3b. Prepare debate points ‘for’ and ‘against’ the given topic. 3c. Prepare the points for computer presentation for the given topic	3d. Make seminar presentation 3e. Partake in debate speaking ‘for ‘or ‘against’ the given topic. 3f. Make effective computer presentations	3.1 Seminar presentation and panel discussions 3.2 Debates: speaking ‘for’ and ‘against’ in given topics 3.3 Verbal presentation in meetings 3.4 Computer presentations, using the different types of computer software: text with different types of fonts, pictures, animations and ppts,
Unit– IV	4a. Draft the given notice	4f. Read the	4.1. Purpose and structure of

Unit	Major Learning Outcomes (in cognitive domain)		Topics and Sub-topics
	Writing Skills	**Speaking Skills**	
Office Communication and Report Writing	using the relevant format. 4b. Draft the given memorandum using the relevant format. 4c. Prepare agenda for the given type of meetings. 4d. Prepare minutes of the given type of meetings. 4e. Prepare reports of the given type of events/episodes/ accidents	agenda of the given meeting. 4g. Read the report of the given event. 4h. Initiate telephone calls for given situation. 4i. Answer official phone calls for given situation.	office communication. 4.2. Formulating notices and memoranda. 4.3. Preparation of agenda, writing minutes of meetings. 4.4. Preparation of reports of events /episodes/ accidents 4.5. Summarising after quick reading of reports/ booklets
Unit-V Business Correspondence	5a. Respond to the given job advertisements by writing your CV/ Resume. 5b. Draft business letters in the given situations. 5c. Draft complaint letters for the given situations. 5d. Compose E- mails with relevant emogies for the given situation.		5.1 Purpose and structure of business communication. 5.2 Writing job application, CVs, resume. 5.3 Enquiry, order and complaint letter. 5.4 Writing e-mails, use of emogies.

***Note**: To attain the COs and competency, above listed Learning Outcomes (LOs) need to be undertaken to achieve the 'Application Level' of Blooms's 'Cognitive Domain Taxonomy'*

9. 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 Business Communication	04	02	02	01	05
II	Non-verbal Communication and Body Language	08	02	02	01	05
III	Presentation Skills	04	02	01	02	05
IV	Office Communication and report writing	08	02	04	04	10
V	Business Correspondence	08	02	04	04	10
Total		**32**	**10**	**13**	**12**	**35**

***Legends**: R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note**: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of LOs. The actual*

distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

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:

a. Compile/collect the different formats [traditional and modern] of business letters.
b. Collect good articles from newspapers and magazines and read them with correct intonation.
c. Listen to Business news on TV and radio.
d. Watch different personalities on you- tube, television and Google for presentation skills and body language.
e. Undertake micro-projects.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (1if any)

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

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the LOs/COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
a. Arrange various communication activities using functional grammar.
b. Show video/animation films to develop listening skills and enhance vocabulary.
c. Use real life situations for explanation.
d. Prepare and give oral presentations.
e. Guide micro-projects in groups as well as individually.

12. SUGGESTED TITLES OF MICRO-PROJECTS

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

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

a. Report on various formal events.

b. Identify a good business leader and study his Presentations.
c. Collect speeches of good business leaders from various sources.
d. Compose Emails for given situations.
e. Prepare Minutes of the meeting for a given situation.
f. Prepare different types of assignments using multimedia:
   i. Prepare a presentation on positive body language during seminar.
   ii. Prepare a presentation using PPT on any given topic.
   iii. Prepare poster for Inter Polytechnic Paper Presentation competition
   iv. Prepare a leaflet(three fold) giving information about your Institute
   v. Prepare a leaflet about the admission process of Polytechnic
g. Prepare Presentations for the following:
   i. Important Meeting in the Organization.
   ii. An Environmental issue
   iii. A Successful Business man [Biographical information]
h. Prepare a questionnaire and conduct the interview of Principal/Head of Department/ Senior Faculty Members/ Senior Students/ Industry Personnel
i. Summarise views of two businessmen from English newspapers/magazines and other sources.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Communication Skills	MSBTE	MSBTE, Mumbai
2	Effective Communication Skills	M Ashraf Rizvi	Tata McGraw-Hill, New Delhi, 2014
3	Communication Skills	Sanjay Kumar and Pushp Lata	Oxford University Press, New Delhi, 2014
4	Business Communication	K.K.Sinha	Tata McGraw Hill, New Delhi, 2014
5	Essentials of Business Communication	Rajendra Pal , J.S.Korlahalli	Sultan Chand And Sons, New Delhi, 2014

14. SOFTWARE/LEARNING WEBSITES

a. https://www.britishcouncil.in/english/learn-online
b. http://learnenglish.britishcouncil.org/en/content
c. http://www.talkenglish.com/
d. languagelabsystem.com
e. www.wordsworthelt.com
f. www.notesdesk.com
g. http://www.tutorialspoint.com
h. www.studylecturenotes.com
i. totalcommunicator.com
j. www.speaking-tips.com