

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION

Diploma Programme in **Electrical Engineering**

I – Scheme

Programme Structure

Programme Educational Objectives (PEOs) (*What s/he will continue to do even after 3-5 years of working in the industry*)

- PEO 1. Provide socially responsible, environment friendly solutions to Electrical engineering related broad-based problems adapting professional ethics.
- PEO 2. Adapt state-of-the-art Electrical engineering broad-based technologies to work in multi-disciplinary work environments.
- PEO 3. Solve broad-based problems individually and as a team member communicating effectively in the world of work.

Program Outcomes (POs) given by NBA. (*What s/he will be able to do at the entry point of industry soon after the diploma programme*)

- PO 1. **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electrical engineering problems.*
- PO 2. **Discipline knowledge:** Apply Electrical engineering knowledge to solve broad-based electrical engineering related problems.*
- PO 3. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electrical engineering problems.*
- PO 4. **Engineering tools:** Apply relevant Electrical technologies and tools with an understanding of the limitations.*
- PO 5. **The engineer and society:** Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in the field of Electrical engineering.*
- PO 6. **Environment and sustainability:** Apply Electrical engineering solutions also for sustainable development practices in societal and environmental contexts.*
- PO 7. **Ethics:** Apply ethical principles for commitment to professional ethics, responsibilities and norms of the practice also in the field of Electrical engineering.*
- PO 8. **Individual and team work:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.*
- PO 9. **Communication:** Communicate effectively in oral and written form.*
- PO 10. **Life-long learning:** Engage in independent and life-long learning activities in the context of technological changes also in the Electrical engineering and allied industry.*

Program Specific Outcomes (PSOs) (*What s/he will be able to do in the Electrical engineering specific industry soon after the diploma programme*)

- PSO 1. Electrical Equipment:** Maintain various types of rotating and static electrical equipment.
- PSO 2. Electric Power Systems:** Maintain different types of electrical power systems.

Notes for All the Semesters

1. Every student has to **separately pass in End-Semester-Examination (ESE)** for **both theory and practical** by securing minimum of 40% marks, (i.e. 30 out of 75, 28 out of 70, 20 out of 50, and 10 out of 25).
2. **Progressive Assessment (PA) for Theory** includes Written Exam/micro projects/ Assignment/Quiz/Presentations/attendance according to the nature of the course. The scheme and schedule for progressive assessment should be informed to the students and discussed with them at the start of the term. This scheme should also be informed in writing to the principal of the institute.
3. Teachers need to give **marks judiciously for PA of theory and practicals** so that there is always a **reasonable correlation** between the **ESE marks** obtained by the student and the **PA marks** given by **respective teachers for the same student**. In case the PA marks in some courses of some students seems to be relatively inflated in comparison to ESE marks, then MSBTE may review the PA records of such students.
4. For developing self-directed learning skills, from each course about 15-20% of the topics/sub-topics, which are relatively simpler or descriptive in nature are to be given to the students for self-study and proper learning of these topics should be assured through classroom presentations by students (see implementation guideline for details).

Programme Code:I – Scheme Diploma Programme in Electrical Engineering												
I – Semester												
Weighted mean score	S. No. & (Rank No.) of Report	Industry Questionnaire S.No.	Course Title	Teaching Scheme/Week			Credits (L+T +P)	Examination Scheme				
				L	T	P		Theory		Practical		Grand Total
								ESE	PA	ESE	PA	
3.34	G2(2)	37	English (Common to all)	3	-	2+	5	70	30*	25	25	150
2.79	26(21)	1	Basic Science	2	-	2	4	35	15*	25	25	200
2.21	35(30)	2	(Common to all) Physics Chemistry									
2.81	24(20)	4	Basic Mathematics (Common to all)	4	2	-	6	70	30*	-	-	100
3.22	G4(4)	45	Fundamentals of ICT (Common to all)	2#	-	2	4	-	-	25	25~ ¹	50
2.97	15(13)	6	Engineering Graphics Mech. Gp.(AE, ME, PT, FG, EE, CE, CH, PS, DC, TC, TX)	2#	-	4	6	-	-	50	50~ ²	100
3.24	3(2)	11	Workshop Practice Mech. Gp.(AE, FG, ME, PT, CE, EE, CH, PS)	-	-	4	4	-	-	50	50~ ²	100
Total				15	2	16	33	210	90	200	200	700

(#): No theory Exam; (*): 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; (+): Language Lab Practical (~): For the courses having ONLY practical examination, the PA has two parts – marks, for~¹ (i) practical part - 15 marks(60%) (ii) micro-project part - 10 marks (40%) and for~² (i) practical part - 30 marks (60%) (ii) micro-project part - 20 marks (40%).

Legends

L: Lecture **T:** Tutorial **P:** Practical **ESE:** End Semester Exam **PA:** Progressive Assessment

Note: Blue highlights are courses common to all programmes and yellow highlights are courses common with other specific programmes.

Programme Code: I – Scheme Diploma Programme in Electrical Engineering												
II – Semester												
Weighted mean score	S. No. & (Rank No.) of Report	Industry Questionnaire S.No.	Course Title	Teaching Scheme/Week			Credits (L+T+P)	Examination Scheme				
				L	T	P		Theory		Practical		Grand Total
								ESE	PA	ESE	PA	
2.38	32(24)	4	Applied Mathematics Elect. & Elx. Gp. (DE, EJ, EE, IE, MU, IS)	4	2	-	6	70	30*	-	-	100
3.21	15(10)	1	Applied Science	2	-	-	-	35	15*	-	-	-
2.21	34(25)	2	Physics Elect. Gp. (EE, IE, IS)	2	-	2	6	35	15*	25	25	150
3.72	1(1)	11	Chemistry Fundamentals of Electrical Engineering	4	2	2	8	70	30*	25@	25	150
3.0	20(15)	15	Elements of Electronics	3	-	2	5	70	30*	25	25	150
2.69	29(21)	8	Basic Mechanical Engineering	3	-	2	5	70	30*	25	25	150
3.36	G4 (3)	40	Business Communication Using Computers (Common to all)	2\$	-	-	2	35\$	15	-	-	50
Total				20	4	8	32	385	165	100	100	750

(\$): Online Exam; (*): 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; @: with external examiner.

Programme Code: I – Scheme Diploma Programme in Electrical Engineering												
III – Semester												
Weighted mean score	S. No. & (Rank No.) of Report	Industry Questionnaire S.No.	Course Title	Teaching Scheme/Week			Credits (L+T+P)	Examination Scheme				
				L	T	P		Theory		Practical		Grand Total
								ESE	PA	ESE	PA	
3.69	2(2)	12	Electrical Circuits	4	2	2	8	70	30*	25	25	150
3.62	3(3)	14	Electrical and Electronic Measurements	4	-	2	6	70	30*	25	25	150
3.34	7(6)	28	Fundamentals of Power Electronics (IE, EE)	4	-	2	6	70	30*	25	25	150
2.38	33(24)	19	Electrical Power Generation	4	-	2	6	70	30*	25	25	150
3.48	4(4)	13	Electrical Materials and Wiring Practice	3	-	4	7	70	30*	50	50 ^{~2}	100
Total				19	2	12	33	350	150	150	150	800

(\$): Online Exam; (*): 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; (~²): For the courses having ONLY practical examination, the PA has two parts – marks for ~² (i) practical part - 30 marks (60%) (ii) micro-project part – 20 marks (40%).

Programme Code: I – Scheme Diploma Programme in Electrical Engineering												
IV – Semester												
Weighted mean score	S. No. & (Rank No.) of Report	Industry Questionnaire S.No.	Course Title	Teaching Scheme/Week			Credits (L+T+P)	Examination Scheme				
				L	T	P		Theory		Practical		Grand Total
								ESE	PA	ESE	PA	
2.9	23(17)	16	DC Machines and Transformers	4	2	2	8	70	30*	25	25	150
2.9	22(17)	22	Electric Power Transmission and Distribution	3	2		5	70	30*	-	-	100
2.97	21(16)	29	Industrial Measurement (EE IE & 3 rd Sem IS)	3	-	2	5	70	30*	25	25	150
2.79, 2.79	26(19), 27(19)	32,33	Digital Electronics and Microcontroller Applications	4	-	2	6	70	30*	25	25	150
3.0, 93	G6(6), EJ2G7(7)	43, 39	Managerial skills and TQM (IS, EE & 5 th Sem DE, PS, EJ, IE)	3	-	-	3	70	30*	-	-	100
3.17	16(11)	7	Electrical Drawing and CAD	-	-	4	4	-	-	50~	50~ ²	100
Total				17	4	10	31	350	150	125	125	750

(*): 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; (~²): For the courses having ONLY practical examination, the PA has two parts – marks for~² (i) practical part - 30 marks (60%) (ii) micro-project part – 20 marks (40%).

Note

- During Summer Break after IV semester (i.e. between IV and V Semester), Polytechnics would ensure mandatory placement of students for 6 weeks industrial training. Preferably, the industry where students would be placed should be large or medium scale, however if such industries are not available, then students can also be placed in small or very small industries but it should be relevant to the branch or discipline of engineering. **This training would be evaluated during V semester.**
- The allotment of the group of students and orientation for industrial training shall be done before the end of IV semester.
- Students should prepare report of training, which will be evaluated during V semester.

Programme Code: I – Scheme Diploma Programme in Electrical Engineering												
V – Semester												
Weighted mean score	S. No. & (Rank No.) of Report	Industry Questionnaire S.No.	Course Title	Teaching Scheme/Week			Credits (L+T+P)	Examination Scheme				
				L	T	P		Theory		Practical		Grand Total
								ESE	PA	ESE	PA	
MSBTE guidelines and industry feedback			Industrial Training (during summer break after IV semester)	-	-	6^	6^	-	-	75	75	150
3.24	13 (9)	18	Induction, Synchronous and FHP Machines	4	-	2	5	70	30*	25	25	150
3.24	12 (9)	24	Switchgear and Protection	4	-	2	6	70	30*	25	25	150
2.79, 2.79	26(19), 27(19)	32, 33	Elements of Industrial Automation	4	-	2	6	70	30*	25	25	150
			Elective I	3	-	2	5	70	30*	25	25	150
3.31	8(7)	36	Energy Conservation and Audit	3	-	2	5	70	30*	25	25	150
2.31	G8 (8)	40	Entrepreneurship Development (Common to all)	2\$	-	2	4	50\$	-	25	25~ ¹	100
3.66	G3(3)	38	Minor Project (Common to all)	-	-	4	4	-	-	50	50	100
Total				20	-	20^	40^	400	150	250	250	1050

(\$): Online Exam; (*): 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; (~¹): For the courses having ONLY practical, the PA has two parts (i) practical part - 15 marks (60%) (ii) micro- project part - 10 marks (40%). (^): Though 6 credits are allocated for Industrial Training it is only for awarding marks. As far as teaching load/time table preparation is considered, each faculty would be assigned with one batch of students (equivalent to practical batch size) for guiding the preparation of industrial training report and its evaluation. For this purpose 1 hour (or two hours on working Saturdays) teaching load would be considered.

Note

- Evaluation of industrial training and its reports is to be done during this semester. Credits of Industrial Training will not affect the framing of the time table.
- Students have to choose any one elective group in V semester as **stream specific specialisation**, and have to take first course of that group as elective- I in V semester. They would be required to take another two courses of the same group/stream in VI semester as elective - II and elective - III. Their major and minor projects should also have emphasis preferably on the same stream of specialisation.

Weighted mean score	S. No. & (Rank No.) of Report	Industry Questionnaire S. No.	Group Number and Name of Specialization
Group A – Industry Automation (Choose any one)			
3.24	11(9)	26	Elective I - Elements of Industrial Automation
Group B – Power System			
2.45	31	20	Elective I - Wind Power Technologies (EE, IS)
Group C – Commercial Electrification and Traction (Choose any one)			
			Elective I - Electrification of Building Complexes

Programme Code: I – Scheme Diploma Programme in Electrical Engineering												
VI – Semester												
Weighted mean score	S. No. & (Rank No.) of Report	Industry Questionnaire S. No.	Course Title	Teaching Scheme/Week			Credits (L+T +P)	Examination Scheme				Grand Total
				L	T	P		Theory		Practical		
								ESE	PA	ESE	PA	
		IF	Testing, Commissioning and Maintenance of Electric Equipment	3	-	2	5	70	30	25	25	150
3.21, 2.86	14(10), 25(18)	31, 30	Utilization of Electrical Energy	4	-	2	6	70	30*	25	25	150
2.62	30(22)	27	Electrical Estimation and Contracting	3	-	2	5	70	30*	25	25	150
			Elective II	3	-	2	5	70	30*	25	25	150
			Elective III	3	-	2	5	70	30*	25	25	150
3.36	G4 (3)	40	Technical Writing (Common to all)	-	-	2	2	-	-	25	25	50
3.66	G3(3)	38	Major Project (Common to all)	-	-	6	6	-	-	75	75	150
Total				16	-	18	34	350	150	225	225	950

(*): 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.

Note

- The **Technical Writing** course is introduced as practical work, in which English faculty members would

facilitate the framing of correct language for writing different chapters and presentation (i.e.PPT. and others) of their project work from English point of view. Name of English teacher has to be included as a 'Language Editor' in the project and this activity will be the part of practical shown against Technical Writing course at VI semester. This work shall be carried out for each batch (size same as for practical).

- b) Students who have chosen the **stream specific specialisation** in elective – I in V semester, should choose the same stream/group courses in elective – II and elective – III in VI semester. Their **major project** should also have emphasis preferably on the same group/stream which could further sharpen their skills in that area.

Weighted mean score	S. No. and (Rank No.) of Report	Industry Questionnaire S. No.	Group Number and Name of Specialization
			Group A – Industry Automation (Choose any one)
3.21	14(10)	31	Elective II -Industrial Drives and Control
2.79	26(19)	33	Elective III - PLC and SCADA
			Group B – Power System (Choose any one for elective II)
2.45	31	20	Elective II - Solar and Biomass Power Technologies (EE, IS)
2.9	22(17)	22	Elective II -Power System Operation and Control
3.24	13(9)	24	Elective III - Substation Practices
			Group C – Commercial Electrification and Traction (Choose any one)
			Elective II -Maintenance of Transformers and Circuit Breakers
			Elective III - Electric Traction and Vehicle

I - Scheme Summary of Teaching Scheme/Week, Credits and Examination Scheme

Electrical Engineering

Semester	Teaching Scheme/Week			Credits (L+T+P)	Examination Scheme				Grand Total
	L	T	P		Theory		Practical		
					ESE	PA	ESE	PA	
I	15	2	16	33	210	90	200	200	700
II	20	4	8	32	385	165	100	100	750
III	19	2	12	33	350	150	150	150	800
IV	17	4	10	31	350	150	125	125	750
V	20	-	20 [^]	40 [^]	400	150	250	250	1050
VI	16	-	18	34	350	150	225	225	950
Total	107	12	84[^]	203[^]	2045	855	1050	1050	5000

([^]): This includes total 6 credits for Industrial Training conducted during Summer Break between IV and V semester.

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:

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

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
L	T	P	C	Theory Marks		Practical Marks		Total Marks
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.

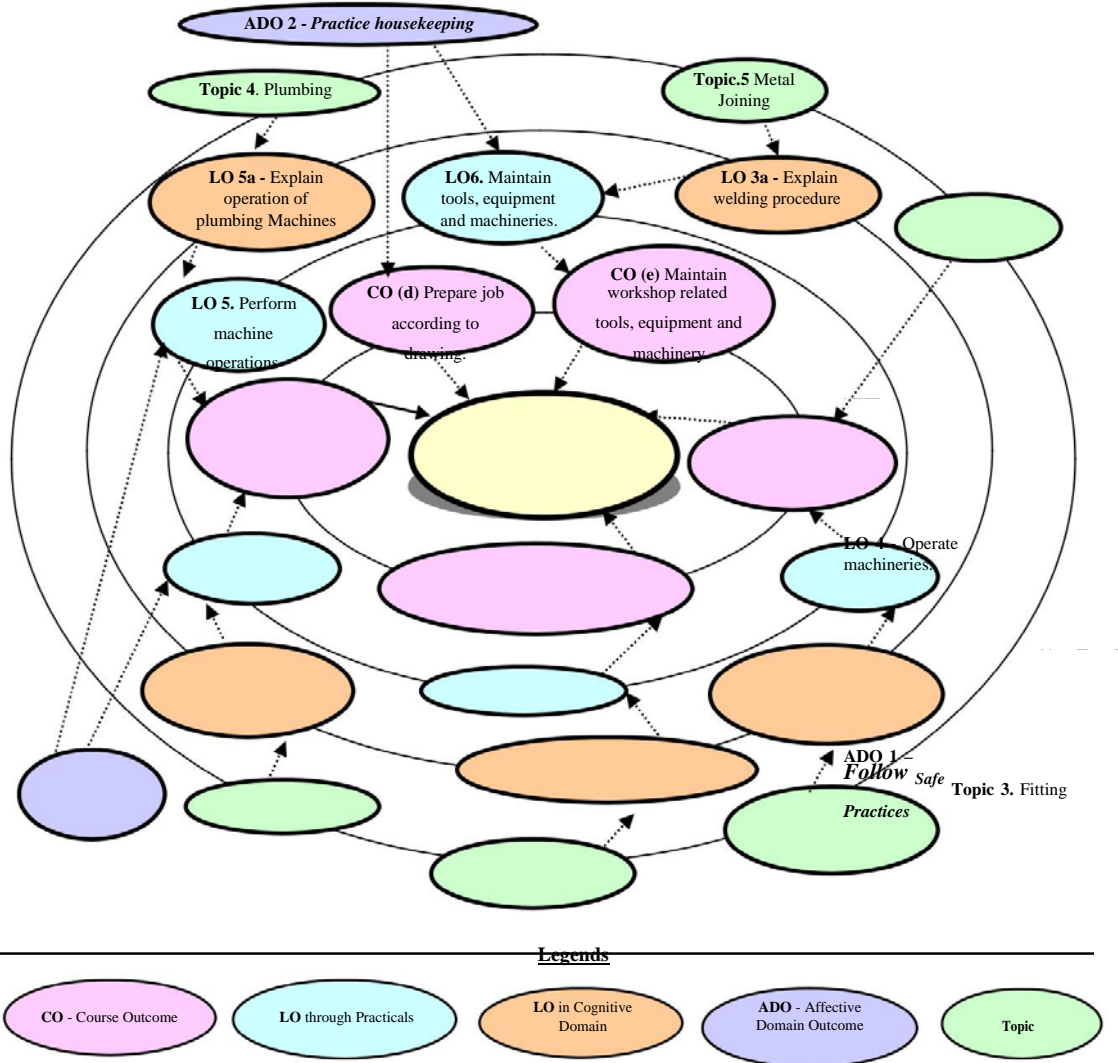


Figure 1 - Course Map

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:

- Follow safety practices.
- Practice good housekeeping.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- 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 ^o	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, scribe, 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,

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

	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, planing, 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:

- 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.
- 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.
- Prepare/Download a specifications of followings:
 - Various tools and equipment in various shops.
 - Precision equipment in workshop
 - Various machineries in workshop
- Undertake a market survey of local dealers for procurement of workshop tools, equipment machineries and raw material.
- 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:

- Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
- '*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=TeBX6cKHWY>
- f. <http://www.youtube.com/watch?v=QHF0sNHttw&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:

- Apply the concepts of algebra to solve engineering related problems.
- Utilize basic concepts of trigonometry to solve elementary engineering problems.
- Solve basic engineering problems under given conditions of straight lines.
- Solve the problems based on measurement of regular closed figures and regular solids.
- 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				Total Marks
L	T	P		Theory Marks		Practical Marks		
L	T	P	C	ESE	PA	ESE	PA	100
4	2	-	6	70	30*	-	-	

(*): 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.

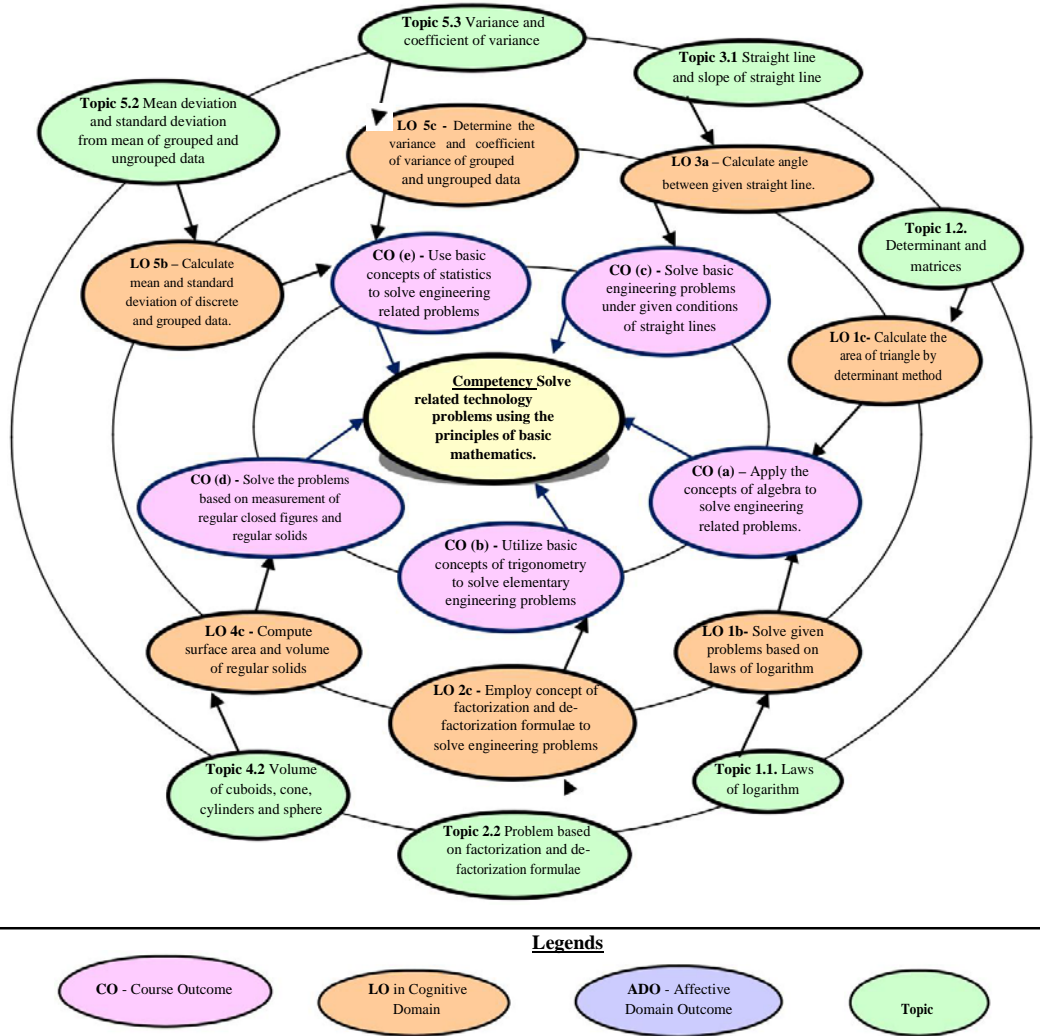


Figure 1 - Course Map

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 based	1a. Solve the given simple problem 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.
1.1		

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.

- Identify engineering problems based on real world problems and solve with the use of free tutorials available on the internet.
- Use graphical softwares: EXCEL, DPLLOT and GRAPH for related topics.
- Use MathCAD as Mathematical Tools and solve the problems of Calculus.
- Identify problems based on applications of matrix and use MATLAB to solve these problems.
- Prepare models to explain different concepts.
- 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:

- Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
- '*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.
- 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).
- With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
- Guide student(s) in undertaking micro-projects.
- 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.

- Prepare charts using determinants to find area of regular shapes.
- Prepare models using matrices to solve simple problems based on cryptography.
- Prepare models using matrices to solve simple mixture problems.
- Prepare charts displaying regular solids.
- Prepare charts displaying regular closed figures.
- 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:

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

4. TEACHING AND EXAMINATION SCHEME

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

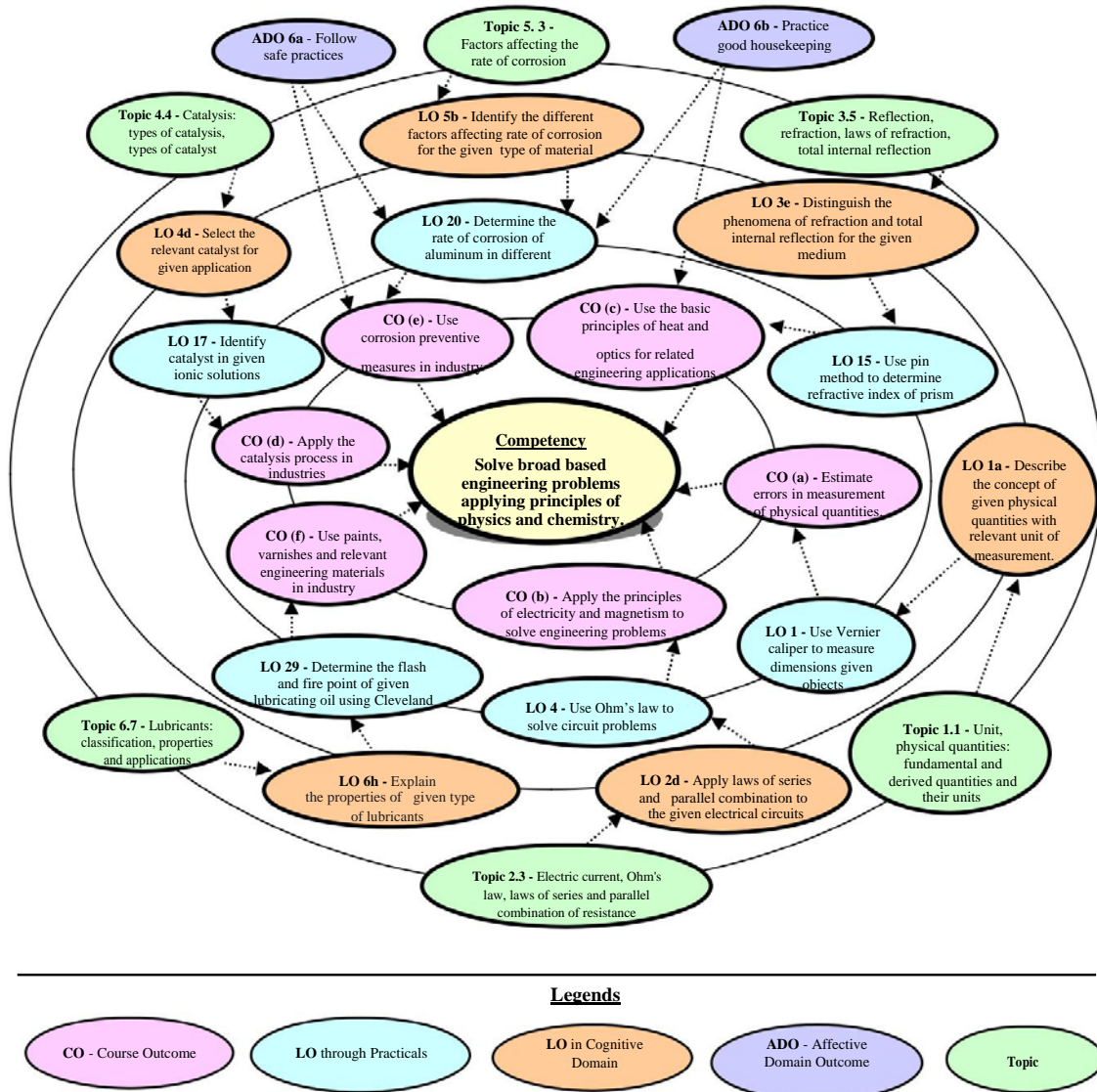


Figure 1 - Course Map

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 judicious 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: ± 0.02 mm 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 M Ω), Capacitance and Temperature	4, 5, 6, 7, 21, 22, 23
5	Resistance Box: 4 decade ranges from 1 ohm to 1K Ω ,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 ^o C, thermometer, micro ammeter, Ge diode	11
11	pH meter reading up to pH14; ambient temp. -40 to 70 ^o 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 ^o 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. 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.	2.1 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 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. 3e. Distinguish the phenomena of total internal reflection for the given mediums. 3f. Describe light propagation in	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 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 crystal structure 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:** Collect 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; <i>et al</i>	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; <i>et al</i>	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. <i>et al</i>	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. <i>et al</i>	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:

- Formulate grammatically correct sentences.
- Summarise comprehension passages.
- Formulate different types of dialogues.
- Use relevant vocabulary to compose paragraphs to express ideas, thoughts and emotions.
- 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				
L	T	P		Theory Marks		Practical Marks		Total Marks
			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 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.

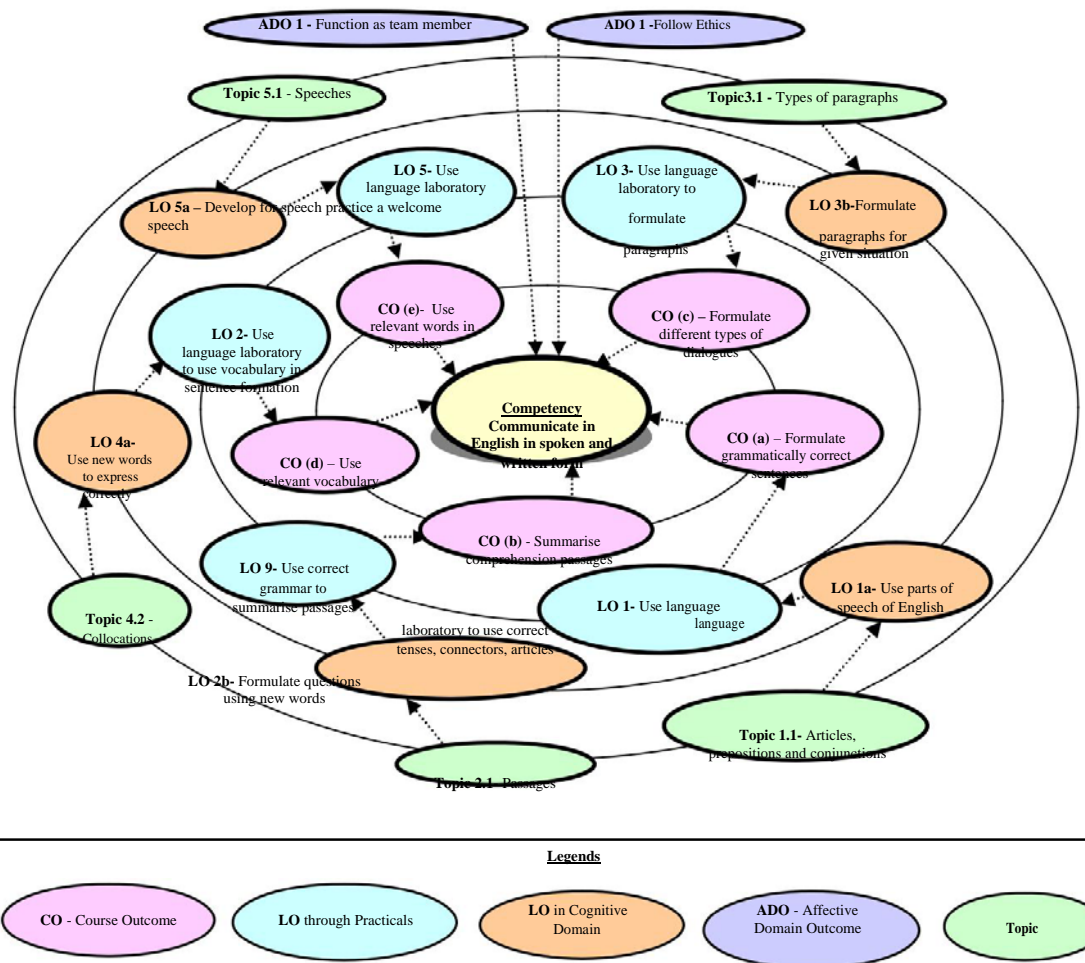


Figure 1 - Course Map

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 of given 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				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	PA	ESE	PA	
2#	-	2	4	-	-	25	25~ ¹	50

(~): 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.

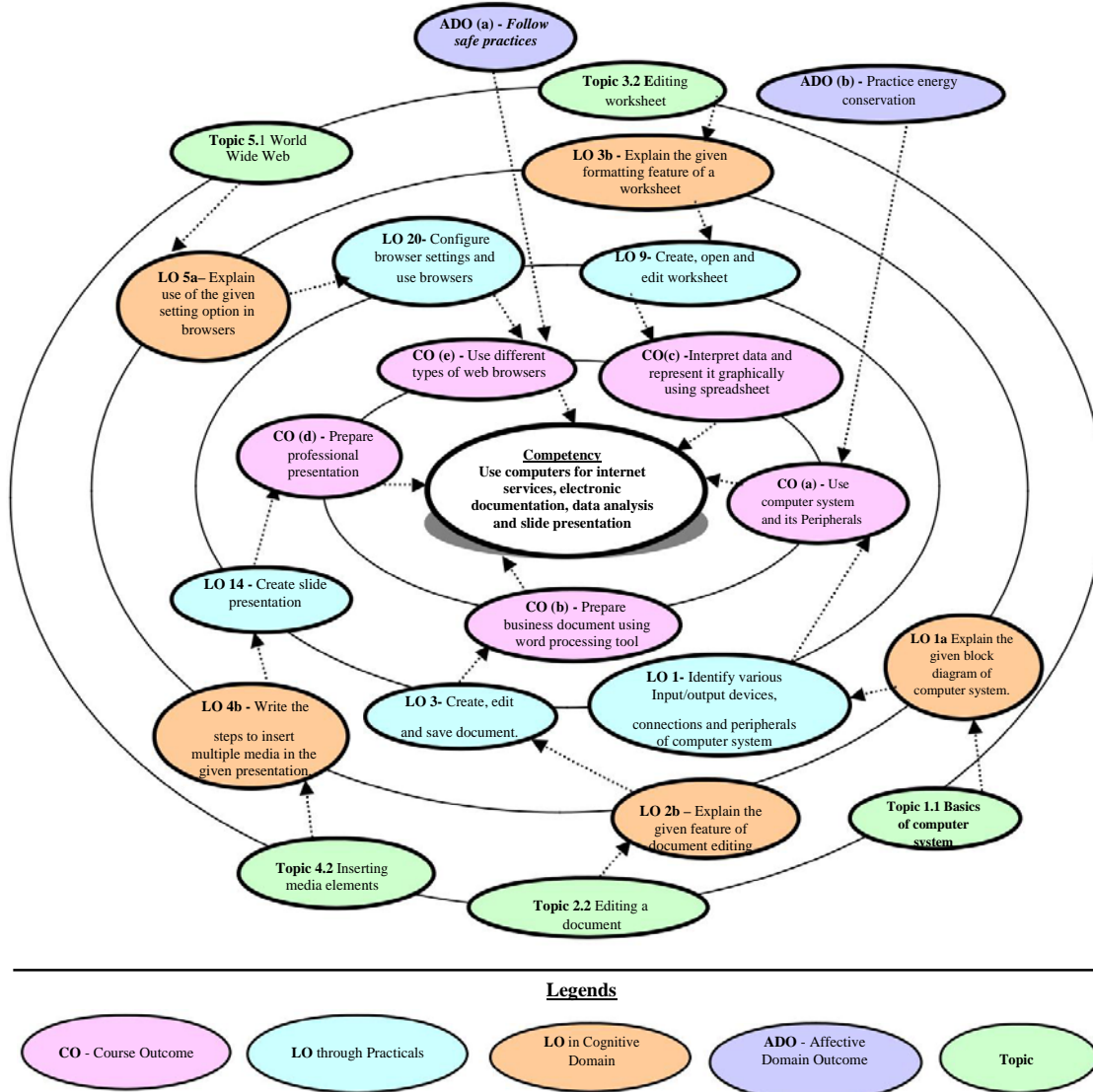


Figure 1 - Course Map

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:

- Follow safety practices.
- Practice good housekeeping.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- 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 Introducti on 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
		<p>spacing, add bullet and numbers in lists, add borders and shading, document views, Page settings and margins, Spelling and Grammatical checks</p> <p>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.</p> <p>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</p> <p>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.</p> <p>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.</p>
Unit– III Spreadsheets	<p>3a. Write steps to create the given spreadsheet.</p> <p>3b. Explain the specified formatting feature of a worksheet.</p> <p>3c. Write steps to insert formula and functions in the given worksheet.</p> <p>3d. Write steps to create charts for the specified data set.</p> <p>3e. Explain steps to perform advance operation on the given data set.</p>	<p>3.1. Working with Spreadsheets: Overview of workbook and worksheet, Create Worksheet, Enter sample data, Save, Copy Worksheet, Delete Worksheet, Close and open Workbook.</p> <p>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.</p> <p>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</p>

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
		<p>Orientation, Header and Footer, Insert Page Breaks, Set Background.</p> <p>3.4. Working with Formula: Creating Formulas, Copying Formulas, Common spreadsheet Functions such as sum, average, min, max, date, In, And, or, mathematical functions such as sqrt, power, applying conditions using IF.</p> <p>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.</p> <p>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.</p>
Unit– IV Presentation Tool	<p>4a. Write the steps to create the specified slide presentation.</p> <p>4b. Write the steps to insert multiple media in the given presentation.</p> <p>4c. Write steps to apply table features in the given presentation</p> <p>4d. Write steps to manage charts in the given presentation</p>	<p>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,</p> <p>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.</p> <p>4.3 Working with Tables: Insert a Table in a Slide, Format Tables, and Import Tables from Other Office Applications.</p>

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:

- Prepare journal of practicals.
- Prepare a sample document with all word processing features.(Course teacher shall allot appropriate document type to each students)
- 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:

- Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
- '*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.
- 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).
- With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
- Guide student(s) in undertaking micro-projects.
- Guide student(s) in undertaking various activities in the lab/workshop.
- Demonstrate students thoroughly before they start doing the practice.
- Show video/animation films for handling/functioning of instruments.
- 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:

- Word documents:** Prepare Time Table, Application, Notes, Reports .(Subject teacher shall assign a document to be prepared by the each students)
- 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).
- 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

- <https://www.microsoft.com/en-in/learning/office-training.aspx>
- <http://www.tutorialsforopenoffice.org/>
- 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:

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

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
L	T	P		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.

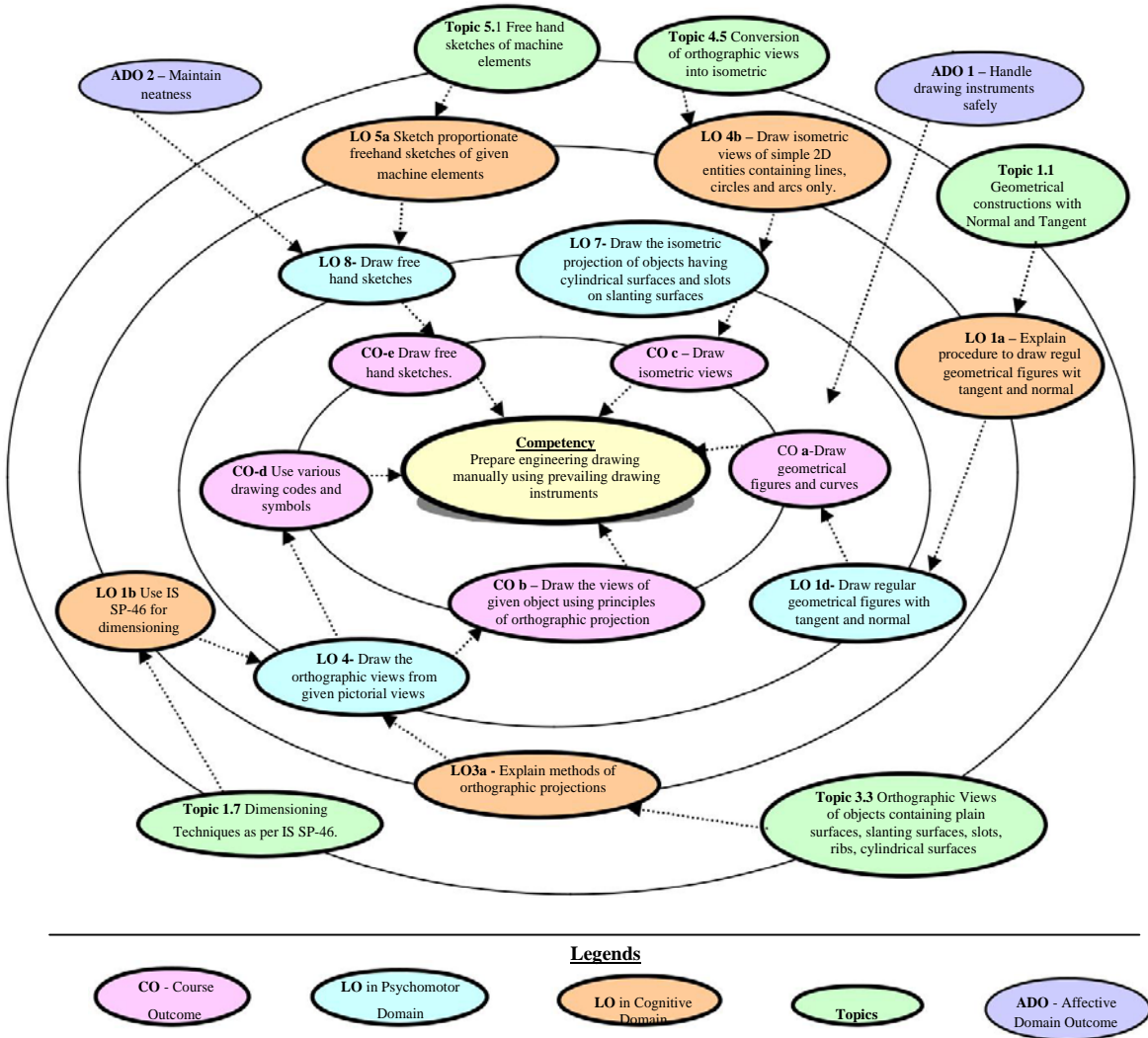


Figure 1 - Course Map

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:

- Follow cleanliness and neatness.
- 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 stroke 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 (MSBTE)**I – Scheme****II – Semester Course Curriculum**CourseTitle: **Applied Mathematics** (DE, EE, EJ, IE, IS, MU)

(Course Code:)

Diploma programme in which this course is offered	Semester in which offered
Industrial Electronics, Digital Electronics, Medical Electronics, Instrumentation, Electrical, Electronics and Telecommunication Engineering	Second

1. RATIONALE

The core technological studies can be understood with the help of potential of applied mathematics. This course is an extension of Basic Mathematics of first semester which is designed for its applications in engineering and technology using the techniques of calculus, differentiation, integration, differential equations and in particular complex numbers and Laplace transform. 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. In analog to digital converter and modulation system integration is important. Differential equation is used in finding the curve and its related applications for various engineering models like LCR circuits. 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 electrical and electronics 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:

- Calculate the equation of tangent, maxima, minima, radius of curvature by differentiation.
- Solve the given problem(s) of integration using suitable methods.
- Apply the concepts of integration to find the area and volume.
- Solve the differential equation of first order and first degree using suitable methods.
- Use Laplace transform to solve first order first degree differential equations.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Total Credits	Examination Scheme				
(In Hours)				(L+T+P)	Theory Marks		Practical 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.

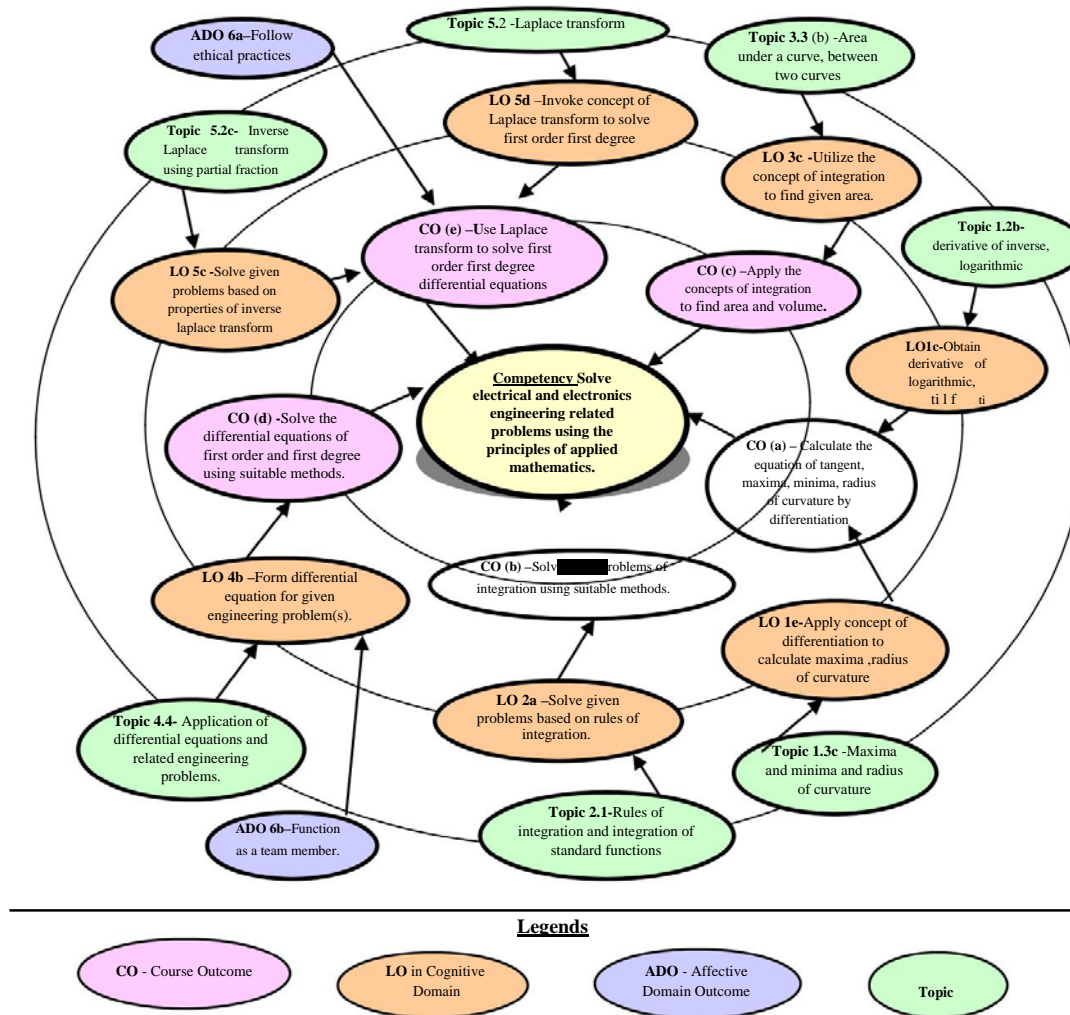


Figure 1 - Course Map

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
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	Solve problems 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 algebra of complex numbers.	V	2
15	Find Laplace transform and inverse Laplace transform using related properties.	V	2
16	Make use of concept of Laplace transform to solve first order first degree differential equation..	V	2
			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 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	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,

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	logarithmic,exponential functions. 1d. Apply the concept of differentiation to find equation of tangent and normal. 1e. Apply the concept of differentiation to calculate maxima and minima and radius of curvature of given problem.	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 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 engineering problem(s). 4c. Solve the given differential equations using the method of variable separable. 4d. Solve the given problems based on linear differential equations.	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 Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit –V Complex Numbers and Laplace transform.	5a. Solve given problems based on algebra of complex numbers. 5b. Solve the given problems based on properties of Laplace transform 5c. Solve the given problems based on properties of inverse Laplace transform. 5d. Invoke the concept of Laplace transform to solve first order first degree differential equations.	5.1 Complex numbers: a. Cartesian, polar and exponential form of a complex number. b. Algebra of complex numbers. 5.2 Laplace transform: a. Laplace transform of standard functions (without proof). b. Properties of Laplace transform such as linearity, first and second shifting properties (without proof). c. Inverse Laplace transform using partial fraction method, linearity and first shifting property. d. Laplace transform of derivatives and solution of first order first degree differential equations.

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	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	Complex numbers and Laplace transform	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.

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:

- Identify engineering problems based on real world problems and solve with the use of free tutorials available on the internet.
- Use graphical software’s: EXCEL, DPLOT, and GRAPH for related topics.
- 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 Laplace transform to related engineering problems.

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.
- g. Use different instructional strategies in classroom teaching.
- h. Use video programs available on the internet to teach abstract topics.

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 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 models using the concept of Laplace transform to solve linear differential equations.
- j. Prepare models using the concept of Laplace transform to solve initial value problem of first order and first degree.
- k. Prepare charts displaying various algebraic operations of complex numbers in complex plane.

13. 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	Advanced Engineering Mathematics	Krezig, Ervin	Wiley Publications, New Delhi, 2016 ISBN:978-81-265-5423-2,
3	Advanced Engineering Mathematics	Das, H.K.	S. Chand Publications, New Delhi, 2008, ISBN-9788121903455
4	Engineering Mathematics, Volume 1 (4 th edition)	Sastry, S.S.	PHI Learning, New Delhi, 2009 ISBN-978-81-203-3616-2,
5	Getting Started with MATLAB-7	Pratap, Rudra	Oxford University Press, New Delhi,2009 ISBN- 0199731241
6	Engineering Mathematics (third edition).	Croft, Anthony.	Pearson Education, New Delhi,2010 ISBN 978-81-317-2605-1

14. 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: **Applied Science** (EE, IE, IS)

(Course Code:)

Diploma Programme in which this course is offered	Semester in which offered
Electrical Engineering, Industrial Electronics, Instrumentation Engineering	Second

1. RATIONALE

Diploma engineers have to deal with various materials and machines. The study of concepts and principles of science like capacitance and current electricity, electromagnetic induction and alternating current, photo-sensors and LASER, water treatment and analysis, electrochemistry and batteries, metals, alloys, insulators and others will help them in understanding the engineering courses where emphasis is laid on the applications. This course is developed in the way by which fundamental information will help the diploma engineers to apply the concepts and principles of advanced science in various engineering applications to solve broad based problems.

2. COMPETENCY

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

- **Apply principles of advanced physics and chemistry to solve broad based engineering 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. Use relevant capacitors in electrical circuits.
- b. Use equipment/instruments based on radioactive and ultrasonic principles.
- c. Use equipment/instruments based on photoelectric effect, X-Ray and LASER.
- d. Select relevant water treatment process for various applications.
- e. Use relevant batteries for different applications.
- f. Use relevant metals, alloys and insulating materials in various 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	Total Marks
4	-	2	Applied Science	Physics	2	2	35	15*	15	10	
				Chemistry	2		35	15*	15	10	

(*): Under the theory PA; Out of 30 marks, 10 marks is for micro-project assessment (5 marks each for Physics and Chemistry) to facilitate attainment of COs and the remaining 20 marks for tests and assignments given by the teacher.

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
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	i) Use condensers to increase and decrease the equivalent capacity of the circuit. ii) Determine the characteristics of condenser using RC circuit.	I	02*
2	i) Use meter bridge to determine the equivalent resistance of the conductors in series and parallel. ii) Use meter bridge to estimate specific resistance of a given wire	I	02
3	i) Use potentiometer to compare emf of two cells ii) Use potentiometer to find internal resistance of a cell	I	02
4	Use resonance tube to determine velocity of sound.	II	02*
5	Use ultrasonic distance – meter to measure distance.	II	02
6	i) Use photoelectric cell to see the dependence of photoelectric current on intensity of light. ii) Use photoelectric cell to see the dependence of photoelectric current on plate potential.	III	02
7	Use LDR to see the dependence of resistance of LDR on intensity of light.	III	02*
8	Use He Ne LASER to find the divergence of LASER beam with distance.	III	02
Chemistry			
9	Determine alkalinity of water sample and chloride content in the given water sample by Mohr's method.	IV	02*
10	Determine total hardness (temporary hardness and permanent hardness) of water sample by EDTA method.	IV	02
11	Determine specific conductance and equivalence conductance of given salt sample solution.	V	02*
12	Determine equivalence point of acetic acid and ammonium hydroxide using conductivity meter.	V	02
13	Determine the rate of sulphation in lead acid storage battery.	V	02
14	Prepare the Thiokol rubber.	VI	02
15	Separate two miscible liquids like acetone and water using distillation technique.	VI	02*
16	Determine acid value of given resin.	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 judicious 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:

- Follow safe practices.
- Practice good housekeeping.
- Practice energy conservation.
- Demonstrate working as a leader/a team member.
- 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	Digital multimeter : 3 1/2 digit display, 9999 counts digital multimeter measures: V_{ac} , V_{dc} (1000V max) , A_{dc} , A_{ac} (10 amp max) , Hz , Resistance (0 - 100 M Ω) , capacitance and Temperature	1,2,3,6,7
2	Micrometer screw gauge : Range : 0-25mm, Resolution: 0.01mm Accuracy ± 0.02 mm or better	2
3	Resistance Box: 4 decade ranges from 1 ohm to 1K Ω ,accuracy 0.1 % - 1 %	1,2,3,6,7
4	Battery eliminator : 0- 12 V ,2A	1,2,3,6,7
5	Meter bridge ,Galvanometer and Jockey	2
6	Potentiometer	3
7	Ultrasonic distance meter	5
8	Resonance tube, tuning fork	4
9	Daniel cell and Leclanche cell.	2
10	LASER kit	8
11	Conductivity meter; conductivity range – 0.01 uS/cm to 200 mS/cm, Cell constant – digital 0.1 to 2.00; Temp. range – 0 to 100 oC	11,12
12	Electronic balance, with the scale range of 0.001g to 500g. pan size 100 mm;	All

S. No.	Equipment Name with Broad Specifications	Exp. S. No.
	response time 3-5 sec.; power requirement 90-250 V, 10 watt.	
13	Simple distillation unit	15

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 Electricity and Capacitance	1a. Explain working of a capacitor. 1b. Calculate the equivalent capacity and energy stored in the combination of capacitors 1c. Calculate the voltage in various components of electric circuit. 1d. Calculate the value of the given resistance using the principle of Wheatstone's bridge. 1e. Calculate the emf of the given cell using potentiometer.	1.1 Capacitors and capacitance. 1.2 Parallel plate capacitor, effect of dielectric on capacitance 1.3 Combination of capacitors, energy stored in a capacitor. 1.4 Cells, emf of cell, internal resistance of cell, Kirchoff's law. Wheatstone's bridge. 1.5 Potential gradient, potentiometer.
Unit– II Radioactivity and Ultrasonic Waves	2a. Describe the phenomenon of radioactivity with examples. 2b. Calculate half-life period of given radioactive substance. 2c. Calculate the value of the period, frequency and velocity of the given type of wave. 2d. Describe the properties of ultrasonic waves. 2e. Explain Piezo-electric effect. 2f. Explain the production of ultrasonic waves and the equipment using it. 2g. Describe the Doppler effect and the instruments using it.	2.1 Radioactivity, α , β and γ particles/ rays and their properties, 2.2 Radioactive decay law, half-life period. 2.3 Sound waves, amplitude, frequency, time - period wave-length and velocity of wave, relation between velocity, frequency and time - period of wave. 2.4 Ultrasonic waves, properties of ultrasonic waves. 2.5 Piezo-electric effect. Piezo materials: Types: Natural: Quartz, Synthetic: Gallium orthophosphate 2.6 Generation of ultrasonic waves using Piezo electric effect. 2.7 Applications of ultrasonic waves. 2.8 Doppler Effect and its applications.
Unit– III Photo electricity, X-Rays and LASERs	3a. Explain concept of photoelectric effect. 3b. Explain the working of photoelectric cell and LDR with sketches.	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.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
		3.2 Photoelectric cell and LDR: principle, working and applications.
	3c. Explain the production of X-Rays with its properties and applications.	3.3 Production of X-rays by Modern Coolidge tube, properties and applications of X-rays.
	3d. Differentiate between LASER and given colour of light	3.4 Laser, properties of laser, absorption, spontaneous and stimulated emission,.
	3e. Describe the lasing action of a typical LASER system and its applications.	3.5 Population inversion, active medium, optical pumping, three energy level system, He-Ne Laser, applications of Laser.
Chemistry		
Unit-IV Water treatment and analysis	4a. Describe the concept of hardness. 4b. Calculate the hardness of water for the given data. 4c. Describe the effects of hard water in boilers. 4d. Explain the given type of water softening process. 4e. Describe the purification of municipal water for the given process. 4f. Describe the reverse osmosis process for the given type of water. 4g. Describe the process of desalination of water.	4.1 Hardness: Types of hardness, soap solution method, EDTA method. 4.2 Effect of hard water in boilers and prevention: Boiler corrosion, caustic embrittlement, priming and foaming, scales and sludges 4.3 Water softening: Lime soda process (hot lime soda and cold lime soda process), zeolite process, ion exchange process (cation exchange and anion exchange). 4.4 Municipal water treatment: Sedimentation, coagulation, filtration and sterilization. 4.5 Waste water: Characteristics, BOD and COD, Sewage treatment, recycling of waste water. 4.6 De-salination process by reverse osmosis.
Unit –V Electrochemistry and Batteries	5a. Differentiate the electrical conductance in metals and electrolytes 5b. Identify factors affecting conductivity of the given solution. 5c. Describe construction of given electrodes. 5d. Describe the process of calculation of the strength of acid and base. 5e. Calculate specific and equivalent conductance of given electrolyte. 5f. Describe construction and working of given type of battery.	5.1 Electrical conductance in metals and electrolytes, specific conductance, equivalent conductance, cell constant. 5.2 Conductance: Nature of solute, nature of solvent, temperature, concentration or dilution. 5.3 Electrodes: Hydrogen electrode, calomel electrode and glass electrode 5.4 Conductometric Titration: 5.5 Batteries- Dry cell, alkaline battery, lead Acid storage cell and Ni-Cd battery, H ₂ -O ₂ fuel cell, Lithium ion battery.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit-VI Metals, Alloys and Insulators	6a. Describe the properties of the given metal. 6b. Select relevant thermocouple alloy for given application. 6c. Describe the properties and uses of the given insulators. 6d. Select relevant insulator for given system. 6e. Describe given techniques of unit operation.	6.1 Properties of metals like copper, aluminium, tungsten, platinum nickel. 6.2 Thermocouple alloy: Composition and characteristics of nickel alloy, platinum/rhodium, tungsten/rhenium, chromel-gold/iron. 6.3 Electrical insulators: Classification, Solid - ceramics, mica, asbestos, urea formaldehyde resin and glass. Liquid-silicon fluid, Gaseous-inert gases, hydrogen and nitrogen gas. 6.4 Types of rubber : Natural and, synthetic, processing of natural rubber. Synthetic rubber : Properties and applications of Buna-N, Thiokol, Neoprene. 6.5 Process industry unit operations: Evaporation, condensation, Distillation, Energy balance and mass balance for above processes. 6.6 Nanomaterials: Applications of Fullerenes, Graphene

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	Capacitance and current electricity	14	03	05	06	14
II	Radioactivity and ultrasonic waves	09	02	02	06	10
III	Photo electricity, X-rays and LASER	09	03	04	04	11
Chemistry						
IV	Water treatment and analysis	12	02	04	06	12
V	Electrochemistry and Batteries.	10	02	03	06	11
VI	Metals, Alloys, Insulators.	10	03	04	05	12
Total		64	64	15	22	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. Seminar on any relevant topic.
- b. 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 two 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. **Capacitors:** Prepare the models of various types of capacitors.
- b. **Current electricity:** Make one circuit with bulbs/ LED/ connected in parallel or series.
- c. **Photosensors:** Prepare working model of simple photosensor using LED.
- d. **LASER:** Prepare the presentation on the industrial application of LASER.
- e. **Water analysis:** Collect water samples from different water sources and determined the acidity, conductivity, dissolved solids, suspended particles in the sample.
- f. **Water treatment:** Collect 3 to 5 water samples from borewell and determined the dosage of bleaching powder required for its sterilization.
- g. **Water analysis:** Determine the soap foaming capacity of bore water on addition of soda ash.

- h. **Energy sources:** Prepare chart showing different types of energy sources with their advantages.
- i. **Electrolytic Cells:** Collect fruit and vegetable and prepare working model of cell.
- j. **Electric Insulators:** Collect the samples of different insulators and list their industrial applications .
- k. **Thermocouple:** Prepare chart showing different types of thermocouples with their characteristics used in electronic and electrical industry .

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; <i>et al</i>	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; <i>et al</i>	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.; <i>et al</i>	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.; <i>et al</i>	National Council of Education Research and Training, New Delhi, 2013, ISBN : 8174506713
5	Concepts of Physics Vol. -1 &2	Verma, H. C.	Bharati Bhawan, New Delhi, 2015 ISBN: 8177091875
6	Engineering Chemistry	Agarwal, Shikha	Cambridge university press ; New Delhi, 2015 ISBN : 9781107476417
7	Engineering Chemistry	Dara, S. S.	S.Chand. Publication, New Delhi, 2013, ISBN: 8121997658
8	Engineering Chemistry	Jain & Jain	Dhanpat Rai and sons; New Delhi, 2015, ISBN : 9352160002
9	Engineering Chemistry	Dr. Vairam, S.	Wiley India Pvt.Ltd. 2013 ISBN: 9788126543342
10	Chemistry for engineers	Agnihotri, Rajesh	Wiley India Pvt.Ltd. 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.physics.org
- f. www.fearofphysics.com
- g. www.sciencejoywagon.com/physicszone
- h. www.chemistryteaching.com
- i. www.visionlearning.com
- j. www.chem1.com
- k. www.onlinelibrary.wiley.com

- l. www.rsc.org
- m. www.chemcollective.org
- n. www.wqa.org
- o. www.em-ea.org

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION (MSBTE)**I – Scheme****II – Semester Course Curriculum**Course Title: **Basics of Mechanical Engineering**

(Course Code:)

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

1. RATIONALE

The electrical engineering technologists have to often use some of the basic aspects of mechanical engineering when handling different types of electrical machines such as bearings, shafts, couplings and such others. Therefore, it is essential that the electrical engineering technologists are to perform simple mechanical engineering tasks for which the basics of mechanical engineering need to be learnt. This requires the basic understanding of the of force, work, energy, materials used for making the machines, principles of motion, their transformation, and the methods of maintenance. equipment and machines, like transmission systems and others for their day-to-day working of the machines. Hence, this course has been developed to address such needs.

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 basic principles of mechanical engineering when using electrical machines.**

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:

- Use principles of force, work, and energy in the area of electrical engineering.
- Use principles of kinetics and kinematics for in the area of electrical engineering.
- Identify different mechanisms in electrical machines.
- Estimate the values of mechanical properties of materials.
- Use relevant lubricants in electrical machines.
- Select relevant mechanical transmission drives for electrical machines.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P) C	Examination Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
ESE	PA	ESE	PA					
4	-	2	6	80	20*	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.

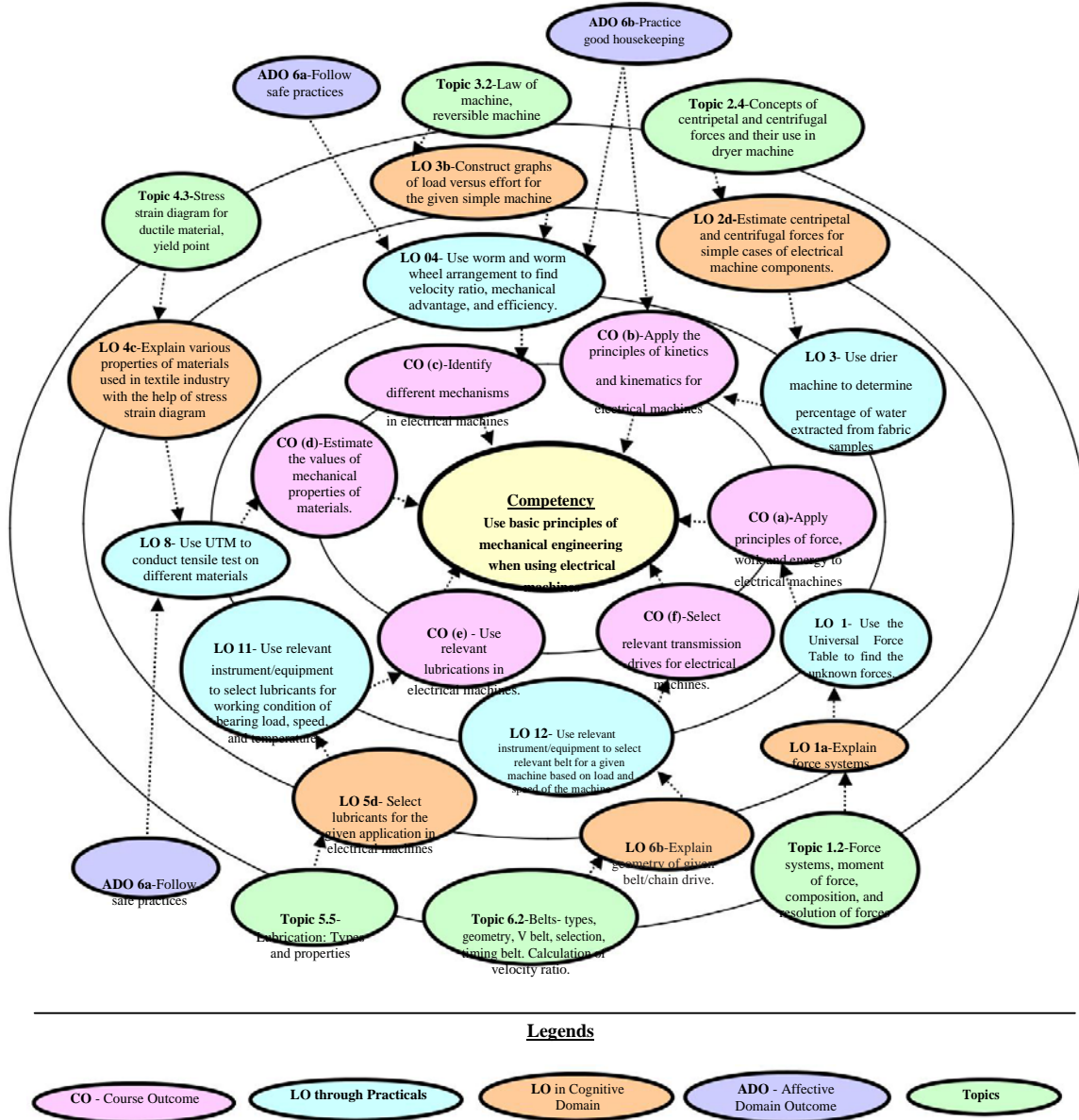


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals/exercises/tutorials in this section are psychomotor domain LOs (i.e. sub-components of the COs) 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	Use the Universal Force Table to find the unknown forces.	I	02*

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. Required
2	Use Five Steel plates of unknown weight to determine the weight of a given plate by equilibrium of co-planner, non-concurrent, non-parallel forces.	I	02
3	Use drier machine to determine percentage of water extracted from fabric samples.	II	03*
4	Use worm and worm wheel arrangement to find velocity ratio, mechanical advantage, and efficiency.	III	02*
5	Use table mounted single purchase crab and double purchase crab to find velocity ratio, mechanical advantage, and efficiency.	III	03
6	Use '2D-working model software'/similar software and related mechanism to calculate displacement, velocities and acceleration of different links.	III	04
7	Use relevant arrangement to determine strain and stress in the given spring.	IV	02*
8	Use UTM to conduct tensile test on different materials to determine the ultimate strength, yield strength, percentage elongation, and percentage reduction in area.	IV	04
9	Identify isotropic material, homogeneous material from given set of materials.	IV	02
10	Determine coefficient of friction between different surfaces like metal, wood, glass.	V	02*
11	Use relevant instrument/equipment to select lubricants for working condition of bearing load, speed, and temperature.	V	02
12	Use relevant instrument/equipment to select relevant belt for a given machine based on load and speed of the machine.	VI	02*
13	Use relevant instrument/equipment to select relevant chain for a given machine based on load and speed of the machine	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 authorities concerned.

S. No.	Equipment Name with Broad Specifications	Exp. No.
1	Universal Force Table (Consists of a circular 40 cm dia. Aluminum disc, graduated into 360 degrees.) with all accessories.	1, 2
2	Five Steel plates of unknown weight.	1, 2
3	Weights 50gm, 100gm, 200gm, 500gm, 1000gm (three pieces of each).	1, 2, 4,5,7
4	Differential axle and wheel (wall mounted unit with the wheel of 40 cm diameter and axles are in steps of 20 cm and 10 cm reducing diameter .	4, 5,
5	Worm and worm wheel (wall mounted unit with threaded spindle, load drum, effort wheel; With necessary slotted weights, hanger and thread).	4
6	Simple screw Jack (Table mounted metallic body , screw with a pitch of 5 mm carrying a double flanged turn table of 20 cm diameter.	4, 5
7	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 diameter.	5
8	Double Purchase Crab winch (Having assembly same as above but with double set of gearing arrangement)	5
9	Wooden or Acrylic working models of various popular mechanisms	4, 5, 6
10	Latest licensed networking version of '2D-working model software'/similar planar mechanism simulation software.	4, 5, 6
11	1 meter and half meter steel rules.	1 to 9
12	Helical springs (Close and open coil) of different sizes and stand.	7, 8, 9
13	Universal Testing Machine 5 Ton capacity.	7, 8, 9
14	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).	10, 11
15	Mass hanger and pointer for friction apparatus.	7, 8, 9
16	Glass strip, Wooden surface, Metallic surface for friction apparatus.	10, 11

S. No.	Equipment Name with Broad Specifications	Exp. No.
17	Working model of different drives such as gear drive, belt drive.	12, 13
18	Actual belts, chains, gears and bearings commonly used in textile industries.	12, 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 Force, Work and Energy	1a. Explain the given terms. 1b. Construct polygon of forces with the given data. 1c. Apply principles of work in the given electrical machine. 1d. Identify the application of potential energy in the given electrical machine.	1.1 Force, principle of transmissibility of force 1.2 Force systems, moment of force, composition and resolution of forces 1.3 Equilibrium and resultant of forces 1.4 Work- definition, work of force, work of couple moment 1.5 Energy- potential energy, gravitational potential energy, elastic potential energy, kinetic energy
Unit– II Kinetics and Kinematics	2a. Evaluate weight of the given substance related to the given electrical machine from its mass. 2b. Explain the given type of motion. 2c. Calculate linear and angular velocities and accelerations for the given simple case of electrical machine component. 2d. Estimate centripetal and centrifugal forces for the given simple case of electrical machine component.	2.1. Kinetics – Mass, weight, inertia, momentum, impulse. 2.2. Newton’s laws of motion. 2.3. Kinematics – linear and angular motion. 2.4. Concepts of centripetal and centrifugal forces and electric machine.
Unit– III Machines and Mechanisms	3a. Determine efficiency of the given simple machine. 3b. Construct graphs of load versus effort for the given simple machine. 3c. Suggest simple mechanisms for the given situation. 3d. Calculate velocity and acceleration of the given simple mechanism.	3.1 Machines - definition, mechanical advantage, velocity ratio, efficiency, simple numerical. 3.2 Law of machine, reversible machine, simple numerical. 3.3 Simple machines: wheel and axle, simple screw jack, worm, and worm wheel, single and double purchase crab. 3.4 Planar Mechanisms- slider crank mechanism and four bar chain mechanism.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
		3.5 Inversions of mechanism. 3.6 Use of simulation software.
Unit-IV Mechanical properties of materials.	4a. Identify stresses in the given component of the given electrical machine. 4b. Estimate stresses in the given component of given electrical machine under simple loading. 4c. Explain various properties of the given material using stress strain diagram. 4d. Calculate factor of safety in the given situation for the given data.	4.1 Simple stresses and strains – stress, strain, types of stresses, simple numerical. 4.2 Hooke's law, elastic limit, Modulus of elasticity, modulus of rigidity, ultimate stress, working stress, simple numerical. 4.3 Stress strain diagram for ductile material, yield point. 4.4 Factor of safety. 4.5 Material: Isotropic, homogeneous, and orthotropic material, their applications.
Unit –V Friction and lubrication.	5a. Evaluate coefficient of friction of the given sample. 5b. Suggest the type of bearing to be used in the given situation with justification. 5c. Select bearings for the given application in electrical industry with justification. 5d. Select lubricants for the given application in electrical industry with justification.	5.1 Concept of friction, laws of friction, types of friction, factors affecting friction, coefficient of friction 5.2 Types of bearings: journal bearing, ball bearing and roller bearing, uses of bearings in textile industry 5.3 Bearing specifications and code system and description. 5.4 Selection of bearings, criteria of selection 5.5 Lubrication: Types and properties
Unit-VI Transmissi on	6a. Select the relevant mechanical drive for the given application with justification. 6b. Explain geometry of the given type of belt/ chain drive to be used with the given type of electric motor. 6c. Explain the terminologies related to the given type of gear with sketches. 6d. Compare the construction the given two types of gear trains. 6e. Calculate the velocity ratio for the given condition.	6.1 Mechanical drives- Types. 6.2 Belts: Types, geometry, V-belt, selection, timing belt, calculation of velocity ratio. 6.3 Chains: Types, geometry, roller chain sprocket, velocity ratio. 6.4 Cams: Types of cams, types of followers, follower positions, follower shape and motion 6.5 Gears: Types and applications 6.6 Spur gear terminologies, involute tooth profile 6.7 Gear in mesh: Interference, undercutting, backlash, calculation of velocity ratio 6.8 Gear trains: simple, compound, reverted and epicyclic.

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	Force ,Work and Energy	08	02	02	03	07
II	Kinetics and Kinematics	08	01	03	04	08
III	Machines and Mechanisms	08	02	04	05	11
IV	Mechanical properties of materials	13	03	05	05	13
V	Friction and lubrication	13	03	04	08	15
VI	Transmission	14	03	05	08	16
Total		64	14	23	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 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:

- Undertake survey of lubricants used in electric machines.
- Give seminar on any relevant topic.
- Library survey regarding engineering material used for transformers.
- Prepare power point presentation or animation for showing different types of transmission drives used in electrical machines.
- Undertake a survey of different types of electric machines and mechanisms used in process industry.

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:

- Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
- '*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.
- 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).
- With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
- Guide student(s) in undertaking micro-projects.
- Demonstrate estimation of kinematic data of various mechanisms used in typical assembly line industry through 2D working model/similar software.
- Use of video, animation films to explain concepts, facts and applications related to construction and working of different transmission drives.

- h. Use real components to teach the concepts related to belts, chains, bearings, gears, V-pulley, timers, pulleys and others
- i. In respect of item 10 above, teachers need to ensure to create opportunities and provisions for such co-curricular activities.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of 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 undertaken individually 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. The concerned faculty could add similar micro-projects:

- a. **Energy:** Compile the applications of centrifugal and centripetal forces in various electric machines.
- b. **Mass and Weight:** Determine the mass and weight of different materials used in a 1 MVA distribution transformer.
- c. **Machines:** Prepare graphs of load versus effort to demonstrate efficiency of various types of motors.
- d. **Mechanisms:** Prepare models for combination of different linkages to form different mechanisms.
- e. **Materials:** Prepare chart of different materials used in 2 MVA high voltage transformer
- f. **Bearings:** Collect bearings according to the specifications and their uses in different types of electric machines.
- g. **Lubricants:** Prepare charts indicating lubricant, specification and their use in electric machines.
- h. **Belts:** Select relevant belt for different process industries using large electrical motors.
- i. **Gears:** Prepare chart displaying specifications of different gears and gearboxes used along with electrical machines.
- j. **Gear trains:** Prepare model of gear train useful for electrical machines.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1.	Machine and Mechanisms	Myszka, David H.	Pearson Education, New York, 2011, ISBN: 9780132157803
2.	Theory of Machines and Mechanisms.	Shigley, Joseph, E, Uicker, J. J. Jr., Pennock, G. R.	Oxford University Press, New York, 2011, ISBN: 9780195371239
3.	Theory of Machines and Mechanisms.	Rattan, S.S.	Tata McGraw-Hill Education, New Delhi, 2009, ISBN: 9780070144774

S. No.	Title of Book	Author	Publication
4.	Basic Electrical Engg.	Mittle, V. N.	Tata McGraw-Hill, New Delhi ISBN : 978-0-07-0088572-5
5.	Electrical Technology	Hughes, Edward	Pearson Education, New Delhi ISBN-13: 978-0582405196
6.	Strength of Materials, Vol. I: Elementary Theory and Problems	Timoshenko, S. P.	CBS Publishers, New Delhi, 2004, ISBN: 9788123910307
7.	Strength of Materials Vol. II: Advanced Theory and Problems: 2	Timoshenko, S. P.	CBS Publishers, New Delhi, 2002, ISBN: 978812 3910772
8.	Engineering Mechanics	Bhavikatti, S. S., Rajashekarappa, K. G.	New Age International, New Delhi, 1994, ISBN:9788122406177
9.	Engineering Mechanics Statics and dynamics	Shames, I. H.	Pearson Education India, New Delhi 2005, ISBN:9788177581232

14. SOFTWARE/LEARNING WEBSITES

- a. www.physicsclassroom.com/mmedia/kinema
- b. fearofphysics.com/Friction/frintro.html
- c. www.sciencejoywagon.com/physicszone
- d. www.science.howstuffworks.com
- e. phet.colorado.edu/en/simulation/forces-and-motion-basics
- f. phet.colorado.edu/en/simulation/friction
- g. www.nptel.ac.in/courses/112102015/22
- h. hperphysics.phy-astr.gsu.edu/hbase/hph.html
- i. www.mechanicalhero.com/2011/12/mechanical-drives.html
- j. physics.stackexchange.com/questions/27897/difference-b-w-kinetics-kinematics-w-concrete-example
- k. www.mecheng.iisc.ernet.in/~bobji/funtri/assign/Lubricants.htm
- l. onlinelibrary.wiley.com/subject/code/000080
- m. nptel.ac.in/courses/116102012/

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION (MSBTE)**I – Scheme****II – Semester Course Curriculum**Course Title: **Elements of Electronics**

(Course Code:)

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

1. RATIONALE

Diploma engineers have to deal with the various electronic components while maintaining various electrical systems. The study of basic operating principles and handling of various electronics devices will help them to troubleshoot electronics equipment used in electrical system. This course is developed in such a way that, students will be able to apply the knowledge to solve broad electronic engineering application problems in electrical engineering field.

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 electronic components and circuits in electrical equipment.**

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:

- Use relevant diode in different electronics circuits.
- Use diode in rectifiers and filters.
- Use BJT and FET in electronics circuits.
- Use DC regulated power supply.
- Use Transistor as an oscillator.
- Use of logic gates in electronics circuits.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
L	T	P		Theory Marks		Practical Marks		Total Marks
			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 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.

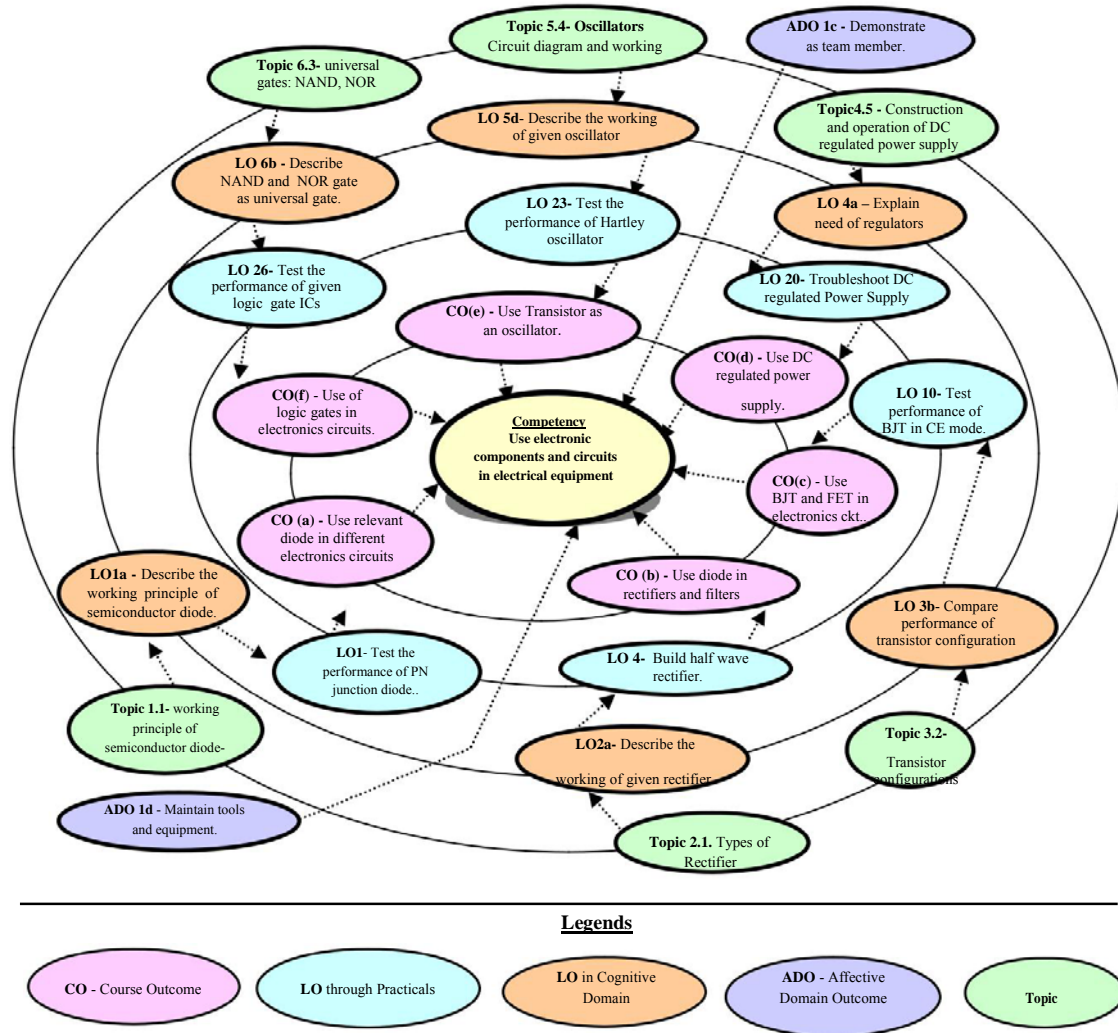


Figure 1 - Course Map

6. SUGGESTED PRACTICALS / EXERCISES

The practicals/exercises/tutorials in this section are psychomotor domain LOs (i.e. sub-components of the COs) 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	Test the performance of PN junction diode.	I	02*
2	Test the performance of zener diode	I	02
3	Test the performance of photo diode by varying the light intensity as well as distance.	I	02

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
4	Build/test half wave rectifier on breadboard.	II	02*
5	Build/ test full wave rectifier on breadboard using two diodes	II	02
6	Build/ test full wave rectifier on breadboard using four diodes	II	02
7	Use LC filter for getting minimum ripple using two diodes.	II	02
8	Use π filter for getting minimum ripple using four diodes.	II	02
9	Identify the terminals of the PNP and NPN.	III	02
10	Test the performance of BJT operated in CE mode.	III	02
11	Test the assembled BJT voltage divider bias circuit	III	02
12	Test the performance of single stage RC coupled amplifier .	III	02*
13	Test the performance of FET drain characteristics.	III	02
14	Test the performance of FET transfer characteristics.	III	02
15	Build and test zener voltage regulator for the given voltage.	IV	02
16	Test the performance of transistorized series voltage regulator	IV	02*
17	Test the performance of transistorized shunt voltage regulator	IV	02
18	Test the various blocks of regulated DC power supply.	IV	02
19	Find out faults at different stages of regulated DC power supply.	IV	02
20	Troubleshoot given DC regulated power supply.	IV	02
21	Test the performance of Regulator IC's: IC's 78XX, 79XX.	IV	02
22	Test the performance of IC 723 as Regulator.	IV	02
23	Test the performance of Hartley oscillator and Colpitt's oscillator.	V	02
24	Test the performance of Wein Bridge and Phase shift oscillator.	V	02
25	Test the performance of Crystal Oscillator.	VI	02
26	Test the performance of given logic gate ICs.	VI	02
27	Test the performance of given flip flop ICs.	VI	02
Total			54

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 judicious 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	Variable DC power supply 0- 30V, 2A, SC protection, display for voltage and current.	1,2,3,9,10,11,13,15,16,17,18,19,20,21
2	Cathode Ray Oscilloscope Dual Trace 20Mhz, 1Mega Ω Input Impedance	4,5,6,7,8,9,10,11,12,13,14, 22
3	Function Generator 0-2 MHz with Sine, square and triangular output with variable frequency and amplitude.	4,5,6,7,8,9,10,11,12,13
4	Digital Multimeter : 3 1/2 digit display, 9999 counts digital multimeter measures: V_{ac} , V_{dc} (1000V max) , A_{dc} , A_{ac} (10 amp max) , Resistance (0 - 100 M Ω) , Capacitance and Temperature measurement	All
5	Lux meter 3000 Lumen. Battery operated hand held type	3
6	Electronic Work Bench : Bread Board 840 -1000 contact points : Positive and Negative power rails on opposite side of the board , 0-30 V , 2 Amp Variable DC power supply, Function Generator 0-2MHz, CRO 0-30MHz , Digital Multimeter.	All
7	Digital IC Trainer: comprising of 0-30 V, 0-2 A, input/output switches along with LEDs, Bread Board 840 -1000 contact points, built in pulse generator.	26, 27.
8	Universal IC Tester: Test a wide range of Digital IC's such as 74 Series, 40/45 Series of CMOS IC's, Test Microprocessors 8085, 8086, Z80 Test Peripherals like 8255, 8279, 8253, 8259, 8251, 8155, 6264,62256,8288,8284.,Auto search facility of IC's,40 pin DIP ZIF sockets provided,28 Touch Key pad with numerical and functional keys 9 Digit Seven Segment Display.	26, 27.

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 Semiconductor Diode	1a. Describe the construction and working principle of the given diode. 1b. Describe characteristics and application of the given diode. 1c. Describe application of the given opto-coupler. 1d. Compare performance parameters of the given devices.	1.1 Construction, symbol, working principle, specification, applications, forward and reverse biasing and V-I characteristic of following semiconductor diodes: PN junction diode, Zener diode. 1.2 Special diodes : LED, Photodiode, LASER diode and Power diode.
Unit – II Rectifiers and Filters	2a. Describe working of the given rectifier. 2b. Compare the performance of the given rectifiers. 2c. Describe the working of the given type of filter circuit. 2d. Calculate ripple factor, PIV and efficiency of the given type of rectifier. 2e. Justify the selection of rectifier for the given application.	2.1 Types of Rectifiers: Half Wave, Full Wave Rectifier (bridge and center tapped): circuit operation I/O waveforms for voltage and current. 2.2 Parameters of rectifier: Average DC value of current and voltage ripple factor ripple frequency PIV of diode, TUF and efficiency of rectifier. 2.3 Types of Filters: Shunt capacitor, Series inductor, LC and π filter.
Unit– III Transistor	3a. Differentiate the working of the given type of transistors 3b. Compare the performance of the given transistor configurations. 3c. Explain the biasing phenomenon of the given circuit. 3d. Explain the function of the given type of amplifier. 3e. Compare the performance of the given type of amplifiers. 3f. Describe the testing procedure of the given type of amplifier. 3g. Compare the performance of the given electronic devices.	3.1 Different types of transistors: PNP, NPN 3.2 Transistor configurations: CB, CE, CC. 3.3 Transistor CE configuration: circuit diagram, input and output characteristics. Different points of characteristics (Cut-off, Active and Saturation), input resistance, output resistance, current gain. 3.4 BJT biasing: DC load line, operating point, voltage divider bias 3.5 Single Stage and multi stage CE amplifier: Circuit diagram, Function of each component, Frequency response and bandwidth. 3.6 Transistor as a switch. 3.7 Construction of FET (N-channel and P- channel), symbol, working principle and characteristics. Circuit diagram for drain and transfer characteristics,

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
		operating regions of characteristics.
Unit– IV Regulators and power supply	4a. Explain concept of the given type of regulation. 4b. Calculate output voltage of the given regulator. 4c. Describe working of the given type of transistorized regulator. 4d. Describe the working of the give type of as variable regulator.	4.1 Load and line regulation. 4.2 Basic Zener diode voltage regulator. 4.3 Transistorized series and shunt regulator - circuit diagram and working. 4.4 Regulator IC's: IC's 78XX, 79XX IC 723 as fixed, variable and Dual. Regulated DC power supply. 4.5 Construction and operation of DC Regulated power supply.
Unit– V Oscillators	5a. Explain the given type of feedback 5b. Compare the performance of the given two types of feedback. 5c. Calculate frequency of oscillations for the given data. 5d. Describe working of the given type of oscillator with circuit diagram. 5e. Compare the performance of the given two types of oscillators	5.1 Types of feedback: Positive feedback, Negative feedback. Barkhausen's criterion 5.2 Oscillator: Circuit Diagram and working of LC, RC and Crystal oscillator. 5.3 Hartley oscillator, Colpitt's oscillator, Wein Bridge and Phase shift oscillator.
Unit–VI Digital Electronics	6a. Convert the given decimal number into binary, octal and hexadecimal number system. 6b. Describe the given gate to work as universal gate. 6c. Build the given logic operations with the given types of gates 6d. Construct the given type of flip flop with sketches.	6.1 Number System: binary, octal decimal and hexadecimal number system. 6.2 Boolean algebra: Demorgans Theorem. 6.3 Logic gates: Logic symbol, logical expression and truth table of AND, OR, NOT EX-OR and EX-NOR gates. 6.4 Universal gates: NAND and NOR. 6.5 Flip flop: Symbol, truth table and working of S R, J K, M S J K, T and D Flip flop.

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	Semiconductor Diode	06	2	4	4	08
II	Rectifiers and Filters	08	2	4	6	12
III	Transistor	12	4	7	7	18
IV	Regulators and power supply	08	3	4	5	12
V	Oscillators	06	2	3	5	10
VI	Digital Electronics	08	2	4	4	10
Total		48	15	26	31	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:

- Prepare journals based on practical performed in laboratory.
- Test different diodes using CRO
- Give seminar on any relevant topic.
- Library survey regarding different data books and manuals.
- Prepare power point presentation for electronics circuits.
- Undertake a market survey of different semiconductor components.
- Trace various electronics components in electrical equipment.

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:

- Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
- '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.
- 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).
- With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
- Guide students for using data manuals.
- 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. **Diode:** Build a circuit on general purpose PCB to clip a positive half cycle at 1.5 v of a waveform with input signal 5Vpp., and prepare the report. (**Duration: 8-10 hours**)
- b. **Diode:** Build a circuit on general purpose PCB to clamp a waveform at 3.0V using diode and passive components.
- c. **Photodiode:** Build a circuit on breadboard to turn the relay on and off by using photo diode and prepare a report.
- d. **Rectifier:** Build a half wave rectifier for 6V, 500mA output current on general purpose PCB.
- e. **Rectifier:** Build a full wave bridge rectifier with capacitor filter for 6V, 500mA output current on general purpose PCB
- f. **BJT:** Build a circuit to switch on and off the LED by using BJT as switching component.
- g. **FET:** Prepare chart on comparison of specifications of FETs using data sheets of at least three FET.
- h. **FET:** Prepare a chart on FETs contains its symbol, advantages and applications. .
- i. **Voltage Regulator:** Build a circuit of DC regulated power supply on general purpose PCB for 9V and 500mA output.
- j. **Oscillator:** Build circuit to generate audio frequency.
- k. **Digital Electronics:** Build LED blinking circuit using suitable digital circuit.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Electronic Devices and Circuit Theory	Boylestead, Robert, Neshelsky, Louis	Pearson Education, New Delhi,2014, ISBN :
	Electronic Devices and Circuit: An Introduction	Mottershead, Allen	Goodyear Publishing Co. New Delhi, ISBN : 9780876202654
2	The Art of Electronics	Horowitz, Paul Hill, Winfield	Cambridge University Press, New Delhi 2015 ISBN : 9780521689175
	Basic Electronic Engineering	Baru, V., Kaduskar, R., Gaikwad S.T.	Dreamtech Press, New Delhi,2015 ISBN: 9789350040126
3	Fundamental of Electronic Devices and Circuits	Bell, Devid	Oxford University Press New Delhi, 2015, ISBN : 9780195425239
6	Electronic Devices and Circuit	Maini, Anil K.	Wiley India, New Delhi, ISBN : 9788126518951

S. No.	Title of Book	Author	Publication
7	Transistor Selector Handbook	-	Tower's International

14. SOFTWARE/LEARNING WEBSITES

- a. www.nptel.iitm.ac.in
- b. www.datasheetcafe.com
- c. www.williamson-labs.com
- d. www.futurlec.com
- e. www.bis.org.in
- f. www.learnerstv.com
- g. www.cadsoft.io
- h. www.khanacademy.

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION (MSBTE)**I – Scheme****II – Semester Course Curriculum**Course Title: **Fundamentals of Electrical Engineering**

(Course Code:)

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

1. RATIONALE

Technologists in electrical engineering are expected to handle electrical machines, instruments, devices and equipment's. Besides this, operations about power system, protection scheme and controls must be studied and developed by the students. The basic aim of this course is that, the student must learn the basic concepts, rules and laws of electric and magnetic circuits and practical's thereof. The basic concepts of electrical engineering in this course will be very useful for understanding of other higher level subjects in further study.

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 basic principles of electrical engineering in different applications.**

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:

- Determine various parameters used in electric circuit.
- Use of basic laws of electrical engineering.
- Make use of capacitor in different conditions.
- Use principles of magnetism.
- Use principles of electromagnetism.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
L	T	P		Theory Marks		Practical Marks		Total Marks
			C	ESE	PA	ESE	PA	
4	2	2	8	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.

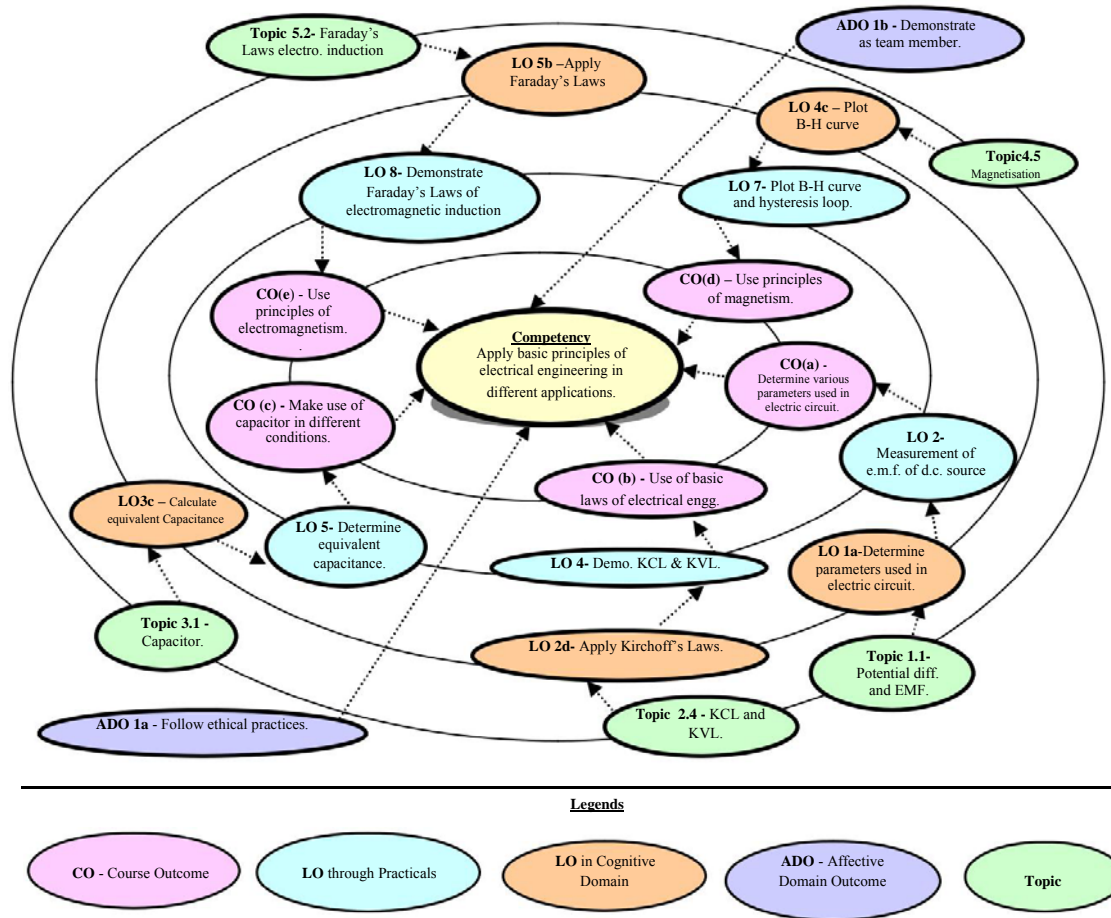


Figure 1 - Course Map

6. SUGGESTED PRACTICALS / EXERCISES

The practical's/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 in Psychomotor Domain)	Unit No.	Approx. Hrs. Required
1	Trace your electrical engineering laboratory: a. Draw layout of electrical laboratory. b. Prepare Charts of electrical safety and demonstrate the operation of fire extinguishing equipments. c. Demonstrate and use electric tools such as pliers, screw driver, insulation cutter, tester	I	02*
2	Measure of e.m.f. of d.c. source and to calculate its internal resistance by connecting it to an external load. Part I	I	02
3	Measure of e.m.f. of d.c. source and to calculate its internal resistance by connecting it to an external load. Part II	I	02

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. Required
4	Determine the equivalent resistance of Series connection.	II	02*
5	Determine the equivalent resistance of Parallel connection.	II	02
6	Use Kirchhoff's current law and Kirchhoff's voltage law to determine currents and voltages in electric circuits. Part I	II	02
7	Use Kirchhoff's current law and Kirchhoff's voltage law to determine currents and voltages in electric circuits. Part II	II	02
8	In the series connected circuits determine the equivalent capacitance.	III	02*
9	In the parallel connected circuits determine the equivalent capacitance.	III	02
10	Determine the time constant of RC circuit analytically and graphically including plotting the charging and discharging curves of a capacitor(C) through resistor (R). Part I	III	02
11	Determine the time constant of RC circuit analytically and graphically including plotting the charging and discharging curves of a capacitor(C) through resistor (R). Part II	III	02
12	For the given magnetic material find the B-H curve and hysteresis loop. Part I	IV	02*
13	For the given magnetic material find the B-H curve and hysteresis loop. Part II	IV	02
14	For the given magnetic material find the B-H curve and hysteresis loop. Part III	IV	02
15	Use Faraday's first law of electromagnetic induction to analyse the behaviors of statically induced e.m.f. and Dynamically induced e.m.f. in the given circuit. Part I	V	02*
16	Use Faraday's first law of electromagnetic induction to analyse the behaviors of statically induced e.m.f. and Dynamically induced e.m.f. in the given circuit. Part II	V	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.
- '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. No.
1	D. C. Ammeter range (0-5A), Portable analog PMMC type as per relevant BIS standard	I
2	D.C. Voltmeter Range (0-150/300V), Portable analog PMMC type as per relevant BIS standard	I
3	D.C. Voltmeter Range (0-15/30/75 V), Portable analog PMMC type as per relevant BIS standard	II
4	Rheostat (0-250 Ohm,2A), Nichrome wire wound rheostat on epoxy resin or class F insulating tube with two fixed and one sliding contact	II
5	Rheostat (0-90 Ohm,5A), Nichrome wire wound rheostat on epoxy resin or class F insulating tube with two fixed and one sliding contact	III
6	Rheostat (0-35 Ohm,10A), Nichrome wire wound rheostat on epoxy resin or class F insulating tube with two fixed and one sliding contact	IV
7	Rheostat (0-350Ohm,1.5A), Nichrome wire wound rheostat on epoxy resin or class F insulating tube with two fixed and one sliding contact	V
8	D. C. Supply, A 230 V d.c. supply (with inbuilt rectifier to convert a.c.to d.c)	V
9	Oil filled capacitor, 10 to 100 μ F Oil filled capacitor with rated voltage up to 500V	V
10	Electrolyte type capacitor, 10 to 100 μ F electrolyte capacitor with rated voltage up to 500V	V
11	Galvanometer, (50mV-0-50mV) PMMC type analog portable galvanometer	V

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 Electrical Parameters	1a. Distinguish the features of the given electric parameters. 1b. Explain the given terms. 1c. Describe the given effect of the electric current with a relevant application. 1d. Calculate work, power and energy for given circuit.	1.1 Direct Current (DC), Alternating Current (AC), Voltage Source and Current Source: Ideal and Practical. 1.2 Electric Current, Electric Potential, Potential Difference (P D), Electro-Motive-Force (EMF). 1.3 Electrical Work, Power and Energy. 1.4 Resistance, Resistivity, Conductivity, Effect of Temperature on Resistance. 1.5 Types of Resistor and their Application 1.6 Heating Effect, Magnetic Effect, Chemical Effect of Electric current.
Unit – II D.C. Circuits	2a. Apply Ohm's law to calculate internal resistance of a given circuit. 2b. Distinguish the given two parameters 2c. Calculate equivalent resistance for a given circuit. 2d. Apply Kirchhoff's laws to determine current and voltage in the given circuit.	2.1 Ohm's Law, Internal resistance of source, internal voltage drop, Terminal Voltage. 2.2 Resistance in Series, Resistance in Parallel. 2.3 Active, Passive, Linear, Non-linear Circuit, Unilateral Circuit and Bi-lateral Circuit, Passive and Active Network, Node, Branch, Loop, Mesh. 2.4 Kirchhoff's Current Law, Kirchhoff's Voltage Law.
Unit- III Capacitors	3a. Describe the construction of the given type of capacitor. 3b. Describe the working of the capacitor in given circuit. 3c. Calculate equivalent capacitance in given d.c. circuit. 3d. Plot charging and discharging curves for a given capacitor.	3.1 Capacitor, Parallel Plate Capacitor. 3.2 Various connections of capacitor. 3.3 Energy Stored in Capacitor. 3.4 Charging and Discharging of Capacitor. 3.5 Breakdown voltage and Di-electric strength. 3.6 Types of Capacitor and Application.
Unit– IV Magnetic Circuits	4a. Distinguish the given terms related to a magnetic circuit. 4b. Calculate various parameters of a given magnetic circuit. 4c. Plot B-H curve and hysteresis loop of a given magnetic materials. 4d. Compare the performance of the given series and parallel magnetic circuit.	4.1 Magnetic lines of force, flux, flux density, magnetic flux intensity. 4.2 Magneto-Motive-Forces (MMF), Ampere Turns (AT), Reluctance, Permeance, reluctivity. 4.3 Electric and Magnetic circuit: Series Magnetic and Parallel Magnetic Circuit. 4.4 Magnetization Curve (B - H Curve) 4.5 Magnetic Hysteresis, Hysteresis Loop., Applications.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit– V Electromag netic Induction	5a. Describe the use of Faraday’s laws of electromagnetic induction in the given application. 5b. Distinguish between the given type of e.m.fs. 5c. Apply Faraday’s laws to calculate induced e.m.f. in given circuit. 5d. Calculate self inductance and energy stored in magnetic field in given circuit.	5.1 Development of Induced e.m.f. and Current, Faraday’s Laws of Electromagnetic Induction. 5.2 Static and dynamic emf, Lenz’s Law, Fleming’s Right hand rule. 5.3 Self Inductance, Coefficient of Self-inductance (L), Mutual inductance, Coefficient of Mutual inductance (M), self induced e.m.f. and mutually induced e.m.f, Coefficient of Coupling. 5.4 Inductance in series. 5.5 Types of inductor, their application and Energy Stored in Magnetic Field.

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	Basic Electrical Parameters	11	02	06	04	12
II	D. C. Circuits	13	02	03	07	12
III	Capacitors	11	02	03	07	12
IV	Magnetic Circuits	13	02	04	08	14
V	Electromagnetic Induction	16	04	06	10	20
Total		64	12	24	44	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:

- Illustrate situations wherein electrical energy is required.
- Prepare models in the form of mini-projects.
- Prepare power point presentation related to basics of electrical engineering.
- Prepare a chart of electric circuit elements and relevant industrial application.
- Prepare question bank referring old MSBTE question papers.

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:

- 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 practical's, 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 Electrical equipment:** Prepare chart showing real-life examples indicating various types of electrical equipment
- b. **Resistance:** Collect photographs of resistances and prepare models of simple series circuit and parallel circuit.
- c. **Capacitance:** Collect photographs of capacitance and prepare models of simple series circuit and parallel circuit.
- d. **Inductance:** Collect photographs of inductance and prepare models of simple series circuit and parallel circuit.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	A Text Book of Electrical Technology Vol-I	Theraja, B. L. Theraja, A. K.	S.Chand and Co. New Delhi 2014 ISBN: 9788121924405
2	Basic Electrical Engg.	Mittle, V. N.	Tata McGraw-Hill, New Delhi ISBN : 978-0-07-0088572-5
3	Electrical Technology	Hughes, Edward	Pearson Education, New Delhi ISBN-13: 978-0582405196
4	Fundamentals of Electrical Engineering	Saxena, S. B. Lal	Cambridge University Press, New Delhi ISBN : 9781107464353
5	Basic Electrical and Electronics Engineering	Jegathesan, V.	Wiley India, New Delhi ISBN : 97881236529513

14. SOFTWARE/LEARNING WEBSITES

- a. www.youtube.com
- b. www.nptel.ac.in
- c. www.wikipedia.com
- d. www.electricaltechnology.org
- e. www.howstuffworks.com
- f. www.electrical4u.com

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

- Avoid communication barriers for effective business communication.
- Make the relevant use of body language to communicate.
- Use audio – visual aids to communicate effectively and efficiently.
- Develop notices, memoranda and reports in relevant formats.
- 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				
L	T	P		Theory Marks		Practical Marks		Total Marks
			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.

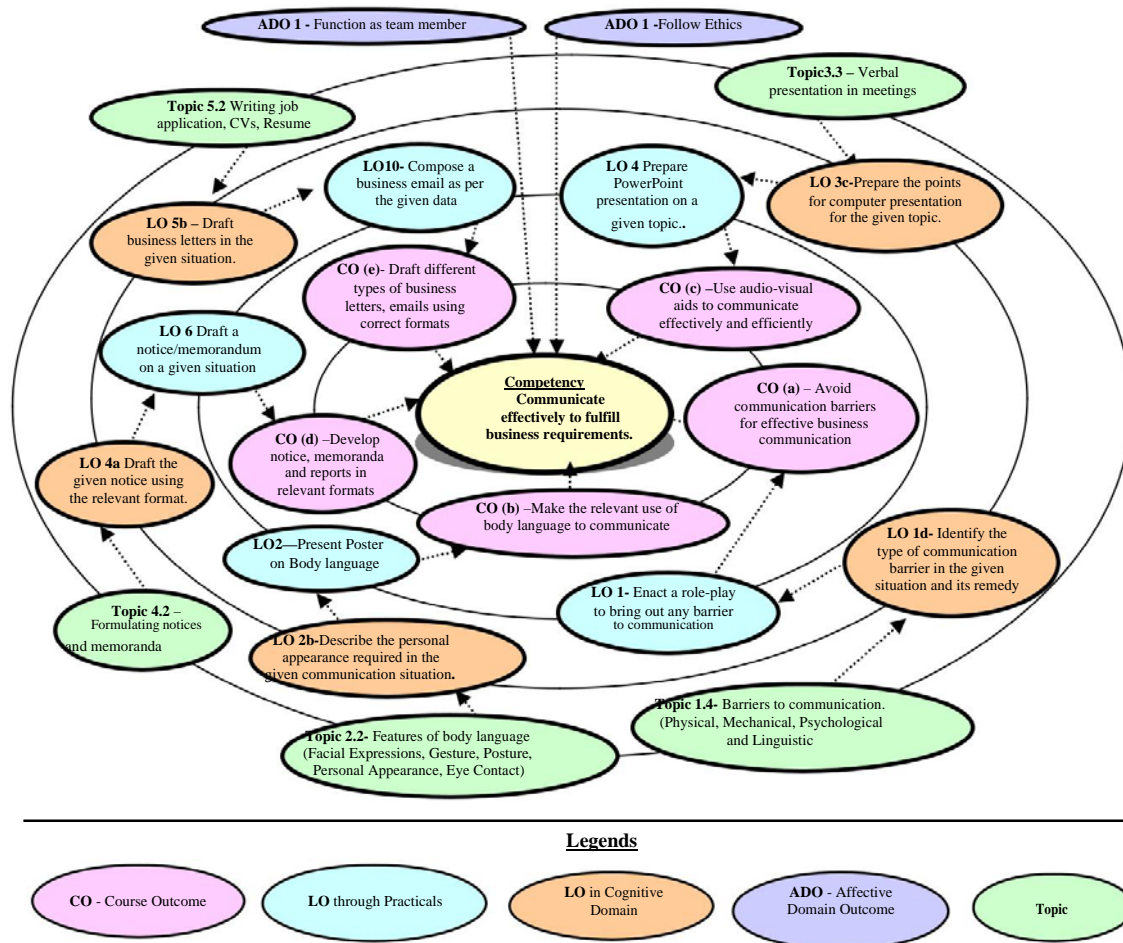


Figure 1 - Course Map

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 judicious 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:

- Maintain Cleanliness.
- Demonstrate working as a leader/a team member.
- 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 (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 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](http://www.languagelabsystem.com)
- e. www.wordsworthelt.com
- f. www.notesdesk.com
- g. <http://www.tutorialspoint.com>
- h. www.studylecturenotes.com
- i. [totalcommunicator.com](http://www.totalcommunicator.com)
- j. www.speaking-tips.com