



MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI
TEACHING AND EXAMINATION SCHEME FOR POST H.S.C. DIPLOMA COURSES.

COURSE NAME : DIPLOMA IN SURFACE COATING TECHNOLOGY

COURSE CODE : SC

DURATION OF COURSE: 6 SEMESTER

WITH EFFECT FROM 2019-20

SEMESTER : FIRST

DURATION : 16 WEEKS

PATTERN : FULL TIME - SEMESTER

SCHEME : I

S. N.	Course Title	Course Abbreviation	Course Code	Teaching Scheme			Credit (L+T+P)	Examination Scheme													Grand Total
				L	T	P		Theory						Practical							
								Exam Duration in Hrs.	ESE		PA		Total		ESE		PA		Total		
									Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	
1	English	ENG	22101	3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
2	Industrial Chemistry	ICT	24112	3	-	4	7	3	70	28	30*	00	100	40	50@	20	50	20	100	40	200
3	Resin Technology-I	BHK	24113	3	-	4	7	3	70	28	30*	00	100	40	50#	20	50	20	100	40	200
4	Pigment Technology-I	BFO	24114	3	-	4	7	3	70	28	30*	00	100	40	50#	20	50	20	100	40	200
5	Fundamentals of ICT	ICT	22001	2	-	2	4	--	--	--	--	--	--	--	25@^	10	25~	10	50	20	50
Total				14	-	16	30	--	280	--	120	--	400	--	200	--	200	--	400	--	800

Student Contact Hours Per Week: **30 Hrs.**

Medium of Instruction: **English**

Theory and practical periods of 60 minutes each.

Total Marks : **800**

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

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

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

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

- **If Candidate not securing minimum marks for passing in the "PA" part of practical of any course of any semester then the candidate shall be declared as "Detained" for that semester.**



Program Name : Diploma in Food Technology/ Diploma in Printing Technology / Diploma in Surface Coating Technology / Diploma in Travel & Tourism / Diploma in Hotel Management & Catering Technology / Diploma in Architecture Assistantship / Diploma in Medical Laboratory Technology.

Program Code : FC / PC / PN / SC / TR / HM / AA / ML

Semester : First

Course Title : English

Course Code : 22101

1. RATIONALE

English language skills have become inevitable in the era of globalization. The skills of language contribute substantially to the career of engineering profession, where almost all the service manuals, installation and commissioning manuals of the various equipment are in English and technologist has to interpret them correctly. Competency in English is need of the hour, not only for Indian industry, but also worldwide, where diploma engineers have the employable opportunity. Therefore, the basic English skills- listening, speaking, reading and writing have become almost mandatory for employability. This course is therefore designed to help the students to communicate in English effectively.

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 in English in spoken and written form effectively.**

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.
- Compose dialogues and paragraphs for different situations.
- Use relevant words as per context.
- Deliver prepared speeches to express ideas, thoughts and emotions.

4. TEACHING AND EXAMINATION SCHEME

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

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



during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.

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

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

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

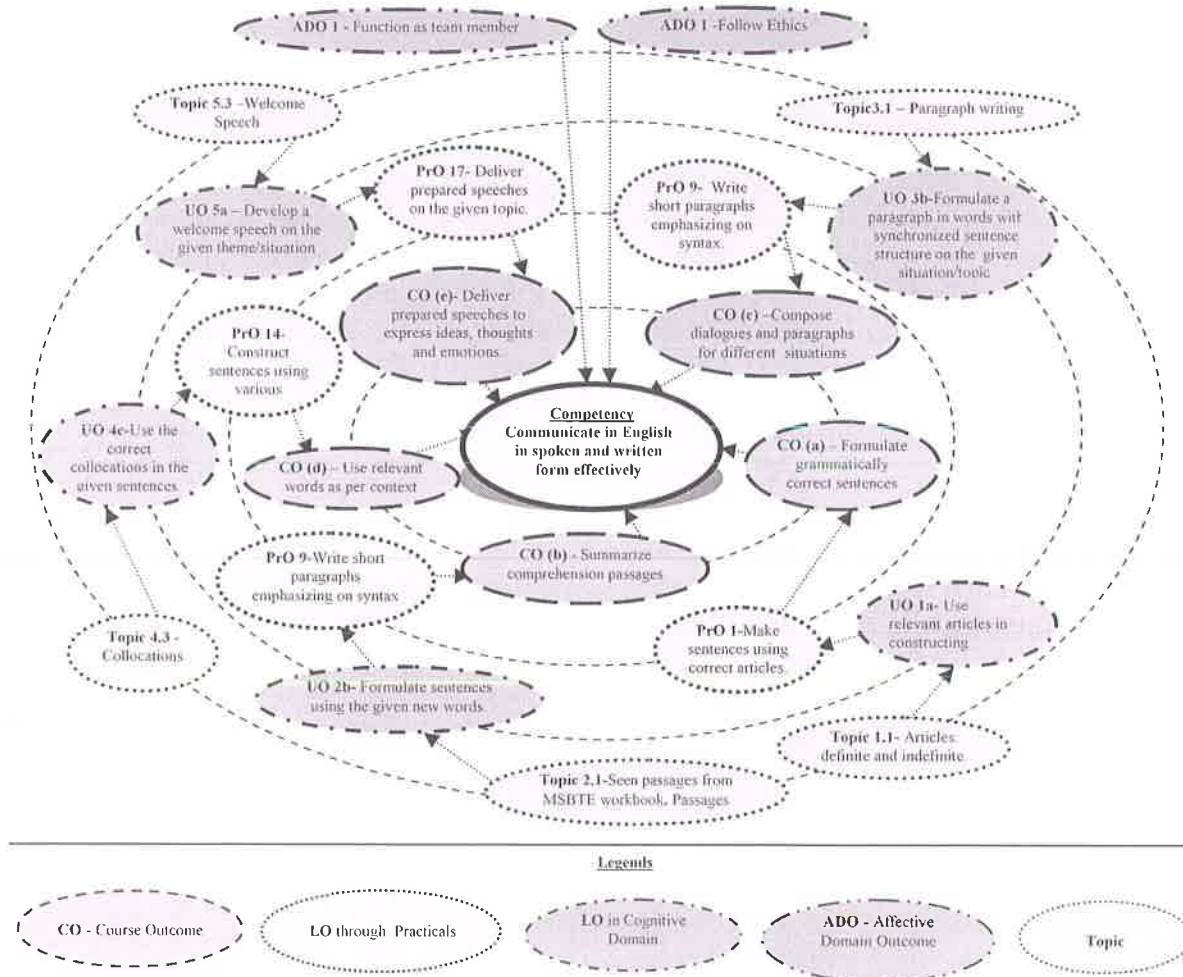


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

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

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
Use 'language laboratory' for different practical tasks			
1	Make sentences using correct articles.	I	2
2	Construct sentences using correct prepositions.	I	2*



S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
3	Formulate sentences using correct conjunctions/connectors.	I	2
4	Rewrite sentences using relevant forms of verbs.	I	2*
5	Change the voice from active to passive and vice –versa.	I	2*
6	Change the narration direct to indirect and vice –versa.	I	2*
7	Repeat words on Language Lab software after listening to them.	I	2*
8	Deliver oral presentations using correct grammar.	I	2*
9	Write short paragraphs emphasizing on syntax.	II	2*
10	Compose dialogues on various situations.	III	2
11	Enact a role play.	III	2*
12	Construct sentences using idioms.	IV	2*
13	Narrate anecdotes of various situations.	IV	2
14	Construct sentences using various collocations.	IV	2
15	Answer questions based on the given passage.	IV	2
16	Use correct pronunciations and voice modulation while reading articles from different sources.	IV	2*
17	Deliver prepared speeches on the given topic.	V	2*
18	Repeat dialogues on Language Lab software after listening to them.	V	2*
Total			36

Note

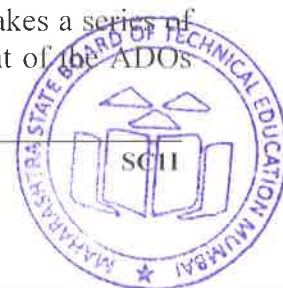
- i. A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs and competency. A judicious mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.
- ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

S.No.	Performance Indicators	Weightage in %
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

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

- a. Follow safety practices.
- b. Maintain Cleanliness.
- c. Demonstrate working as a leader/a team member.
- d. Follow ethics.

Acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs



according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

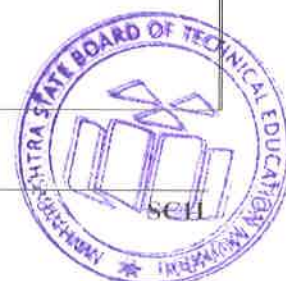
The following topics/subtopics is to be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency.

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), Graphic 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	Unit Outcomes (UOs) (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. Change the active and passive voice from the specified passage/list. 1f. Change the narration 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: Usage 1.3. Conjunctions: Coordinating and Subordinating 1.4. Types of sentences: Assertive, Imperative, Exclamatory, Interrogative 1.5. Tenses - Present Tense (Simple, Continuous, Perfect) - Past Tense (Simple, Continuous, Perfect) - Future Tense (Simple) 1.6. Active and Passive Voice 1.7. Direct and Indirect Speech



Unit	Unit Outcomes (UOs) (in cognitive domain)		Topics and Sub-topics
	Writing Skills	Speaking Skills	
Unit- II Comprehension	2a. Answer the given questions of the specified passage. 2b. Formulate sentences using the given new words 2c. Use correct syntax to construct meaningful sentences for the given situation. 2d. Answer the questions on the given unseen passage.	2e. Pronounce the words correctly in the given passage. 2f. Give oral instructions with correct pronunciation and intonation for the given situation. 2g. Answer the questions orally on the given unseen passage with correct pronunciation.	2.1 Seen Passages From Msbte Work Book 2.2 Importance Of Comprehension 2.3 Unseen Passages 2.4 Interpretation Of Passages In Written And Spoken Form
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 on 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 Types of Paragraph i. Technical ii. Descriptive iii. Narrative iv. Compare and Contrast 3.2 Dialogue Writing i. Greetings ii. Development of Dialogue iii. Closing Sentence
Unit- IV Vocabulary Building	4a. Remove the spelling errors in the given sentences/paragraph 4b. Use relevant words to correctly express for the given themes/situation. 4c. Use the collocations correctly. 4d. Construct sentences using given idioms.	4e. Speak in specified formal situations with correct pronunciation. 4f. Speak in specified informal situations with correct pronunciation. 4g. Speak sentences using relevant collocations	4.1. Rules of Spelling 4.2. Words Often Confused 4.3. Collocations 4.4. Idioms
Unit-V Speeches	5a. Develop a welcome speech on the given theme/situation. 5b. Develop a farewell speech for the given theme/situation.	5e. Introduce oneself with correct pronunciation, intonation and using verbal and non-verbal gestures. 5f. Give extempore talks	5.1. Importance of Public Speaking 5.2. Characteristics of Good Speech 5.3. Welcome Speech 5.4. Farewell Speech



Unit	Unit Outcomes (UOs) (in cognitive domain)		Topics and Sub-topics
	Writing Skills	Speaking Skills	
	5c. Formulate a speech for introducing a guest in the given situation. 5d. Develop a vote of thanks for the given situation.	with correct pronunciation, intonation and using verbal and non-verbal gestures for the given theme/ situation.	5.5. Introducing a Guest 5.6. Vote of Thanks

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above 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	12	02	04	08	14
II	Comprehension	20	05	06	13	24
III	Paragraph and Dialogue Writing	06	02	04	06	12
IV	Vocabulary Building	06	02	04	06	12
V	Speeches	04	02	02	04	08
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 UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

10. SUGGESTED STUDENT ACTIVITIES

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

- Collect good articles from newspapers and find and write the meanings of words.
- Listen to TV news.
- Read articles from magazines/newspapers.
- 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 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 PrOs, UOs and ADOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than **16 (sixteen) student engagement** hours during the course.

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

- a. Develop language games, activities, crossword puzzles enhancing word power to be used in English language.
- b. Prepare advertisement for five technical projects using contextual vocabulary.
- c. After studying standard English newspapers, prepare a booklet identifying various grammatical aspects of sentences.
- d. Prepare a booklet of the interviewing any successful person in your locality in context with his life journey, inspiration, social contribution, role model and keys to success.
- e. Prepare a booklet of the contribution of eminent Indian scientists and develop well organized paragraphs.
- f. Summarise the contents of a famous book/books.[fiction/non fiction]
- g. Prepare a collage using different idioms with their origins and their contextual usage.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	English Workbook	MSBTE	MSBTE, Mumbai, 2017
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

S. No.	Title of Book	Author	Publication
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. [language-labsystem.com](http://www.language-labsystem.com)
- e. www.wordsworthelt.com



Program Name : Diploma in Surface Coating Technology
Program Code : SC
Semester : First
Course Title : Industrial Chemistry
Course Code : 24112

1. RATIONALE

This course will help to understand the fundamentals of chemistry. Student will familiarize with raw materials and specialty chemicals and its applications in surface coating industries. It will also explain the principle of electrochemistry along with area of application in industries. Besides, another important topic of sewage and industrial waste water treatment, factors responsible for pollution and environmental protection will be deal with it.

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 the principles of industrial chemistry for characterizing the chemical materials.

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:

- Prepare solutions of various concentrations.
- List various oils used in surface coating with their properties and applications.
- Judge quality of water with justification.
- Understand principles of electrochemistry and corrosion.
- Test application properties of specialty materials.

4. TEACHING AND EXAMINATION SCHEME

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

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

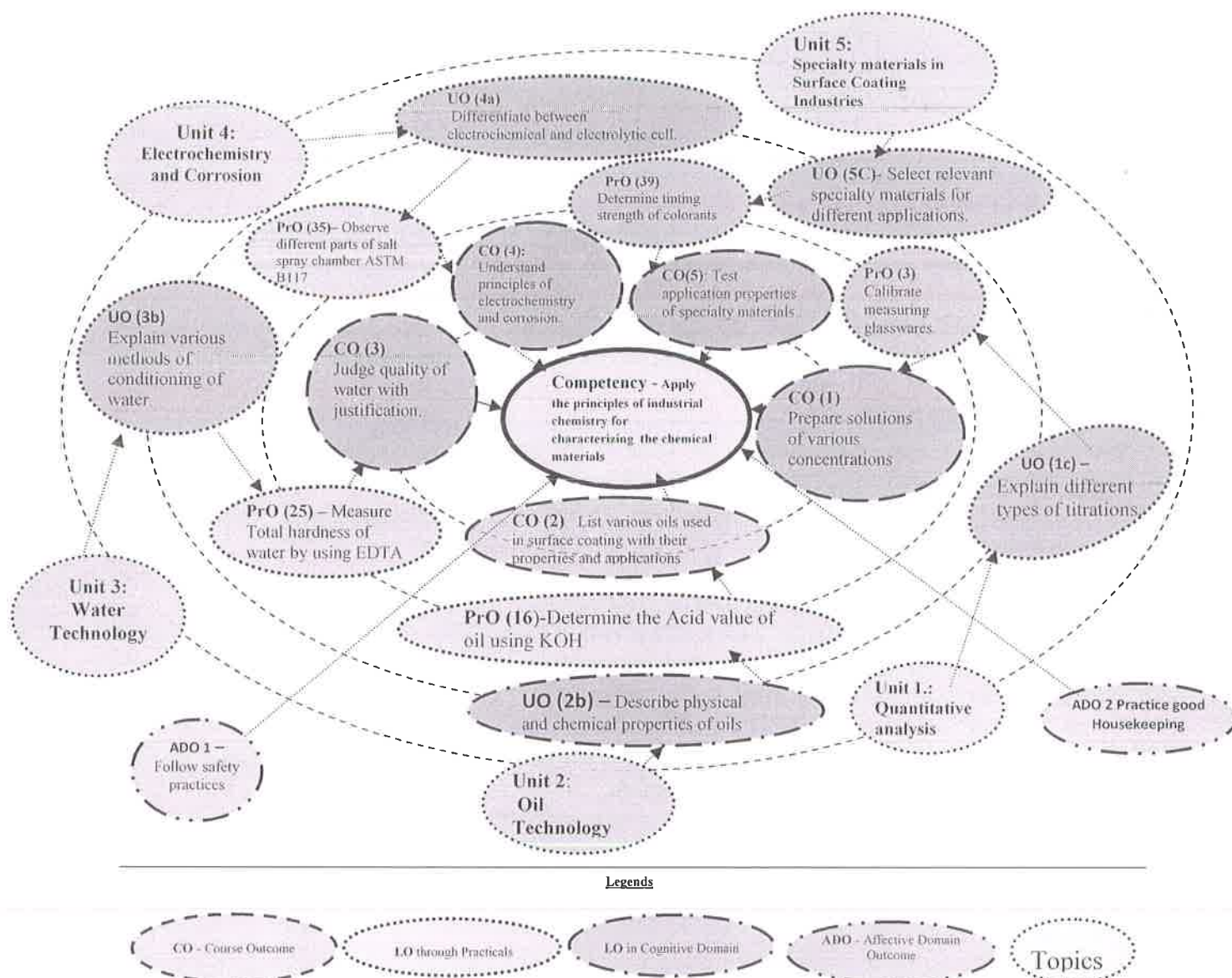
Legends: L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit, ESE - End Semester Examination; PA - Progressive Assessment

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

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



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



Legends

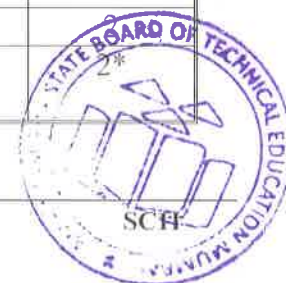


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

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

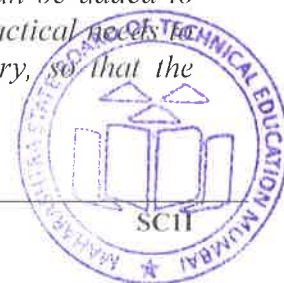
S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. Required
1	Use of personal protective equipments.	I	2
2	Identify given measuring glassware with their specifications.	I	2
3	Calibrate measuring glasswares.	I	2*
4	Prepare Phenolphthalein indicator as per given specification.	I	2
5	Prepare Methyl Orange indicator as per given specification.	I	2
6	Prepare primary standard solution using Oxalic acid as per given specification. (Part I: Preparation of reagents)	I	2*



7	Prepare primary standard solution using Oxalic acid as per given specification. (Part II: Standardization of Oxalic acid solution)	I	2*
8	Prepare primary standard solution Sodium carbonate as per given specification. (Part I: Preparation of reagents)	I	2
9	Prepare primary standard solution Sodium carbonate as per given specification. (Part II: Standardization of Sodium carbonate solution)	I	2
10	Prepare KOH solution of various normalities.	I	2*
11	Prepare NaOH solution of various normalities.	I	2
12	Prepare HCl solution of various normalities.	I	2*
13	Prepare Acetic Acid solution of various normalities.	I	2
14	Test pH of acid and alkali solutions using pH meter, pH paper and indicator	I	2*
15	Determine ash content of given compound using furnace.	I	2
16	Determine Acid value of oil using KOH	II	2*
17	Determine saponification value of oils.	II	2
18	Determine iodine value of oils using Wij's solution	II	2
19	Determine density of oils using Hydrometer	II	2
20	Determine density of oils using Weight per liter cup	II	2
21	Determine density of oils using Specific gravity Bottle	II	2*
22	Determine viscosity of oils using flow cup	II	2*
23	Determine viscosity of oils using Gardner tube viscometer.	II	2
24	Compare viscosities of oils by varying the temperature by Redwood viscometer.	II	2
25	Measure Total hardness of water by using EDTA method	III	2*
26	Measure Magnesium hardness of water by using EDTA method	III	2
27	Determine chloride content of water by silver nitrate	III	2
28	Measure Calcium hardness of water by Murexide method	III	2
29	Measure P alkalinity of water.	III	2*
30	Measure M alkalinity of water.	III	2
31	Measure Conductivity of water by conductivity meter.	III	2
32	Measure pH of Water by pH meter.	III	2
33	Prepare distilled water using simple distillation method.	III	2*
34	Verify Faraday's Law of electrochemistry	IV	2*
35	Observe different parts of salt spray chamber ASTM B117	IV	2*
36	Observe different parts of salt spray chamber IS 101	IV	2
37	Determine rate of corrosion in acidic solution	IV	2*
38	Determine adhesive strength of adhesive	V	2
39	Determine tinting strength of colorants	V	2*
40	Determine water absorptivity for water proofing materials	V	2
Total			48

Note

i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicious mix of minimum 24 or more practicals need to be performed, out of which, the practicals marked as '*' are compulsory, so that the



student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.

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

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

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

- Follow safety practices.
- Practice good housekeeping.
- Practice energy conservation.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical Practices.

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

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1	Weighing Balance (Digital , 0.01gm)	All PrOs
2	Burette (50ml)	2,3,4,5,6,7,8,9,10,11,12,13,16,17,18,25,26,27,28,29,30
3	Burette Stand	2,3,4,5,6,7,8,9,10,11,12,13,16,17,18,25,26,27,28,29,30
4	Pipette (10ml,25ml)	2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,25,26,27,28,29,30,31,32
5	Conical Flask (25 ml,50ml,250ml)	2,3,4,5,6,7,8,9,10,11,12,13,16,17,18,25,26,27,28,29,30
6	Volumetric Flask (50ml,250ml,500ml,1000ml)	2,3,4,5,6,7,8,9,10,11,12,13,16,17,18,25,26,27,28,29,30



Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1	Weighing Balance (Digital , 0.01gm)	All PrOs
7	Measuring Cylinder (10ml,100ml)	2,3,4,5,6,7,8,9,10,11,12,13,16,17,18,25,26,27,28,29,30
8	Gloss Rod (6mm Diameter)	2,4,5,6,7,8,9,10,11,12,13,16,17,18,25,26,27,28,29,30
9	Beaker (100ml,250ml,500ml,1000ml)	2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,37,40
10	Specific Gravity bottle (15ml)	21
11	pH Meter	14,32
12	Hydrometer	19
13	Weight per liter Cup (50cc,100cc)	20
14	Gardner Tube Viscometer	23
15	Furnace	15
16	Conductivity Meter	31
17	Water Condenser	33
18	Thermometer (0 ⁰ C to 110 ⁰ C)	22,24,33
19	Round Bottom Flask (500 ml)	17,33
20	Salt Spray Chamber ASTM B117	35
21	Salt Spray Chamber IS 101	36
22	Redwood Viscometer	24
23	Flow Cup B4	22
24	Stopwatch (Analogue)	22
25	Watch Glass (3")	2,4,5,6,7,8,9,10,11,12,13,16,17,18,25,26,27,28,29,30
26	Metal Panel (100mm X 150 mm)	34,37
27	Silicon Crucible	15
28	Glass Plate	39
29	Spatula	39
30	Spring Balance	38
31	Electroplating Assembly	37
32	Air Condenser	17
33	Test Tube (15 ml)	2,3,4,5,6,7,8,9,10,11,12,13,16,17,18, 25,26,27,28,29,30

8. UNDERPINNING THEORY COMPONENTS

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



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit– I Quantitative Analysis	1a. Define terms related to volumetric analysis. 1b. Describe terms related to volumetric analysis 1c. Explain different types of titrations. 1d. Calculate terms related to volumetric analysis. 1e. Explain principle of gravimetric analysis.	1.1 Basic Concepts, definition & significance of atomic weight, molecular weight & equivalent weight of materials. 1.2 Concepts of Molar solutions, Molal solutions and Normal solutions, Types of titrations. 1.3 Preparation of Solutions- Primary & Secondary Standards, Types of Indicators, Selection of Indicators, 1.4 Calculations in volumetric analysis. 1.5 Introduction and Principle of gravimetric analysis.
Unit– II Oil Technology	2a. Classify different types of oils 2b. Describe physical and chemical properties of oils. 2c. Explain drying mechanism of oil. 2d. State uses of oils in paints and varnish industries. 2e. Determine oil length of binder.	2.1 Classification of oils, 2.2 Physical and chemical properties of Oils. 2.3 Drying mechanism of Oils. 2.4 Uses of Oils in paints and Varnish industries. 2.5 Concept of oil length in binders.
Unit-III Water Technology	3a. Define conditioning, purification and softening of water. 3b. Explain various methods of conditioning of water. 3c. Describe various water pollutants. 3d. Describe sewage water treatment. 3e. State significance of IS-10500 and IS-3025	3.1 Properties & uses of water. 3.2 Conditioning, purification and softening of water. 3.3 Methods of conditioning, Ion exchange resin, demineralization, distillation process, precipitation methods, phosphate conditioning, silica, iron and oxygen removal, Municipal water purification, conditioning of seawater. 3.4 Introduction to Water Pollution and various water pollutants. Sewage water treatment. 3.5 IS-10500, IS-3025
Unit-IV Electrochemistry and Corrosion	4a. Differentiate between electrochemical and electrolytic cell. 4b. State Faraday's law of electrolysis. 4c. Define anode and cathode. 4d. State applications of electrochemistry in industries. 4e. Describe the corrosion.	4.1 Introduction to Electro chemistry. 4.2 Faraday's laws of electrolysis. 4.3 Electro chemical series, 4.4 Introduction to Anode, Cathode and their reactions. 4.5 Applications of electrochemistry in various industries. 4.6 Introduction to corrosion and effects of corrosion.



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit V: Specialty materials in Surface Coating Industries	5a. Describe types of specialty materials used in surface coating related areas. 5b. State properties of adhesives. 5c. Select relevant specialty materials for different applications.	5.1 Types of colorants. 5.2 Types, properties and applications of adhesives. 5.3 Applications of polymer in construction industries. 5.4 Introduction to sealants and underbody.

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

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Quantitative Analysis	10	02	04	08	14
II	Oil Technology	10	02	04	08	14
III	Water Technology	10	02	04	08	14
IV	Electrochemistry and Corrosion	09	02	04	08	14
V	Specialty materials in Surface Coating Industries	09	02	04	08	14
Total		48	10	20	40	70

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

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

10. SUGGESTED STUDENT ACTIVITIES

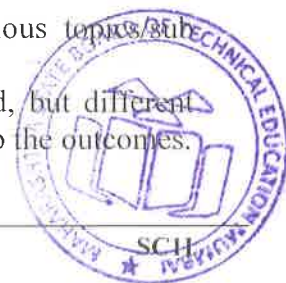
Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

1. Collect information regarding damages /consequences caused due to corrosion.
2. Collect information of various calibration methods of glasswares.
3. Visit to any paint and allied industry.
4. Visit to exhibitions and conferences.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

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



- c. About **15-20% of the topics/sub-topics** which is relatively simpler or descriptive in nature is to be given to the students for **self-directed learning** and assess the development of the COs through classroom presentations (see implementation guideline for details).
- d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for **co-curricular activities**.
- e. Guide student(s) in undertaking micro-projects.
- f. Correlate subtopics with paint and allied industry.
- g. Use Flash/Animations to explain various concepts, solutions preparations and analysis methods.
- h. Before starting practical, teacher should demonstrate the working methodology.
- i. Instructions to students regarding care and maintenance of measuring equipments.
- j. Show video/animation films to explain principles of industrial procedures.
- k. Teacher should ask the students to go through instruction and Technical manuals.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be **individually** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should **not exceed three**.

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

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

- a. Determine hardness and pH of water samples from different places.
- b. Collect information about different types of edible oil with their physio-chemical properties.
- c. Compare minerals present in potable water and waste water.
- d. Collect information on waste water treatment plant.
- e. Collect information of dust collector, scrubbing operations.
- f. Collect information regarding different equipments present in market for water purification.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Quantitative Inorganic Analysis	Arthur I. Vogel	Woolwich Polytechnic, London ISBN : 9780582463219
2	Solvents, Oils, Resins & driers	Thos H Durrans	London ISBN : 9781295455638
3	Chemical Process Industries	R. Norris Shreve	McGraw-Hill Book Company, London ISBN: 0070858144



S. No.	Title of Book	Author	Publication
4	Fundamentals of Electrochemistry	V. S. Bagotsky	John Wiley & Sons, Inc., Hoboken, New Jersey ISBN: 978-0-471-70058-6
5	Concrete Technology	Dr.R.P.Rethaliya	Charotar Publishing House Pvt. ISBN:-78-93-80358-20-8
6	Wastewater Engineering Treatment and Reuse	Metcalf and Eddy	Tata Mc-Graw Hill Publishing Company Limited New Delhi ISBN:0-07-0495394

14. SOFTWARE/LEARNING WEBSITES

- a) <https://www.youtube.com/watch?v=vRvm5zrHxjI>
- b) <https://www.youtube.com/watch?v=CWH4P2JVfcg>
- c) <https://www.youtube.com/watch?v=6qutTkJ4rO8>
- d) <https://www.youtube.com/watch?v=TjFIY9lkVAQ>
- e) <https://www.youtube.com/watch?v=gvoQdRScZWY>
- f) <https://www.youtube.com/watch?v=m8t4btjJd5Y>
- g) https://www.youtube.com/watch?v=OxhCU_jBiOA
- h) <https://www.youtube.com/watch?v=uzYVK7aa5oU>
- i) https://www.youtube.com/watch?v=J1ljxodF9_g
- j) <https://www.youtube.com/watch?v=8hvnqgN8cYg>
- k) <https://www.youtube.com/watch?v=xxNfJLMNS4E>
- l) <https://www.youtube.com/watch?v=Ag9Dym0Fwd0>
- m) <https://www.youtube.com/watch?v=OnV9kq6j3Tk>
- n) <https://www.youtube.com/watch?v=CtVNRJDj-ec>
- o) <https://www.youtube.com/watch?v=5C-yyZfDh18>
- p) <https://www.youtube.com/watch?v=wRAo-M8xBHM>
- q) <https://www.youtube.com/watch?v=6Kd0qIczD24>
- r) <https://www.youtube.com/watch?v=uPkEGAHo78o>
- s) <https://www.youtube.com/watch?v=QQL4-FOkzn4>
- t) <https://www.youtube.com/watch?v=Q7yuDJUcJ74>
- u) <https://www.youtube.com/watch?v=i4SF47hjnQ>



Program Name : Diploma in Surface Coating Technology
Program Code : SC
Semester : First
Course Title : Resin Technology-I
Course Code : 24113

1. RATIONALE

This course introduces resins as a vehicle, medium, binder, film forming material and as a polymer in surface coatings. It includes raw materials, basic chemistry, manufacturing processes, properties and applications of resins. The course explains the function of resin in a particular paint and thereby affecting the performance during paint application, post application, during life cycle of paint.

2. COMPETENCY

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

- Select relevant resins for preparation of paints and coatings.

3. COURSE OUTCOMES (COs)

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

1. Explain various polymers and polymerization techniques.
2. Select raw materials for resins.
3. State properties and applications of resins.
4. Determine physico-chemical properties of resins.
5. Select relevant resin for paints and coatings.

4. TEACHING AND EXAMINATION SCHEME

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

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

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



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

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

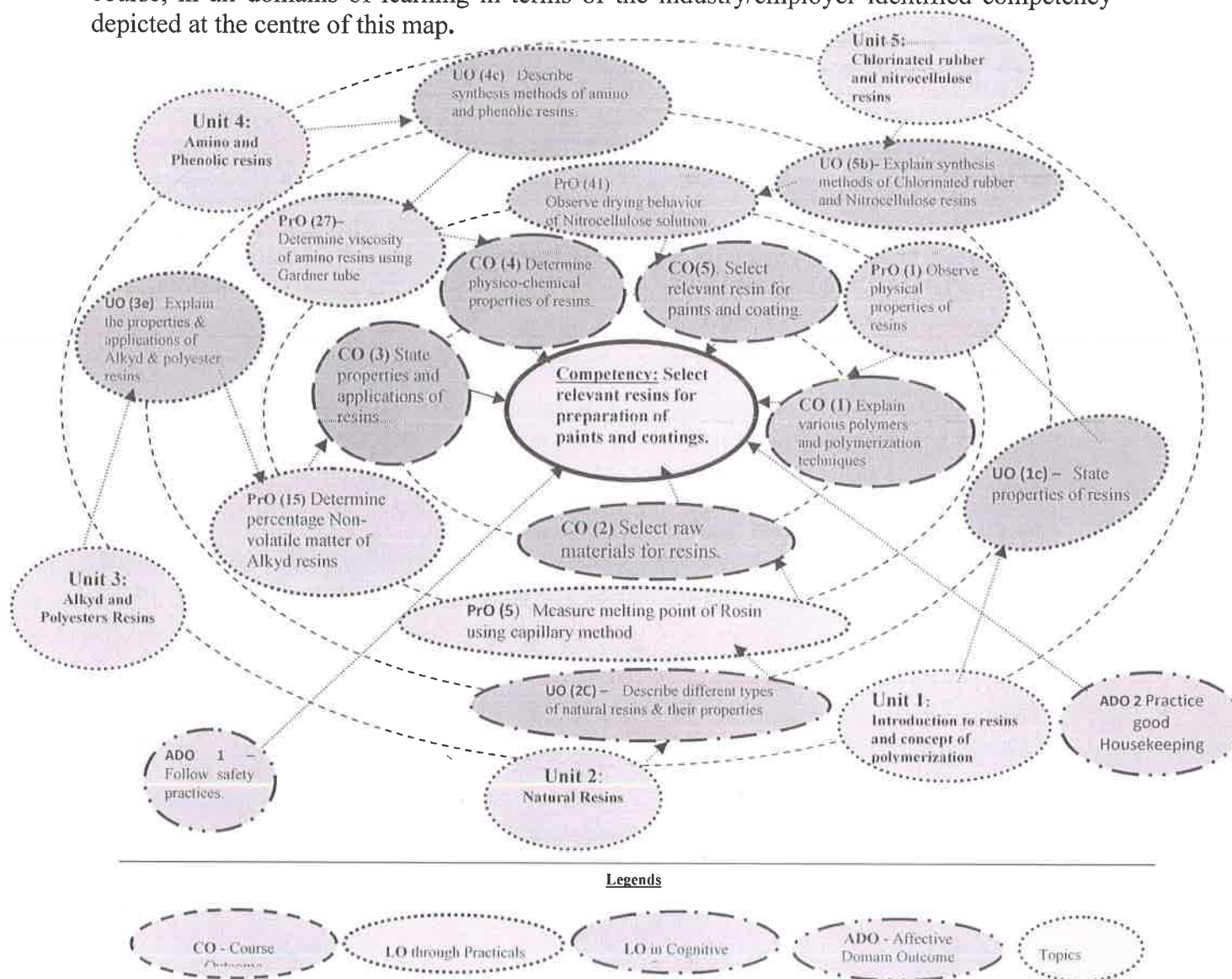


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

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

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
1	Observe physical properties of resins.	I	2*
2	Measure electrolyte stability of emulsion using acid and alkali solution.	I	2*
3	Measure viscosity of emulsion using Brookfield viscometer.	I	
4	Measure melting point of Rosin using ring and ball method.	II	
5	Measure melting point of Rosin using capillary method.	II	

6	Measure melting point of Shellac using ring and ball method.	II	2
7	Measure melting point of Shellac using capillary method.	II	2
8	Test solvent solubility of natural resin samples.	II	2
9	Determine the acid value of natural resin using KOH solution: (Part-I: Preparation and standardization of reagents)	II	2*
10	Determine the acid value of natural resin using KOH solution: (Part-II: Determination)	II	2*
11	Determine acid value of alkyd resin using KOH solution: (Part-I: Preparation and standardization of reagents)	III	2*
12	Determine acid value of alkyd resin using KOH solution: (Part-II: Determination)	III	2*
13	Determine acid value of polyester resin using KOH solution: (Part-I: Preparation and standardization of reagents)	III	2
14	Determine the acid value of polyester resin using KOH solution: (Part-II: Determination)	III	2
15	Determine percentage non-volatile matter of Alkyd resins.	III	2*
16	Determine viscosity of alkyd resins using flow cup method	III	2
17	Determine percentage non-volatile matter of polyester resins.	III	2
18	Determine viscosity of polyester resins using flow cup method	III	2*
19	Test the drying behavior of alkyd resin by varying concentration of drier.	III	2
20	Test the drying behavior of alkyd resin by varying parentage non-volatile matter.	III	2
21	Test the drying behavior of alkyd resin by varying wet film thickness.	III	2
22	Test acid, alkali resistance of alkyd resin film	III	2*
23	Test acid, alkali resistance of polyester resin film.	III	2
24	Determine the Hydroxyl value of alkyd resins. (Part-I: Preparation and standardization of Reagents)	III	2
25	Determine the Hydroxyl value of alkyd resins. (Part-II: Determination)	III	2
26	Determine viscosity of amino resins using flow cup method.	IV	2
27	Determine the viscosity of amino resins using Gardner tube viscometer.	IV	2*
28	Determine percentage non-volatile matter of amino resins.	IV	2
29	Determine melting point of solid phenolic resin using ring and ball method.	IV	2*
30	Determine melting point of solid phenolic resin using capillary method.	IV	2
31	Determine compatibility of phenolic resin with drying and nondrying oils.	IV	2
32	Determine optimum baking schedule of alkyd-amino resins with varying ratios. (Part –I: Preparation of panels)	IV	2*
33	Determine optimum baking schedule of alkyd-amino resins with varying ratios. (Part II: testing of panels)	IV	2*
34	Prepare chlorinated rubber solution.	V	2
35	Test viscosity and adhesion of chlorinated rubber film.	V	2
36	Determine percentage non-volatile matter of chlorinated rubber	V	2



	solution.		
37	Determine solubility of chlorinated rubber solution.	V	2
38	Test color and clarity of nitrocellulose solution.	V	2*
39	Determine viscosity of nitrocellulose solution.	V	2
40	Determine percentage non-volatile matter of nitrocellulose solution.	V	2
41	Observe drying behavior of Nitrocellulose solution.	V	2*
42	Observe compatibility of nitrocellulose solution with various resins.	V	2
Total			48

Note

- i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicious mix of minimum 24 or more practical needs to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.
- ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

Sr. No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment, raw materials, reagents etc.	05
b.	Setting and operation	20
c.	Safety and housekeeping	15
d.	Observations and Recording	20
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
Total		100

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

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

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

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year



- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Test tubes (15 ml capacity)	01, 02, 8, 31, 37
2	Measuring Cylinders (10 ml, 50ml 100ml)	01, 02, 08, 22, 23, 31, 34, 36, 37, 38, 42
3	Beakers (50, 100, 250 ml)	All PrOs
4	Burette (50ml, L.C.: 0.1 ml)	02, 09, 10, 11, 12, 13, 14, 24, 25
5	Conical Flasks (100 ml, 250 ml)	02,09, 10, 11, 12, 13, 14, 24, 25
6	Volumetric flask (100, 250, 500 ml)	09, 10, 11, 12, 13, 14, 24, 25
7	Brookfield Viscometer (Manual Model)	03,
8	Ring and Ball Apparatus	04,06, 29,
9	Melting Point Apparatus	05, 07, 30
10	Capillaries	05, 07, 30
11	Thermometer (0-100 and 0-360 ^o C)	04, 05, 06, 07, 16, 18, 26, 27, 29, 30, 35
12	Pipette (10 ml, 25 ml)	09, 10, 11, 12, 13, 14, 24, 25
13	Glass rod (6 mm/10 mm)	All PrOs
14	Weighing Balance (Digital Display, 300 g, Sensitivity. 0.01 g)	09, 10, 11, 12, 13, 14, 15, 17, 20, 24, 25, 28, 35, 39
15	Petri Dish (size-3")	15, 17, 20, 28, 35, 40
16	Ovens (Max temp-250 ^o C)	15, 17, 20, 28, 32, 33, 40
17	Flow Cup B-4	16, 18, 26, 35, 39
18	Stop Watch (Analogue)	16, 18, 19, 20, 21, 22, 23, 26, 27, 40, 35, 39
19	Spirit Level	16, 18, 26, 34, 38
20	Metal Panels (MS panel, 75*100*0.8mm)	19, 20, 21, 22, 23, 32, 33, 41
21	Brush (Soft Brush, 1" rectangular)	19, 20, 21, 22, 23, 32, 33, 41
22	WFT Applicators (10, 25, 50, 100 micron)	21
23	Water Condenser	24, 25
24	Gardner Tube Viscometer	27

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit- I Introducti on to resins and concept of polymeriza tion	1a. List various binders. 1b. Classify resins. 1c. State properties of resins. 1d. Write reactions of polymerization. 1e. Explain various methods of polymerization.	1.1 Concept of binders, resins and film former. 1.2 Classification of binders with examples. 1.3 Properties of resins. 1.4 Concept of polymerization. 1.5 Reactions of polymerization. 1.6 Methods of polymerization.



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit- II Natural Resins	2a. Name various sources of natural resins. 2b. List natural resins. 2c. Describe different types of natural resins & their properties 2d. State modification of natural resins. 2e. State properties & applications of natural resins. 2f. State application of varnishes. 2g. List properties and application of bituminous & hydrocarbon resins.	2.1 Introduction to natural resins and their sources. 2.2 Processing methods of natural resins. 2.3 Properties & applications of natural resins. 2.4 Modification of natural resins. 2.5 Introduction to varnishes. 2.6 Properties and applications of bituminous compounds and hydro carbon resins.
Unit-III Alkyd and Polyesters Resins	3a. Classify alkyd and polyester resins. 3b. Describe different raw materials for alkyd and polyester resins. 3c. Write esterification reactions for formation of alkyd and polyester resins. 3d. Explain manufacturing method of alkyd and polyester resin. 3e. State properties & applications of alkyd & polyester resins. 3f. Describe modifications of alkyd and polyester resins.	3.1 Introduction to alkyd resins. 3.2 Classification of alkyd resins. 3.3 Raw materials for alkyd resins. 3.4 Esterification reactions of alkyd. 3.5 Manufacturing methods of alkyd. 3.6 Properties & applications of alkyd. 3.7 Modifications of alkyd resins. 3.8 Introduction to polyester resins. 3.9 Classification of polyester resins. 3.10 Raw materials for polyester resins. 3.11 Esterification reactions of polyester. 3.12 Manufacturing methods for polyester resins. 3.13 Properties and application of polyester resin. 3.14 Significance of styrene in polyesters as a reactive diluent.
Unit -IV Amino and Phenolic resins	4a. Classify amino resins. 4b. List raw materials for amino and phenolic resins. 4c. Describe synthesis methods of amino and phenolic resin. 4d. State properties & applications of amino and phenolic resins. 4e. State significance of P: F ratio in synthesis of phenolics. 4f. Describe phenolic resins as an insulating resin. 4g. List application of phenolic resin based insulating varnishes. 4h. Differentiate amino and phenolic resins.	4.1 Introduction to amino resins. 4.2 Classifications of amino resins. 4.3 Raw materials for amino resins. 4.4 Chemistry of amino resins. 4.5 Properties and applications of amino resins. 4.6 Comparison of urea formaldehyde and melamine formaldehyde resins. 4.7 Types of phenolics. 4.8 Raw materials and reactions of phenolics. 4.9 P: F ratio and its significance. 4.10 Properties and application of Phenol Formaldehyde resins. 4.11 Modifications of phenolic resins. 4.12 Applications of phenolic resins in oleo-resinous and insulating varnishes.



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
		4.13 Comparison of amino and phenolic resins.
Unit-V Chlorinated Rubber and Nitrocellulose resins	5a. State importance of chlorinated rubber as a binder. 5b. Explain synthesis method of Chlorinated rubber and Nitrocellulose resins. 5c. State significance of dampening 5d. State properties and application of CR and NC. 5e. Describe compatibility of CR and NC with other resins. 5f. State application parameters of CR and NC.	5.1 Introduction to Chlorinated rubber (CR). 5.2 Process of Chlorination for rubber. 5.3 Properties and application of chlorinated rubber resins. 5.4 Fire retarding properties and chemical resistance of CR. 5.5 Compatibility of chlorinated rubber with other synthetic resins 5.6 Introduction to Nitrocellulose (NC). 5.7 Preparation of NC lacquers. 5.8 Properties and application of NC.

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

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to resins and concept of polymerization	08	2	4	6	12
II	Natural Resins	10	3	4	7	14
III	Alkyd and Polyesters Resins	12	3	5	10	18
IV	Amino and Phenolic resins	10	3	4	7	14
V	Chlorinated Rubber and Nitrocellulose resins	08	2	4	6	12
Total		48	13	21	36	70

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

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

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related **co-curricular** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

- Market survey of resin manufacturing industries.
- Collect standards test methods for resin testing.
- Visit to resin manufacturing plant/resin testing laboratories.
- Collect the technical paper published in various technical journals regarding new developments in resin technology.



11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

- a. Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
- b. '*L*' in item No. 4 does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
- c. About *15-20% of the topics/sub-topics* which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the COs through classroom presentations (see implementation guideline for details).
- d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
- e. Guide student(s) in undertaking micro-projects.
- f. Correlate properties and application of resins for preparation of coatings.
- g. Use relevant raw materials calculations for formulating resins systems.
- h. Use Flash/Animations to explain various reactions, manufacturing methods of resin manufacturing,
- i. Before starting practical, teacher should demonstrate the principle, working mechanism and experimental set up used for conducting practical.
- j. Instructions to students regarding care and maintenance of measuring equipments.
- k. Before starting practical, teacher should instruct various safety precaution need to take while handling instrument and chemicals,
- l. Teacher should ask the students to go through instruction, technical specifications and MSDS

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be *individually* undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should *not exceed three*.

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

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

- a. Collect data of various synthetic and natural resins with properties and application.
- b. Compare different viscometer under different condition.
- c. Collect solubility data of various resins and solvents.
- d. Collect MSDS of various reagents, chemicals and resins, used in laboratories.
- e. Collect formulating principles for various synthetic resins.
- f. Collect data of various modifications of resins with properties influenced by modification and their applications.
- g. Collect the crosslinking reaction behaviors of various resins systems.

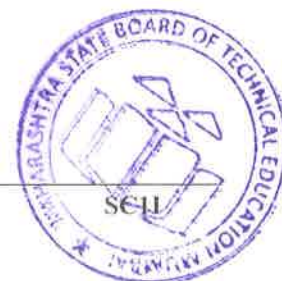


13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Outlines of Paint Technology (3rd Edition)	W. M. Morgan	CBS Publishers & Distributors Pvt. Ltd, 2000 ISBN: 9788123904306
2	Surface Coatings, Vol I: Raw Materials and Their Usage	Oil and Colour Chemists Association of Australia St (OCCA)	Chapman & Hall, 1993 ISBN: 9780412552106
3	Organic Coating Technology	H. F. Payne	John Wiley & Sons Inc (1961) ISBN: 9780471673538
4	Basics of Paints Technology Part I	V.C. Malshe and Meenal Sikchi	Antar Prakash Centre for Yoga, 2004 ISBN: 9788190329859
5	Surface Coatings: Science & Technology (2nd Edition)	Dr. Swaraj Paul	John Wiley and Sons Ltd.2014 ISBN:9788126552559
6	Modern Technology of Paints, Varnishes & Lacquers (2nd Edition)	NIIR Board	Asia Pacific Business Press Inc. 2007 ISBN: 8178330881

14. SOFTWARE/LEARNING WEBSITES

- a. <https://www.youtube.com/watch?v=M0ERRJ885GI>
- b. <https://www.youtube.com/watch?v=1vUCtP0iRM0>
- c. <https://www.youtube.com/watch?v=PfK.nvqEIkbo>
- d. <https://www.youtube.com/watch?v=KV3TBgRN6Bw>
- e. <https://www.youtube.com/watch?v=QWGD8w1e2Ww>
- f. <https://www.youtube.com/watch?v=MsZfUcagJZE>
- g. <https://www.youtube.com/watch?v=tKmSLiDBfGI>
- h. <https://www.youtube.com/watch?v=Jajxa5iCanU>
- i. <https://www.youtube.com/watch?v=dDArpD6UTcY>
- j. https://www.youtube.com/watch?v=8Z1SOOt_k2U
- k. <https://www.youtube.com/watch?v=tEro9DJYfiI>
- l. https://www.youtube.com/watch?v=C_PQ0edV3gg
- m. https://www.youtube.com/watch?v=5yvIq_Z87mA



Program Name : Diploma in Surface Coating Technology
Program Code : SC
Semester : First
Course Title : Pigments Technology - I
Course Code : 24114

1. RATIONALE

This course will give basic knowledge about pigments and their application in paints and coatings. This part- I of the course will deal only with black and white pigments and extenders. This will make the students' grasping easier as this is a new course for students. The course will include the names of pigments, processing and their properties and uses.

2. COMPETENCY

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

- Select relevant pigments for various 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:

1. Understand pigments and extenders.
2. Classify organic and inorganic pigments.
3. Select raw materials for pigments preparation.
4. Determine properties of pigments.
5. Select processes for pigment preparation.

4. TEACHING AND EXAMINATION SCHEME

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

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

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

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

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



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

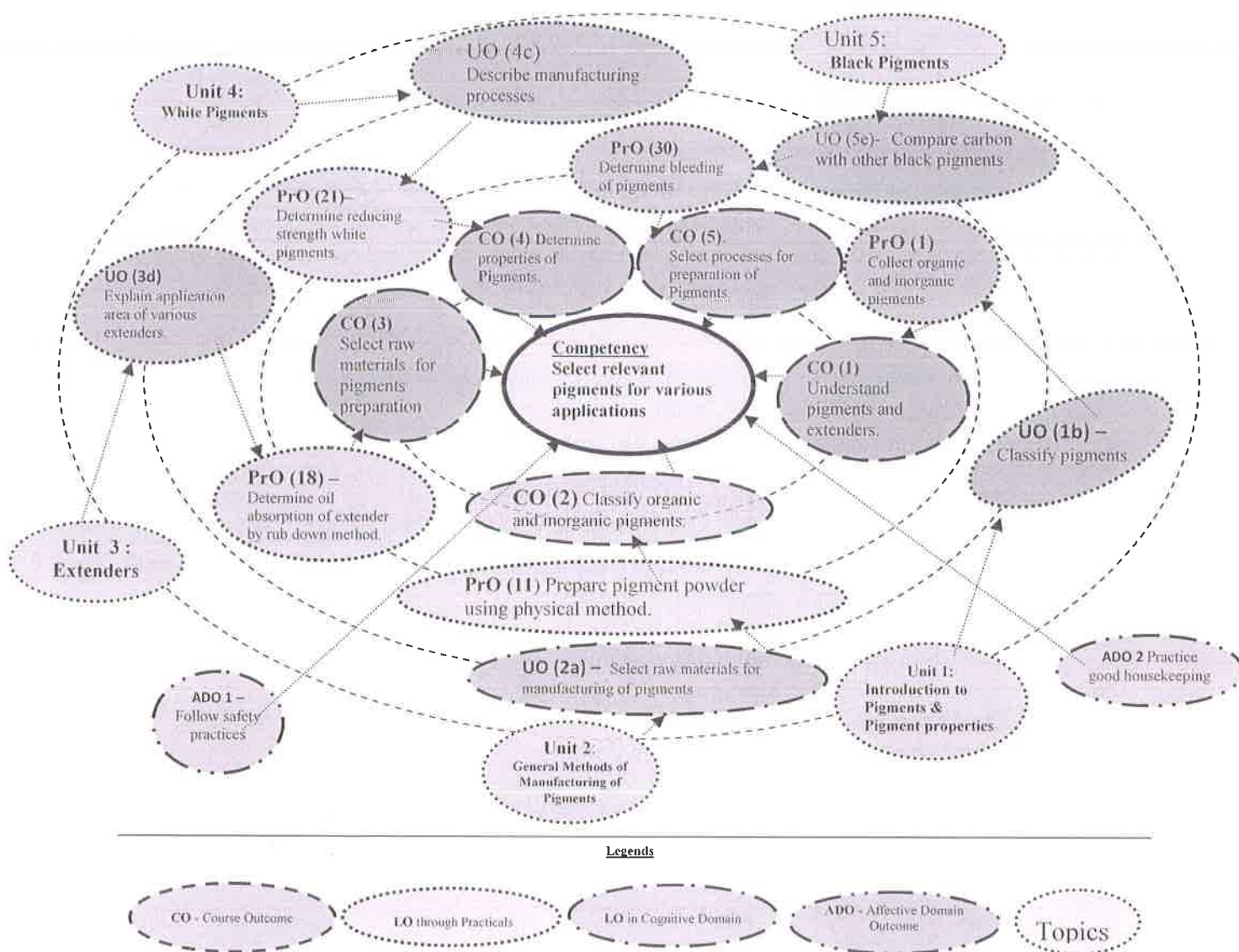


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

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

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
1	Collect organic and inorganic pigments.	I	02*
2	Identify different components of microscope.	I	02
3	Classify color of organic and inorganic pigments.	I	



4	Measure bulk density of pigment using taping method.	I	02*
5	Measure specific gravity of pigments using <i>Specific Gravity</i> bottle.	I	02*
6	Identify shape of pigments using microscope.	I	02
7	Determine oil absorption of true pigments by rub down method.	I	02*
8	Measure hiding power of true pigments using Morest chart	I	02*
9	Prepare drawdown of pigment using automatic muller.	I	02
10	Determine residue using 45-micron sieves.	II	02
11	Prepare pigment powder using physical method.	II	02*
12	Measure particle size and bulk density of prepared pigment sample	II	02*
13	Prepare barytes by chemical method.	II	02
14	Measure oil absorption and hiding power of prepared barytes sample.	II	02
15	Determine moisture content of extenders by heating method.	III	02*
16	Compare heat resistance of the pigments using oven.	III	02*
17	Test pH of extenders using water suspension method.	III	02
18	Determine oil absorption of extender by rub down method.	III	02
19	Compare hiding power of extenders and true pigments using Morest chart.	III	02*
20	Identify shape of extenders using microscope.	III	02
21	Determine reducing strength of white pigments.	IV	02*
22	Determine oil absorption of TiO ₂ .	IV	02
23	Determine oil absorption of ZnO.	IV	02
24	Determine oil absorption of Lithophone.	IV	02
25	Compare hiding power of TiO ₂ with barytes extender.	IV	02*
26	Determine acid and alkali resistance (Part I: Sample Preparation)	I/IV	02*
27	Determine acid and alkali resistance (Part II: Comparison with original)	I/IV	02*
28	Determine oil absorption of black pigments	V	02
29	Determine hiding power of black pigments	V	02*
30	Determine bleeding of pigments	V	02*
31	Determine heat resistance of black pigments	V	02
32	Determine tinting strength of black pigments	V	02
	Total		48

Note

i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicious mix of minimum 12 or more practical needs to



be performed, out of which, the practical's 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. Evaluation of pigment properties mentioned in above PrOs are based on IS 33, 34.
- iii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

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

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

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

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

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Spatula	All PrO
2	Glass Plate	All PrO
3	Weighing balance	04,05,07,08,09,10,11,12,13,14,15,17,18, 19, 21,22,23,24,25,26,27,28,29,30,31
4	Automatic Muller	09



S. No.	Equipment Name with Broad Specifications	PrO. No.
5	Puller Spatula	08, 16, 17, 19, 21, 25, 26, 27, 29, 31, 32
6	pH meter	17, 26, 27
7	Stirrer Assembly	13
8	Petri dish	01, 10, 15, 16, 17, 26, 27, 31
9	Beaker (50 ml, 100 ml)	05, 07, 08, 09, 13, 14, 16, 17, 18, 19, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 32
10	Conical Flask	17, 26, 27
11	Oven	13, 15, 16, 17, 26, 27, 31
12	Thermometer (0-100 °C, 0-360 °C range)	13, 15, 16, 17, 26, 27, 31
13	Sieve analysis set	10, 12
14	Microscope	02, 06, 20
15	Measuring Cylinder (50 CC, 100 CC)	04, 12, 26, 27
16	Conical Flask (50 ml, 100 ml)	13, 17, 26, 27
17	Sp. Gr. Bottle	05
18	Test tube set	30
19	Moisture chart	08, 14, 19, 25, 29
20	Jar mill	11
21	Glass Rod	13, 17, 20, 26, 27, 30

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit- I Introduction to Pigments & Pigment properties	1a. List the pigments. 1b. Classify pigments. 1c. List applications of pigments. 1d. Select pigments for various coatings. 1e. State physical and chemical properties of pigments.	1.1 Introduction of pigments. 1.2 Classification of Pigments. 1.3 Application of Inorganic and Organic pigments in coatings. 1.4 Difference between pigments and extenders. 1.5 General Properties, Evaluation of Pigments as per IS: 33 & 34
Unit- II General Methods of Manufacturing of Pigments	2a. Select raw materials for manufacturing of pigments. 2b. Write basic composition of different pigments. 2c. Describe the parameters affecting on the pigment's properties. 2d. Describe the various stages used in pigment manufacturing.	2.1 General methods of pigment manufacturing. 2.2 Stages Involved in the manufacturing of white Pigments. 2.3 Dry and wet Grinding techniques. 2.4 Sampling & Blending of Pigments. 2.5 Concept of aggregates, agglomerates and individual particles. 2.6 Survey of Pigment Industry in India.

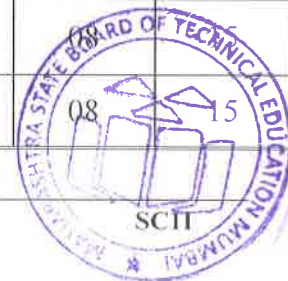


Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit-III Extenders	3a. State the source of extenders 3b. Describe the raw materials for manufacturing of various extenders 3c. Explain properties of various extenders. 3d. Explain application area of various extenders.	3.1 Properties and applications of compounds of Calcium. 3.2 Properties and applications of compounds of Magnesium. 3.3 Properties and applications of compounds of Barium. 3.4 Properties and applications of compounds of Aluminum. 3.5 Properties and applications of compounds Silicates.
Unit –IV White Pigments	4a. Write composition of white pigments. 4b. State properties of white pigments. 4c. Describe manufacturing processes. 4d. Compare properties interior & exterior pigments.	Titanium Dioxide 4.1 Introduction to TiO ₂ . 4.2 Raw material for TiO ₂ manufacturing. 4.3 General manufacturing methods. 4.4 Properties and uses of TiO ₂ 4.5 Pigment surface modification. Other white Pigments: 4.6 Composition, Properties & uses of Zinc Oxide, Zinc Phosphate. 4.7 Composition, Properties & uses of Lithopone & Antimony Oxide.
Unit-V Black Pigments	5a. List the raw material. 5b. Select methods for manufacturing. 5c. Describe various types of black pigments. 5d. Describe manufacturing process. 5e. Compare carbon with other black pigments	Organic Black Pigments: 5.1 Introduction, types, composition of black pigments. 5.2 Raw materials for pigments manufacturing. 5.3 Methods of black pigments manufacturing. 5.4 Properties and application of Black pigments. 5.5 Dispersion of black pigments. In-Organic Black Pigments: 5.6 Properties and uses of black pigments like graphite, black Iron oxide 5.7 Comparison of organic and inorganic black pigments. 5.8 Properties and application of Black pigments.

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

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to Pigments & Pigment properties	10	03	04		
II	General Methods of Manufacturing	10	03	04		



Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
	of Pigments					
III	Extenders	10	03	04	08	15
IV	White Pigments	10	03	04	08	15
V	Black Pigments	08	02	02	06	10
	Total	48	14	18	38	70

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

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

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related **co-curricular** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

- a. Prepare/Download the specifications of followings;
 - i. Physical testing methods of pigment.
 - ii. Chemical testing methods of pigment.
 - iii. Pigment manufacturing plant equipment.
- b. Visit to any pigment Industry and prepare a report consisting of
 - i. Overview of manufacturing methods.
 - ii. Plant layout.
 - iii. Various standards practices.
 - iv. Working of Effluent Treatment Plant.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

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



- i. Before starting practical, teacher should demonstrate the working procedure of practical.
- j. Instructions to students regarding care and maintenance of measuring equipments.
- k. Show video/animation films to explain functioning of various pigments.
- l. Teacher should ask the students to go through instruction and Technical manuals.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-projects are group-based. However, in the fifth and sixth semesters, it should be preferably be **individually** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups must be formed for micro-projects, the number of students in the group should **not exceed three**.

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

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

- a. Collect information of pigment industries.
- b. Collect information of pigments manufacturing processes.
- c. Compare various organic and In-Organic pigments.
- d. Collect information of surface treatment processes for pigments.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	Handbook of Synthetic Dyes and Pigments	Kishore M. Shah	Edu-tech publishing co.,1994 ISBN: 9788192666006
2	Outline of Paint Technology (3 rd Edition)	W M Morgan	CBS Publishers & Distributors Pvt. Ltd, 2000 ISBN: 9788123904306
3	Organic Coating Technology vol-II	H F Payne	John Wiley & Sons Inc, 1961 ISBN: 9780471673538
4	Basic of Paint Technology-I	V C Malshe and Meenal Sikchi	Antar Prakash Centre for Yoga,2004 ISBN: 9788190329859
5	Surface Coating Science and Technology	Dr. Swaraj Paul	John Wiley & Sons Ltd, 2007 ISBN: 9788126552559
6	Surface Coatings, Vol-I Raw Materials and Their Usage	Oil and Colour Chemists Association of Australia (OCCA)	Chapman & Hall, 1993 ISBN: 9780412552106



14. SOFTWARE/LEARNING WEBSITES

- a. <https://www.youtube.com/watch?v=Ww2QRpSG4fA>
- b. <https://www.youtube.com/watch?v=MikiTYpg2aQ>
- c. <https://www.youtube.com/watch?v=GvLkNoWjKz0>
- d. https://www.youtube.com/watch?v=lmZDtrwe_7o
- e. <https://www.youtube.com/watch?v=CtiKkJrB-ag>
- f. https://www.youtube.com/watch?v=Hqs_VqLcc0Q
- g. <https://www.youtube.com/watch?v=1B5R4ndvycQ>
- h. <https://www.youtube.com/watch?v=bdwUicNFCn8>
- i. <https://www.youtube.com/watch?v=oVaAeRjNvB0>
- j. <https://www.youtube.com/watch?v=VqSwHLpOd88>
- k. <https://www.youtube.com/watch?v=4OILhf4QuHg>
- l. <https://www.youtube.com/watch?v=QqxfgwUteoQ>
- m. <https://www.youtube.com/watch?v=s1KuwKZ4SPg>
- n. <https://www.youtube.com/watch?v=bnc0ddBMLww>
- o. <https://www.youtube.com/watch?v=8vAeV5aWK3U>
- p. <https://www.youtube.com/watch?v=x6e2CxFIVJw>
- q. <https://www.youtube.com/watch?v=AM-NrQoRIYY>
- r. <https://www.youtube.com/watch?v=U6qnDuZ0xn0>
- s. <https://www.youtube.com/watch?v=7Y0yGaT3EZQ>
- t. <https://www.youtube.com/watch?v=rsPQ8G9-GgI>
- u. https://www.youtube.com/watch?v=L1CK9bE3H_s
- v. <https://www.youtube.com/watch?v=3pMkGgrgZRM>
- w. <https://www.youtube.com/watch?v=IMF53-EwXtY>
- x. <https://www.youtube.com/watch?v=pOPg7ImWOYI>



Program Name : Diploma in Food Technology/ Diploma in Printing Technology / Diploma in Surface Coating Technology / Diploma in Travel & Tourism / Diploma in Hotel Management & Catering Technology.

Program Code : FC / PC / PN / SC / TR / HM

Semester : First

Course Title : Fundamentals of ICT

Course Code : 22001

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:

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

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
L	T	P		Theory						Practical						
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
Max	Min	Max	Min		Max	Min	Max	Min	Max	Min	Max	Min	Max	Min		
2	--	2	4	--	--	--	--	--	--	--	25@^	10	25~	10	50	20

(~¹): For the courses having **ONLY practical** examination, 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
ESE - End Semester Examination; PA - Progressive Assessment; # No theory exam



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

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

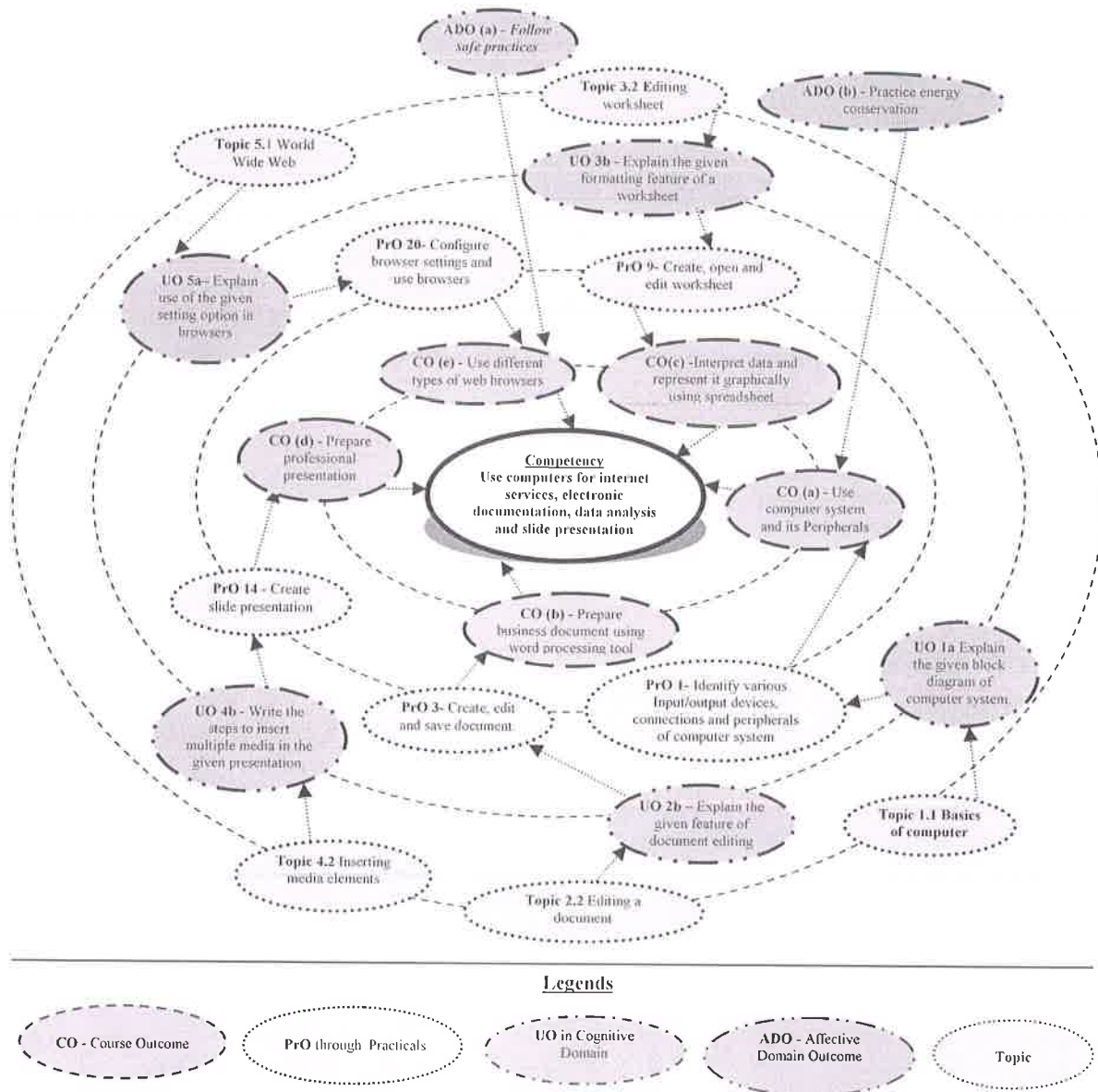


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

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

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
Computer system and Operating system:			
1	Identify various Input/output devices, connections and peripherals of computer system	1	1*

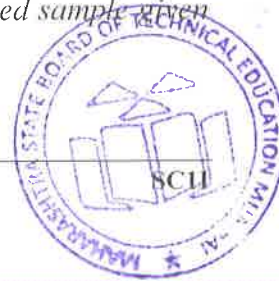


S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
2	Manage files and folders : Create, copy, rename, delete, move files and folder	I	1
Word Processing			
3	Create, edit and save document : apply formatting features on the text - line, paragraph	II	2*
4	Use bullets, numbering, page formatting	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 UOs is given in the above table, more such PrOs can be added to attain the COs and competency.
- ii. Hence, the 'Process' and 'Product' related skills associated with each PrOs 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

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

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

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

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of PrOs, 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 to 18
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 are to be taught and assessed in order to develop HOs for achieving the COs to attain the identified competency.



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



Unit	Unit Outcomes (UOs) (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 Entering 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 Shading, Sheet Options, Adjust Margins, Page</p>



Unit	Unit Outcomes (UOs) (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	Unit Outcomes (UOs) (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 UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

- Not Applicable -

10. SUGGESTED STUDENT ACTIVITIES

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

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

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

- 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
7	Computer Fundamentals	Dr. Rajendra Kawale	Devraj Publications, Dist Solapur, Maharashtra

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

Program Name : Computer Engineering Groups

Program Code : CO/CM/IF/CW

Duration of Program : 6 Semesters

With Effect From Academic Year: 2017 - 18

Semester : Second

Duration : 16 Weeks

S. N.	Course Title	Course Abbreviation	Course Code	Teaching Scheme			Credit (L+T+P)	Examination Scheme													Grand Total
				L	T	P		Theory						Practical							
								Exam Duration in Hrs.	ESE		PA		Total		ESE		PA		Total		
									Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	
1	Elements of Electrical Engineering	EEC	22215	4	-	2	6	3	70	28	30*	00	100	40	25#	10	25	10	50	20	150
2	Applied Mathematics	AMI	22224	4	2	-	6	3	70	28	30*	00	100	40	--	--	--	--	--	--	100
3	Basic Electronics	BEC	22225	3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
4	Programming in 'C'	PCI	22226	3	2	2	7	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
5	Business Communication Using Computers	BCC	22009	-	-	2	2	--	--	--	--	--	--	--	35@^	14	15~	06	50	20	50
6	Computer Peripheral and Hardware Maintenance	CPH	22013	2	-	2	4	--	--	--	--	--	--	--	50#	20	50~	20	100	40	100
7	Web Page Designing with HTML	WPD	22014	2	-	2	4	--	--	--	--	--	--	--	50@	20	50~	20	100	40	100
Total				18	4	12	34	--	280	--	120	--	400	--	210	--	190	--	400	--	800

Student Contact Hours Per Week: **34 Hrs.**

Medium of Instruction: **English**

Theory and practical periods of 60 minutes each.

Total Marks : **800**

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

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

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

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

➤ **If Candidate not securing minimum marks for passing in the "PA" part of practical of any course of any semester then the candidate shall be declared as "Detained" for that semester.**



Program Name : Computer Engineering Program Group
Program Code : CO/CM/IF/CW/IF/DE/EJ/IE/IS
Semester : Second
Course Title : Elements of Electrical Engineering
Course Code : 22215

1. RATIONALE

A technologist is expected to have some basic knowledge of electrical engineering as they have to work in different engineering fields and deal with various types of electrical machines and equipment. Hence, it is necessary to understand magnetic circuits, AC fundamentals, polyphase circuits, different types of electrical machines, their principles and working characteristics. This course deals with the basic fundamentals of electrical engineering and working principles of commonly used AC and DC motors and their characteristics. The basic concepts of electrical engineering in this course will be very useful for understanding of other higher level courses.

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 electrical equipment in industrial 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:

- Use principles of magnetic circuits.
- Use single phase AC supply for electrical and electronics equipment.
- Use three phase AC supply for industrial equipment and machines.
- Connect transformers and DC motors for specific requirements.
- Use FHP motors for diversified applications.
- Use relevant protective devices/switchgear for different requirements.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
L	T	P		Theory						Practical						
				ESE		PA		Total		ESE		PA		Total		
			Paper Hrs.	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
4	-	2	6	3	70	28	30*	00	100	40	25#	10	25	10	50	20

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

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

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

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

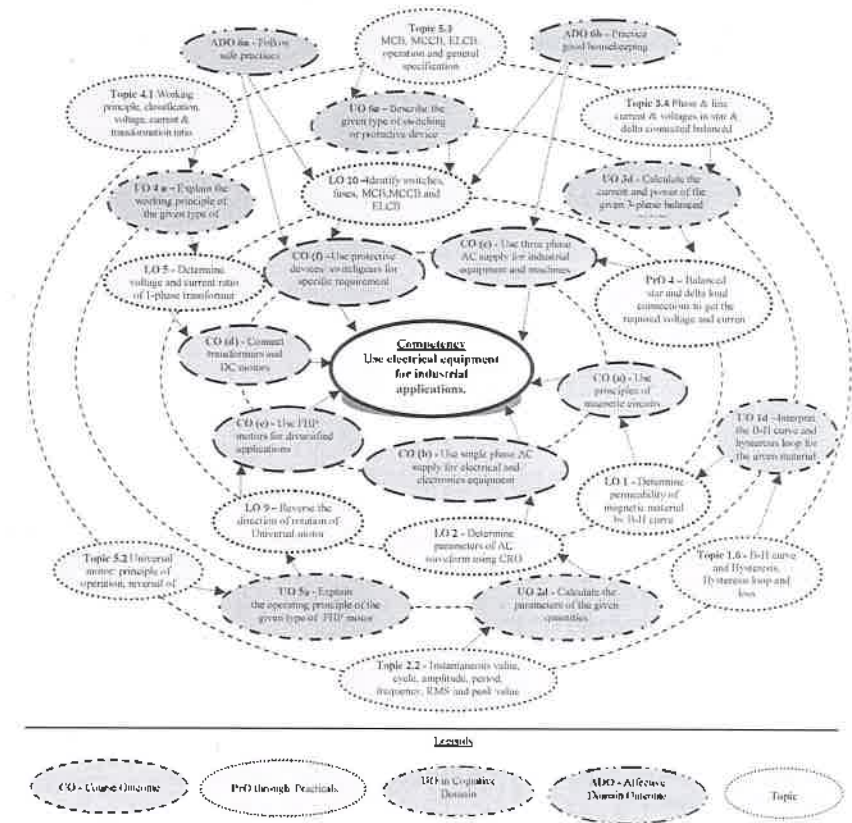


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

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

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Determine the permeability of magnetic material by plotting its B-H curve.	I	02*
2	Determine frequency, time period, peak value, rms value, peak factor and form factor of a sinusoidal A.C. waveform on C.R.O.	II	02*



S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	Part I		
3	Determine frequency, time period, peak value, rms value, peak factor and form factor of a sinusoidal A.C. waveform on C.R.O. Part II	II	02
4	Find the phase difference between voltage and current on C.R.O. for resistive, inductive and capacitive circuits. Part I	II	02
5	Find the phase difference between voltage and current on C.R.O. for resistive, inductive and capacitive circuits. Part II	II	02
6	Connect balanced star and delta load connections to get the required voltage and currents. Part I	III	02*
7	Connect balanced star and delta load connections to get the required voltage and currents. Part II	III	02
8	Determine voltage and current ratio of single phase transformer.	IV	02*
9	Operate the DC shunt motor using 3-point starter.	IV	02
10	Operate the DC shunt motor using 4-point starter.	IV	02
11	Reverse the direction of rotation of single phase induction motor.	V	02*
12	Reverse the direction of rotation of Universal motor.	V	02
13	Identify switches, fuses, switch fuse and fuse switch units, MCB, MCCB and ELCB.	VI	02
14	Connect the switches, fuses, switch fuse and fuse switch units, MCB, MCCB and ELCB in a circuit. Part I	VI	02
15	Test circuit using series lamp and multimeter.	VI	02*
16	Use the earth tester.	VI	02
17	Use the insulation tester.	VI	02
18	Use different types of digital clamp-on meters	VI	02
	Total		36

Note

- i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicious mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.
- ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

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



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

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

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

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Exp. S. No.
1	Single Phase Transformer: 1kVA, single-phase, 230/115 V, air cooled, enclosed type	1,5
2	Single phase auto transformer (Dimmerstat) - Single-Phase, Air cooled, enclosed model, Input: 0 ~ 230, 10A, Output: 0 ~ 270Volts	1,2,3,5
3	CRO - 20 MHz, Dual channel	2,3
4	Three phase Auto Transformer -15 kVA, Input 415 V, 3 phase, 50 Hz. Output 0-415 V, 30 A per Line. Cooling air natural	4
5	Loading Rheostat - 7.5 kW, 230V, 3 phase, 4 wire, Balanced load. (Each branch having equal load). Load : Wire Wound Fixed Resistors	4
6	Lamp Bank - 230 V 0-20 A	5
7	DC shunt motor coupled with DC shunt Generator	6,7
8	Single phase Induction motor - 1/2 HP, 230 V, 50 Hz, AC supply	8
9	Universal motor - 1/4 Hp	9
10	Digital Multimeter - 3 1/2 digit	Common
11	DC and AC Ammeters: 0-5-10 Amp	on
12	DC and AC Voltmeters: 0-150-300 V	
13	Tachometer: Non contact type, 0-10000 rpm	
14	Rectifier: solid state, Input- 415 V, 3-Phase, AC, Output - 230 V DC regulated, 20 Amp	

8. UNDERPINNING THEORY COMPONENTS

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



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Magnetic Circuits	1a. Describe the salient features of the given type of circuits. 1b. Apply Fleming's left hand rule and Lenz's law to determine direction of induced EMF in the given circuit. 1c. Explain the given type(s) of induced emf. 1d. Interpret the B-H curve and hysteresis loop for the given material.	1.1 Magnetic flux, flux density, magneto motive force, magnetic field strength, permeability, reluctance 1.2 Electric and magnetic circuits 1.3 Series and parallel magnetic circuits 1.4 Faraday's laws of electromagnetic induction, Fleming's right hand rule, Lenz's law 1.5 Dynamically and statically induced emf, self and mutual inductance 1.6 B-H curve and hysteresis, hysteresis loop and hysteresis loss.
Unit– II AC Fundamentals	2a. Describe the salient features of the given type of power supply. 2b. Represent the given AC quantities by phasors, waveforms and mathematical equations. 2c. Explain the response of the given pure resistive, inductive and capacitive AC circuits with sketches 2d. Calculate the parameters of the given circuit. 2e. Calculate impedance, current, power factor and power of the given AC circuit.	2.1 A.C. and D.C. quantity, advantages of A.C. over D.C. 2.2 Single phase A.C. sinusoidal A.C. wave: instantaneous value, cycle, amplitude, time period, frequency, angular frequency, R.M.S. value, Average value for sinusoidal waveform. Form factor, Peak factor 2.3 Vector representation of sinusoidal A.C. quantity, Phase angle, phase difference, concept of lagging and leading – by waveforms, mathematical equations and phasors 2.4 Pure resistance, inductance and capacitance in A.C. circuit 2.5 R-L and R-C series circuits 2.6 Impedance and impedance triangle 2.7 Power factor and its significance 2.8 Power – active, reactive and apparent, power triangle
Unit– III Polyphase AC Circuits	3a. Describe the salient features of the given type of AC power supply. 3b. Explain the concept of symmetrical system and phase sequence of the given AC supply. 3c. Distinguish the characteristics of the given type(s) of star (or delta) connections with sketches. 3d. Calculate the current and power of the given three phase	3.1 3 phase system over 1 phase system 3.2 3-phase emf generation and its wave form 3.3 Phase sequence and balanced and unbalanced load 3.4 Phase and line current, phase and line voltage in star connected and delta connected balanced system 3.5 Current, power, power factor in a 3 phase balanced system 3.6 Star and delta connections

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	balanced system.	
Unit-IV Transformer and DC Motors	4a. Explain the working principle of the given type of transformer. 4b. Distinguish the construction of the given type of transformer. 4c. Describe the construction and working of the given type of DC motor. 4d. Select relevant type of DC motor for the given application with justification.	4.1 Transformer: Working principle, emf equation, Voltage ratio, current ratio and transformation ratio, losses 4.2 Auto-transformer – comparison with two winding transformer, applications 4.3 DC motor construction - parts its function and material used 4.4 DC motor -Principle of operation 4.5 Types of D.C. motors, schematic diagram, applications of dc shunt, series and compound motors
Unit –V Fractional Horse Power (FHP) Motors	5a. Explain the working principle of the given type of FHP motor. 5b. Select relevant FHP motor for the given application with justification. 5c. Describe the procedure to connect the given type of FHP motor for the given application with sketches. 5d. Describe the procedure to connect stepper motor for the given application with sketches.	5.1 FHP: Schematic representation, principle of operation and applications of: split phase Induction motor, capacitor start induction run, capacitor start capacitor run and permanent capacitor motors, shaded pole motors 5.2 Universal motor: principle of operation, reversal of rotation and applications 5.3 Stepper motor: types, principle of working and applications
Unit-VI Protective Devices and Switchgear	6a. Describe the features of the given type of protective device. 6b. Select the relevant protective device for the given application with justification 6c. Select suitable switchgear for the given situation with justification. 6d. State the I.E. rule related to be applied for the given type of earthing with justification.	6.1 Fuse: Operation, types 6.2 Switch Fuse Unit and Fuse Switch Unit: Differences 6.3 MCB, MCCB and ELCB: Operation and general specifications 6.4 Earthing: Importance of earthing, factors affecting earthing 6.5 Methods of reducing earth resistance, I.E rules relevant to earthing

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



9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Magnetic Circuits	10	02	04	04	10
II	AC fundamentals	10	02	04	04	10
III	Polyphase AC circuits	08	02	04	04	10
IV	Transformer and DC motors	14	04	04	06	14
V	Fractional Horse Power (FHP) motors	12	04	04	06	14
VI	Protective Devices and Switchgear	10	02	04	06	12
Total		64	16	24	30	70

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

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

10. SUGGESTED STUDENT ACTIVITIES

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

- Market survey regarding commonly used electrical equipment which are not covered in the curriculum.
- Prepare power point presentation or animation for showing working of DC or AC motors.
- Undertake a market survey of different domestic electrical appliances based on the following points:
 - Manufacturers
 - Specifications/ratings
 - Salient features
 - Applications

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 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.

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

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

- Magnetic circuits:** Each batch will collect B-H curves and hysteresis loops for various types magnetic and non magnetic materials from internet. Based on the permeability and shapes of the curves, each student will decide the suitability of each material for different applications.
- Magnetic circuits:** Each batch will prepare a coil without core. Students will note the deflection of galvanometer connected across the coil for: movement of the North Pole of permanent magnet towards and away from the coil (slow and fast movement), movement of the South Pole of permanent magnet towards and away from the coil (slow and fast movement). Students will demonstrate and prepare a report based on their observations.
- AC fundamentals:** Each batch will visit a nearby sub-station or industry and observe the arrangement for power factor correction/improvement. Each batch will prepare a report based on their observation.
- Polyphase circuits:** Each batch will observe the three phase power distribution panel in their own Institute/Commercial complex/mall etc. and draw single line diagram and prepare a report.
- Transformer:** Each batch will visit nearby pole mounted sub-station and prepare a report based on the following points:
 - Rating: kVA rating, primary and secondary voltage, connections
 - Different parts and their functions
 - Earthing arrangement
 - Protective devices
- Fractional horse power motor:** Each batch will select a FHP motor for a particular application (assume suitable rating). They will visit local electrical market (if the market is not nearby you may use the Internet) and prepare a report based on the following points:
 - Manufactures
 - Technical specifications
 - Features offered by different manufacturers
 - Price range
 Then select the motor which you would like to purchase. Give justification for your selection in short.
- Each batch will visit Institute workshop and prepare a report which includes the following points:
 - Different types of prime movers used, their specifications and manufacturers
 - Method of starting and speed control



- iii. Different protective and safety devices used
 - iv. Maintenance
- h. Each batch will select any one electrical device/equipment which is not included in the curriculum and prepare a short power point presentation for the class based on the following points: construction, working, salient features, cost, merits, demerits, applications, manufacturers etc.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Electrical Technology Vol - I	Theraja, B. L.	S. Chand and Co., New Delhi, ISBN: 9788121924405
2	Electrical Technology Vol - II	Theraja, B. L.	S. Chand and Co., New Delhi, ISBN: 9788121924375
3	Basic Electrical Engineering	Mittle and Mittal	McGraw Hill, New Delhi, ISBN: 978-0-07-0088572-5
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. Scilab
- b. SIMULINK (MATLAB)
- c. PSIM
- d. P-SPICE (student version)
- e. Electronics Workbench
- f. www.nptel.iitm.ac.in
- g. www.onlinelibrary.wiley.com
- h. xiendianqi.en.made-in-china.com/
- i. ewh.ieee.org/soc/es/
- j. www.electrical-technologies.com/
- k. www.howstuffworks.com.



Program Name : Computer Engineering Program Group
Program Code : CO/CM/IF/CW
Semester : Second
Course Title : Applied Mathematics
Course Code : 22224

1. RATIONALE

The core technological studies can be understood with the help of potential of mathematics. This course is being introduced into diploma course to provide mathematical background. The course will give them the insight to understand and analyze engineering problems scientifically using calculus, integration, differential equations and numerical methods. This subject enhances the multidimensional, logical thinking and reasoning capabilities. It also improves the systemic approach in computer programming language.

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 computer related broad-based engineering problems using 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 problems of integration using suitable methods.
- Solve the concept of integration to find area and volume.
- Solve the differential equation of first order and first degree using suitable methods.
- Apply the concepts of numerical methods in computer programming languages.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme				Examination Scheme												
L	T	P	Credit (L+T+P)	Theory						Practical						
				ESE		PA		Total		ESE		PA		Total		
				Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
4	2	--	6	3	70	28	30*	00	100	40	--	--	--	--	--	--

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

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

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

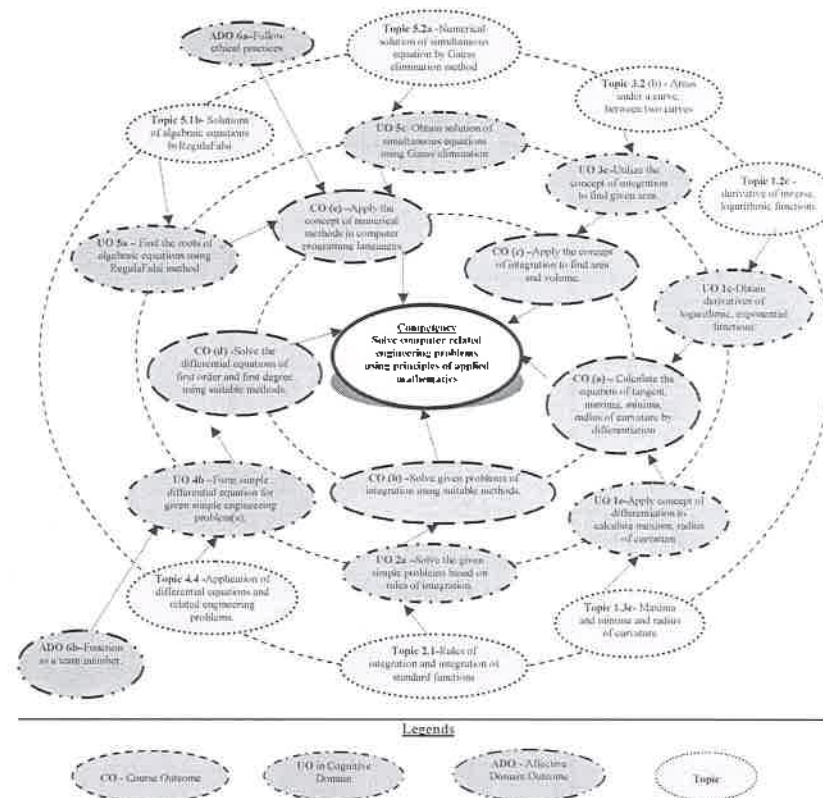
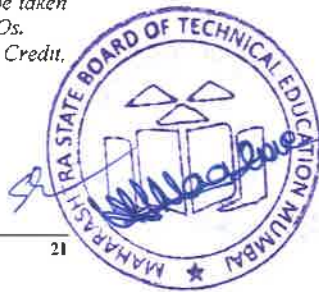


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The tutorials in this section are 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.	1	2
2	Solve problems to find derivatives of implicit function and parametric function	1	2
3	Solve problems to find derivative of logarithmic and	1	2



S. No.	Tutorials	Unit No.	Approx. Hrs. Required
	exponential functions.		
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 finding the roots of algebraic equations using Regula Falsi Method.	V	2
15	Solve problems based on finding the roots of transcendental equations using Newton Raphson's Method.	V	2
16	Solve problems based on solution of system of equations using Gauss elimination method and Gauss Seidal Method.	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 is to be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Differential Calculus	1a. Solve the given simple problems based on functions. 1b. Solve the given simple problems based on rules of differentiation. 1c. Obtain derivatives of given logarithmic, exponential functions. 1d. Apply the concept of differentiation to find equation 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, product, quotient of functions. b) Derivatives of inverse, logarithmic



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	tangent and normal for given problem. 1e. Apply the concept of differentiation to calculate maxima and minima and radius of curvature for the given problem.	and exponential functions. 1.3 Applications of derivative: a) Second order derivative without examples. b) Equation of tangent and normal c) Maxima and minima d) Radius of curvature
Unit– II Integral Calculus	2a. Solve the given simple problem(s) based on rules of integration. 2b. Obtain the given simple integral(s) using substitution method. 2c. Integrate given simple functions using the integration by parts. 2d. Evaluate the given simple integral by partial fractions.	2.1 Simple Integration: Rules of integration and integration of standard functions. 2.2 Methods of Integration: a) Integration by substitution. b) Integration by parts c) Integration by partial fractions.
Unit– III Applications of Definite Integration	3a. Solve given simple problems based on properties of definite integration. 3b. Apply the concept of definite integration to find the area under the given curve (s). 3c. Utilize the concept of definite integration to find area between given two curves. 3d. Invoke the concept of definite integration to find the volume of revolution of given surface.	3.1 Definite Integration: a) Simple examples b) Properties of definite integral (without proof) and simple examples. 3.2 Applications of integration : a) Area under the curve. b) Area between two curves. c) Volume of revolution.
Unit-IV First Order First Degree Differential Equations	4a. Find the order and degree of given differential equation(s). 4b. Form simple differential equations for given simple engineering problems 4c. Solve given differential equations using the method of variable separable. 4d. Solve the given simple problem(s) 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 –V Numerical methods	5a. Find the roots of given algebraic equations using Bisection method and Regula falsi method. 5b. Determine the roots of given nonlinear equation(s) using Newton's-Raphson method.	5.1 Solutions of algebraic equations: a. Bisection Method. b. Regula falsi Method c. Newton Raphson Method. 5.2 Numerical solutions of simultaneous equations:

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	5c. Obtain the solutions of given simultaneous equations using Gauss elimination method. 5d. Solve given system of linear equations using Jacobi's method and Gauss Seidal method.	a. Gauss elimination method b. Jacobi's Method. c. Gauss Seidal Method.

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

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Differential calculus	20	04	08	12	24
II	Integral calculus	14	02	06	08	16
III	Applications of Definite Integration	10	02	02	04	08
IV	First Order First Degree Differential Equations	08	02	02	04	08
V	Numerical Methods	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 with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

10. SUGGESTED STUDENT ACTIVITIES

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

- Identify engineering problems based on real world problems and solve with the use of free tutorials available on the internet.
- Use graphical software: EXCEL, DPLLOT, and GRAPH for related topics.
- Use Mathcad as Mathematical Tools and solve the problems of Calculus.
- Identify problems based on applications of differential equations and solve these problems.
- Prepare models to explain different concepts of applied mathematics.
- Prepare a seminar on any relevant topic based on applications of integration.
- Prepare a seminar on any relevant topic based on some Numerical methods.

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

12. SUGGESTED MICRO-PROJECTS

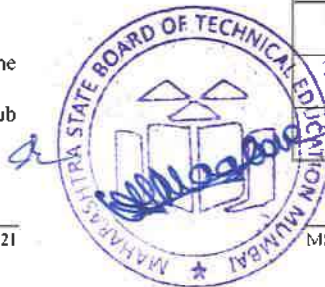
Only one micro-project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs,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

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

- Prepare models using the concept of tangent and normal to bending of roads in case of sliding of a vehicle.
- Prepare models using the concept of radius of curvature to bending of railway track.
- Prepare charts displaying the area of irregular shapes using the concept of integration.
- Prepare charts displaying volume of irregular shapes using concept of integration.
- Prepare models using the concept of differential equations for mixing problem.
- Prepare models using the concept of differential equations for radio carbon decay.
- Prepare models using the concept of differential equations for population growth.
- Prepare models using the concept of differential equations for thermal cooling.
- Write algorithm to find the approximate roots of algebraic equations.
- Write algorithm to find the approximate roots of transcendental equations.
- Write algorithm to solve system of linear equations.

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.
	Advanced Engineering Mathematics	Das, H.K.	S. Chand Publications, New Delhi, 2008, ISBN-9788121903455



S. No.	Title of Book	Author	Publication
4	Engineering Mathematics, Volume I (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.



Program Name : Computer Engineering Program Group
Program Code : CO/CM/IF/CW
Semester : Second
Course Title : Basic Electronics
Course Code : 22225

1. RATIONALE

In today's world most of the consumer appliances are based on electronic circuits and devices. The foundation for working of computer or any of its peripherals are based on electronics. This course has been designed to develop skills to understand and test simple electronic components and circuits. After studying this course students will develop an insight to identify, build and troubleshoot simple electronic circuits.

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 simple electronic circuits of computer system.

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:

- Identify electronic components in electronic circuits.
- Use diodes in different applications.
- Interpret the working of junction transistor in the electronic circuits.
- Interpret the working of unipolar devices in the electronic circuits.
- Use sensors and transducers.

4. TEACHING AND EXAMINATION SCHEME

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

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

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



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

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

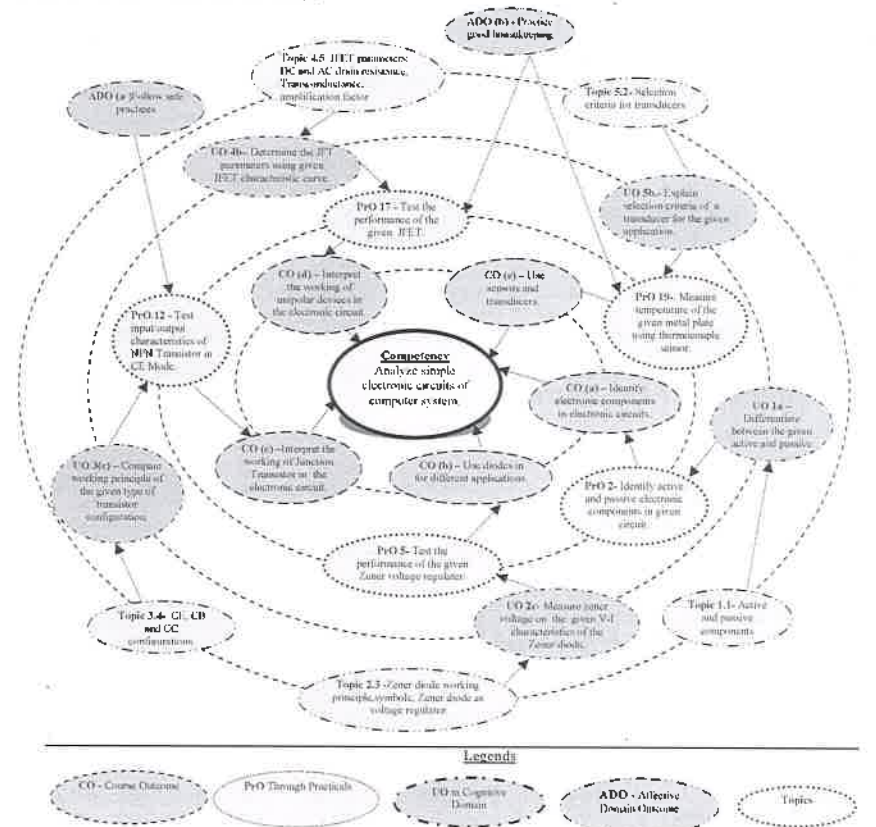


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

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

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Measure amplitude, time period and frequency of sine wave and square wave using CRO.	I	02*
2	Identify active and passive electronic components in the given	I	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	circuit.		
3	Test the performance of the given PN junction diode.	II	02*
4	Test the performance of the given Zener diode.	II	02
5	Test the performance of the given Zener voltage regulator.	II	02
6	Convert AC signal into DC signal using Half wave rectifier.	II	02
7	Convert AC signal into DC signal using full wave rectifier	II	02
8	Use filters to get regulated DC.	II	02
9	Convert AC signal into DC signal through Bridge rectifier.	II	02
10	Test the performance of the given Bridge rectifier using filter.	II	02
11	Test input/output characteristics of NPN Transistor in CE Mode.	II	02
12	Test input/output characteristics of NPN Transistor in CB Mode.	III	02*
13	Test input/output characteristics of NPN Transistor in CC Mode.	III	02
14	Determine gain and bandwidth of Single stage RC coupled amplifier.	III	02
15	Determine gain and bandwidth of 2 stage RC coupled amplifier.	III	02
16	Test the performance of the given JFET & Determine the characteristics parameter of the given JFET.	III & IV	02*
17	Measure temperature of the given metal plate using thermocouple sensor.	IV	02
18	Test the performance of the given circuit consist of photoelectric sensor.	V	02*
	Total		36

Note

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

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

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

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

- Follow safety practices.
- Practice good housekeeping.



- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical practices.

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

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Exp. S.No.
1	Single/Dual regulated Power supply(0 to 15Volts)	3-18
2	Digital multimeter, 3 and ½ digit, separate range for resistances and capacitance, component tester, AC and DC measurement.	3 – 20
3	Dual trace CRO/DSO, 50MHz, with function generator and component tester.	1,4-18
4	Function generator, 20MHz.	1,4-18
5	Trainer kits / breadboard for Rectifiers, regulator, Transistors, JFET and RC coupled single / two stage amplifiers.	4-18
6	Heater, Thermocouple and photoelectric sensor	19,20

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Electronic Components and Signals	1a. Differentiate between the given active and passive electronic components. 1b. Calculate value of the given resistor and capacitor using colour code. 1c. Compare the characteristics of the given voltage and current source. 1d. Interpret with sketches the given signal.	1.1 Active and passive components 1.2 Resistor, capacitor, inductor symbols, working principles, applications, colour codes, specifications. 1.3 Voltage and Current Source 1.4 Signal waveform, Time and frequency domain representation, Amplitude, Frequency, Phase, Wavelength 1.5 Types of Signals: sinusoidal, triangular and square 1.6 Integrated Circuits – analog and digital.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit– II Diodes and Their Applications	2a. Explain with sketches working of the given diode using V-I characteristics. 2b. Measure zener voltage on the given V-I characteristics of the zener diode. 2c. Describe with sketches the working principle of given type of filter. 2d. Compare the salient features of the given type of rectifiers.	2.1 Symbol, construction and working principle of P-N junction diode 2.2 Rectifiers: Half wave, Full wave and Bridge Rectifier, working principle, circuit diagram, performance parameters PIV, ripple factor, efficiency, Need for filters: circuit diagram and working of 'L', 'C' and 'π' filter. 2.3 Zener diode working principle, symbols, as voltage regulator 2.4 Symbol, construction and working principle of light emitting diode(LED) 2.5 Working principle and block diagram of regulated power supply.
Unit– III Bipolar Junction Transistor	3a. Describe with sketches the construction and working of the given type of device. 3b. Explain with sketches the working principle of the given transistor configuration. 3c. Determine the current gain of the given transistor configuration. 3d. Explain with sketches the specified transistor parameter. 3e. Explain with sketches the concept of the specified transistor biasing.	3.1 Unipolar and Bipolar devices 3.2 Symbol, construction and working principle of NPN transistor. 3.3 Transistor as switch and amplifier. 3.4 CE, CB and CC configurations. 3.5 Regions – Cut-off, saturation and Active region. 3.6 Transistor parameters- alpha, beta, input and output resistance and relation between alpha and beta 3.7 Transistor biasing- DC load line, Q-point and Fix bias and voltage divider biasing. 3.8 RC coupled amplifier.
Unit-IV Field Effect Transistors	4a. Explain with sketches the construction and working principle of the given type of FET. 4b. Determine the FET parameters from the given FET characteristic curve. 4c. Describe the specified JFET parameter. 4d. Describe the specified MOSFET parameter.	4.1 FET-Types: JFET and MOSFET 4.2 Classification of JFET 4.3 Symbol, construction and working principle of N-channel and P-channel JFET, Drain and transfer characteristics of JFET 4.4 JFET parameters: DC and AC drain resistance, Transconductance, amplification factor 4.5 Symbol, construction and working principle of MOSFET.
Unit –V Sensors and Transducers	5a. Differentiate between the given type of sensor and transducer	5.1 Working of sensors and transducers 5.2 Selection criteria for transducers 5.3 Active and passive transducers

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	5b. Explain selection criteria of a transducer for the given application. 5c. Describe with sketches the working of photodiode and photo transistor as control device for the given application. 5d. Describe the steps to measure the temperature of a given metal using the given transducer.	5.4 Inductive, capacitive, resistive pressure and Piezoelectric transducer 5.5 Photodiode and phototransistor transducers 5.6 Thermocouple and Proximity sensors.

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

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Electronic Components and Signals	08	02	04	06	12
II	Diodes and Their Applications	10	04	04	08	16
III	Bipolar Junction Transistor	14	04	06	08	18
IV	Field Effect Transistor	08	02	03	06	11
V	Sensors and Transducers	08	03	04	06	13
Total		48	15	21	34	70

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

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

10. SUGGESTED STUDENT ACTIVITIES

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

- Prepare journals based on practical performed in laboratory.
- Study of datasheet of electronic components.
- Prepare charts of symbols of Electronic components.
- Search information about Ratings and specifications of Regulator, diode transistors, CRO, function generator.
- Collect information of analog and digital ICs and prepare charts of the same.
- Collect information of passive transducers and prepare charts of the same.
- Prepare posters to illustrate the use of photoelectric sensors in remote controls.

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 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 students in preparing charts and display boards.
- Guide students in searching information regarding datasheets and electronic components.
- Show Video/Animation clippings for 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 PrOs, UOs and ADOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than 16 (sixteen) student engagement hours during the course.

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

- 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.
- Diode:** Build a circuit on general purpose PCB to clamp a waveform at 3.0V using diode and passive components.
- FET:** Prepare chart on comparison of specifications of FETs using data sheets of at least three FET.
- FET:** Prepare a chart on FETs contains its symbol, advantages and applications.
- Rectifier:** Build a half wave rectifier for 6V, 500mA output current on general purpose PCB.
- Rectifier:** Build a full wave bridge rectifier with capacitor filter for 6V, 500mA output current on general purpose PCB.
- BJT:** Build a circuit to switch on and off the LED by using BJT as switching component.
- Photodiode:** Build a circuit on breadboard to turn the relay on and off by using photo diode and prepare a report.
- Voltage Regulator:** Build a circuit of DC regulated power supply on general purpose PCB for 9V and 500mA output.

- Transistor as a switch:** Build / test transistor switch circuit on breadboard/General purpose PCB for various input signal.
- Use of sensors for driving relays / output devices:** Students will build/test circuit on breadboard/General purpose PCB. Verify output of designed circuit by applying different inputs.
- Prepare display boards consisting of electronic components:** prepare display boards/ models/ charts/ Posters to visualize the appearance of electronic active and passive components.

13. SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Electronic Instrumentation	Kalsi, H.S.	McGraw Hill Education, New Delhi, 2010, ISBN: 978-0070702066
2	Electronics Principles	Malvino, Albert Paul, David	McGraw Hill Education, New Delhi, ISBN: 978-0070634244
3	A text book of Applied Electronics	Sedha, R.S.	S Chand and Co., New Delhi, 2008, ISBN 978-8121927833
4	A course in electrical and electronic measurements and instrumentation	Sawhney, A.K.	Dhanpat Rai & Company, New Delhi, 2014 edition, ISBN:- 978-8177001006
5	Principles of Electronics	Mehta, V.K. Mehta, Rohit	S. Chand and Co. Ram Nagar, New Delhi-110 055, 11 th Edition, 2014, ISBN 9788121924504

14. SOFTWARE/LEARNING WEBSITES

- <https://learn.sparkfun.com/tutorials/transistors>
- <http://www.pitt.edu/~qiw4/Academic/ME2082/Transistor%20Basics.pdf>
- http://faculty.cord.edu/luther/physics225/Handouts/transistors_handout.pdf
- <http://www.technologystudent.com/elect/transist1.htm>
- <http://www.learningaboutelectronics.com/Articles/N-channel-JFET>
- <http://www.electrical4u.com/jfet-or-junction-field-effect-transistor>
- www.nptel.com
- <http://www.electronics-tutorials>



Program Name : Computer Engineering Program Group
Program Code : CO/CM/IF/CW/IF
Semester : Second
Course Title : Programming in 'C'
Course Code : 22226

1. RATIONALE

Diploma engineers (also called technologists) have to write programs to cater with various IT solutions. In order to develop a program to solve a given problem, they have to build logic, develop algorithms and flow charts. This course is designed keeping in view developing these skills. Besides its use to write codes for low level programming such as developing operating systems, drivers, and compilers: 'C' has been widely used as a general-purpose language to develop basic applications. This course deals with fundamental syntactic information about 'C' that will help the students to apply the basic concepts, program structure and principles of 'C' programming paradigm to build given application. The course is basically designed to create a base to develop foundation skills of programming language.

2. COMPETENCY

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

- Develop 'C' programs to solve broad-based computer related problems.

3. COURSE OUTCOMES (COs)

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

- Develop flowchart and algorithm to solve problems logically.
- Write simple 'C' programs using arithmetic expressions.
- Develop 'C' programs using control structure.
- Develop 'C' programs using arrays and structures.
- Develop/Use functions in C programs for modular programming approach.
- Develop 'C' programs using pointers.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
L	T	P		Theory						Practical						
				Paper Hrs.	ESE		PA		Total	ESE		PA		Total		
3	2	2	7	3	70	28	30*	00	100	40	25@	10	25	10	50	20

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

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



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

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

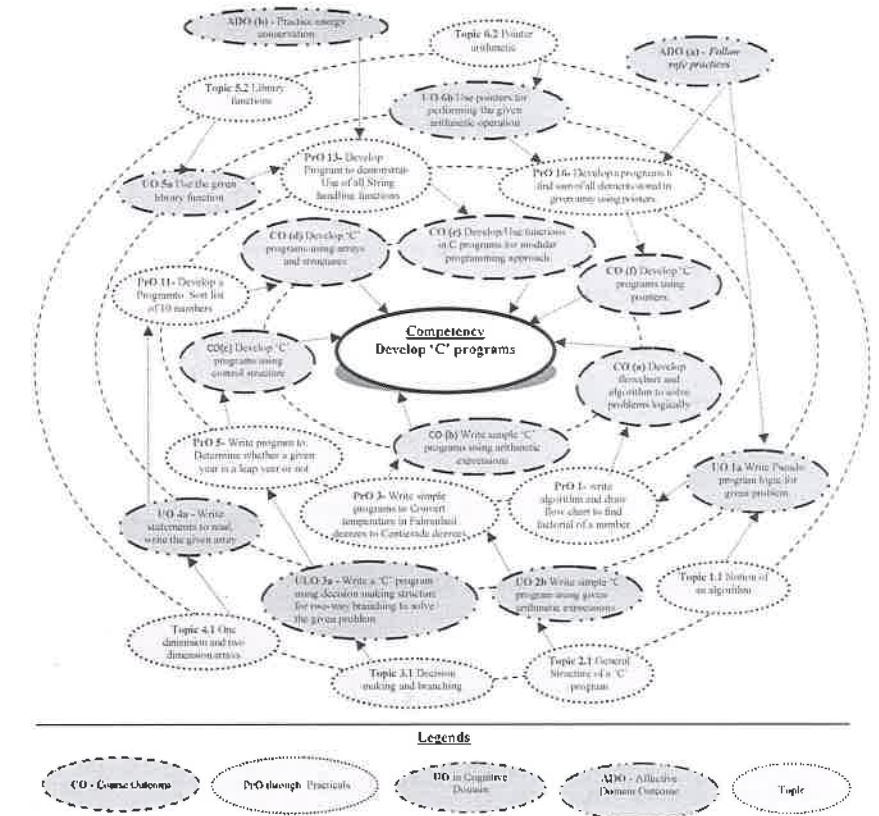


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

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

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Write/compile/execute simple 'C' program: Develop minimum 2 programs using Constants, Variables, arithmetic expression.	II	02
2	Write/compile/execute simple 'C' program: Develop minimum	II	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	2 programs increment/decrement operators, exhibiting data type conversion		
3	Write simple programs to convert temperature in Fahrenheit degrees to Centigrade degrees.	II	2
4	Write simple programs to calculate the area and perimeter of the rectangle, and the area & circumference of the circle	II	2
5	Decision Making and branching using if, if-else structure Write program to: (i) Determine whether a given year is a leap year or not. (ii) Determine whether a string is palindrome.	III	02*
6	Write program to: (i) Find the greatest of the three numbers using conditional operators (ii) Find if a given character is vowel.	III	02
7	Using switch statement: Write programs to : (i) Print day of week by taking number from 1 to 7. (ii) Print a student's grade by accepting percent marks.	III	02
8	Using switch statement: Write programs to check whether the triangle is isosceles, equilateral, scalene or right angled triangle	III	02
9	Looping: Write a program to : (i) Find sum of digits of a given number. (ii) Generate multiplication table up to 10 for numbers 1 to 5.	III	02
10	Write a program to : (iii) Find Fibonacci series for given number. (iv) Write a program to produce the following output: <pre> 1 2 3 4 5 6 7 8 9 10 </pre>	III	02
11	Array: Develop a Program to: (i) Sort list of 10 numbers. (ii) Perform addition of 3x3 matrix.	IV	02
12	Structure: Develop a Program to: (i) Create a structure called library to hold details of a book viz. accession number, title of the book, author name, price of the book, and flag indicating whether book is issued or not. Fetch some sample data and display the same. (ii) Develop and execute C Program to Add Two Distances given in kilometer-meter Using Structures	IV	02
13	Library Functions: Develop Program to demonstrate: (i) Use of all String handling functions. (ii) Use of few Mathematical functions. (iii) Use of few other miscellaneous functions.	V	02
14	User Defined Functions: Develop a Program to: (i) Create a function to find GCD of given number. Call this function in a program.	V	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	(ii) Find Factorial of given number using recursion.		
15	Pointers: Develop a Program to Print values of variables and their addresses.	VI	02
16	Develop a Program to Find sum of all elements stored in given array using pointers.	VI	02
Total			32

Note

- i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. All the above listed practical need to be performed compulsorily, so that the student reaches the 'Applying Level' of Blooms's 'Cognitive Domain Taxonomy' as generally required by the industry.
- ii. The 'Process' and 'Product' related skills associated with each PrO are to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
a.	Correctness of algorithm	40
b.	Debugging ability	20
c.	Quality of input and output displayed (messaging and formatting)	10
d.	Answer to sample questions	20
e.	Submit report in time	10
Total		100

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

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

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

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Exp. S. No.
1	Computer system (Any computer system with basic configuration)	All
2	'C' Compiler	

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Program Logic Developm ent	1a. Write Pseudo program logic for the given problem. 1b. Identify the given symbols of a flow chart. 1c. Explain guidelines for preparing flowchart with example. 1d. Create flowchart to logically solve the given problem.	1.1 Fundamentals of algorithms: Notion of an algorithm. Pseudo-code conventions like assignment statements and basic control structures. 1.2 Algorithmic problems: Develop fundamental algorithms to solve simple problems such as: (i) solve simple arithmetic expression (ii) find the greatest of three numbers (iii) determine whether a given number is even or odd (iv) determine whether a given number is prime. 1.3 Flowchart: Flowchart, Symbols of flowchart, Guidelines for preparing Flowchart
Unit– II Basics of C program ming	2a. Identify the given building block of a C program. 2b. Write simple 'C' program using the given arithmetic expressions 2c. Write a simple 'C' Program demonstrating the given data type conversion 2d. Write I/O Statements for the given data.	2.1 Introduction to C: History of 'C' General Structure of a 'C' program: Header files, 'main' function. 2.2 Data Concepts: Character set, tokens, keywords, Identifiers, Variables, Constant, data types, C operators, Arithmetic operators, Arithmetic expression, declaring variables, and data type conversion. 2.3 Basic Input output: Input and Output statements, using printf() and scanf(), character input/output statements, Input/output formatting, Use of comments
Unit– III Control Structure s	3a. Write a 'C' program using decision making structure for two-way branching to solve the given problem. 3b. Write a 'C' program using	3.1 Decision making and branching: Relational and logical operators. 'if' statement, 'if else' statement, 'nested if-else', 'if-else ladder' The 'switch' statement

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	decision making structure for multi-way branching to solve the given problem. 3c. Write a 'C' program using loop statements to solve the given iterative problem. 3d. Use related statements to alter the program flow in the given loop.	3.2 Looping: While loop, Do... While loop For loop, Go to statement, Use of break and continue statements
Unit-IV Array and Structure	4a. Write statements to read, write the given array. 4b. Manipulate the given array of characters and numbers. 4c. Use the structure for solving the given problem. 4d. Write a sample program to demonstrate use of the given enumerated data type.	4.1 Characteristics of an array. One dimension and two dimension arrays 4.2 Array declaration and Initialization 4.3 Array of characters, Operation on array 4.4 Character and String input/output 4.5 Introduction and Features of Structures. Declaration and Initialization of Structures 4.6 Type def, Enumerated Data Type, using structures in C Program
Unit –V Function s	5a. Use the given Library function. 5b. Develop relevant user defined functions for the given problem. 5c. Write 'C' codes to pass the given function parameters using "call by value" and "call by reference" approach. 5d. Write recursive function for the given problem.	5.1 Concept and need of functions 5.2 Library functions: Math functions, String handling functions, other miscellaneous functions. 5.3 Writing User defined functions, scope of variables. 5.4 Parameter passing: call by value, call by reference. 5.5 Recursive functions
Unit-VI Pointers	6a. Use pointers to access memory locations using pointer to solve the given problem. 6b. Use pointers for performing the given arithmetic operation. 6c. Develop a program to access elements of the given array using pointers. 6d. Develop a program to access elements of the given structure using pointers.	6.1 Concepts of pointers: declaring, initializing, accessing. 6.2 Pointer arithmetic. 6.3 Handling arrays using pointers 6.4 Handling functions using pointers 6.5 Handling structures using pointers

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



9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Program Logic Development	04	02	02	04	08
II	Basics of C programming	06	02	04	04	10
III	Control Structures	10	02	02	08	12
IV	Arrays and Structures	12	02	02	10	14
V	Functions	10	02	04	08	14
VI	Pointers	06	02	02	08	12
Total		48	12	16	42	70

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

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

10. SUGGESTED STUDENT ACTIVITIES

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

- Prepare journal of practicals.
- 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 learning 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 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 students thoroughly before they start doing the practice.
- Encourage students to refer different websites to have deeper understanding of the subject.
- 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 PrOs, UOs and ADOs. The micro-project could be industry application-based, internet-based, workshop-based, laboratory-based or field-based. Each student will

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

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

- Prepare sample mark sheet for 10 students.
 - Generate salary slips of employees in an organization.
 - Develop book issue system of library.
 - Any other micro-projects suggested by subject faculty on similar line.
- (Use structure and other features of 'C' to develop above listed applications)

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Programming in ANSI C	Balgurusamy, E.	McGraw Hill Education, New Delhi 2012. ISBN: 978-1259004612
2	The C Programming Language	Brian, W. Kernighan, Ritchie Dennis	PHI Learning Private Limited, New Delhi 1990. ISBN: 978-8120305960
3	Let us C	Kanetkar, Yashawant	BPB Publications, New Delhi 2016. ISBN:978-8183331630

14. SOFTWARE/LEARNING WEBSITES

- <http://nptel.ac.in/courses/106105083/4>
- www.w3schools.com
- www.programiz.com/c-programming
- <https://www.codecademy.com/courses/getting-started-v2/0/1>
- <http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-087-practical-programming-in-c-january-iap-2010/>
- <http://spoken-tutorial.org/>



Program Name: All Branches of Diploma in Engineering and Technology.
Program Code: CE/CR/CS/CH/PS/CM/CO/IF/CW/DE/EJ/EN/EQ/ET/EX/IE/MU/EE/
 EP/EU/IS/IC/AE /FG/ME/PG/PT/DC/TX/TC
Semester : Second
Course Title : Business Communication Using Computers
Course Code : 22009

1. RATIONALE

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

2. COMPETENCY

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

- Communicate effectively and skillfully at workplace.

3. COURSE OUTCOMES (COs)

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

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

4. TEACHING AND EXAMINATION SCHEME

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

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



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

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

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

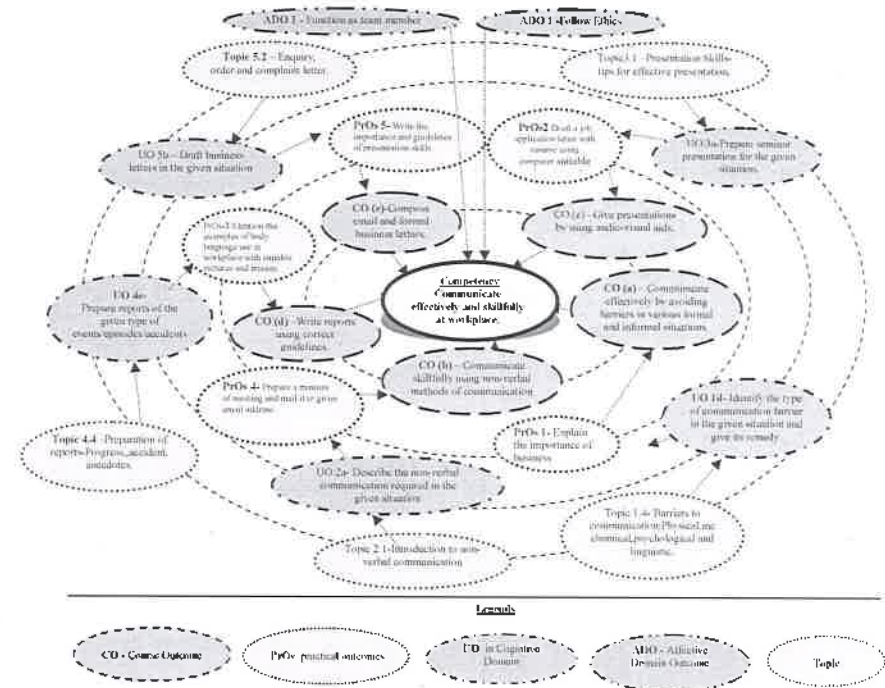


Figure 1 - Course Map

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

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

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

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

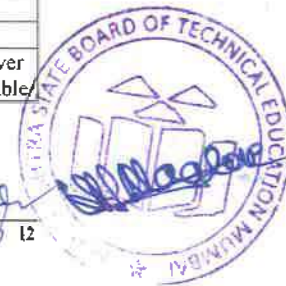
Note

- i. A suggestive list of practical LOs is given in the above table, more such practical LOs can be added to attain the COs and competency. A 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. The size of batch for the practical should not exceed more than 21 students strictly for the maximum attainment of COs and PrOs.
- ii. Hence, the 'Process' and 'Product' related skills associated with each LO of the laboratory/workshop/field work are to be assessed according to a suggested sample given below:

7. MAJOR EQUIPMENTS / INSTRUMENTS REQUIRED

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

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

**8. UNDERPINNING THEORY COMPONENTS**

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

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

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

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

9. SUGGESTED SPECIFICATION TABLE FOR INTERNAL END SEMESTER EXAMINATION

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

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

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

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

SUGGESTED STUDENT ACTIVITIES

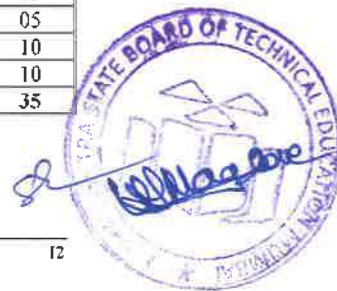
Other than the classroom and laboratory learning, following are the suggested student-related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

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



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

12. SUGGESTED TITLES OF MICRO-PROJECTS

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

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

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

13. SUGGESTED LEARNING RESOURCES

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

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

14. SOFTWARE/LEARNING WEBSITES

- a. <https://www.britishcouncil.in/english/learn-online>
- b. <http://learnenglish.britishcouncil.org/en/content>
- c. <http://www.talkenglish.com/>
- d. [languagelabsystem.com](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



Program Name : Computer Engineering Program Group
Program Code : CO/CM/IF/CW
Semester : Second
Course Title : Computer Peripheral and Hardware Maintenance
Course Code : 22013

1. RATIONALE

Maintenance and troubleshooting of computer system and its peripherals is an important skill to upkeep the computer systems and peripherals. Diploma pass out must be able to use and maintain these system peripherals authentically. They must also possess basic skills of assembling desktop computers, interfacing with peripheral devices, installing new devices and carry out preventive and breakdown maintenance and troubleshooting. This course is designed to develop these vital skills in them through lab based activities to solve problems associated with computer hardware.

2. COMPETENCY

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

- **Maintain computer hardware and peripherals.**

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:

- Identify different types of computer systems.
- Troubleshoot common motherboard problems.
- Select processors required for relevant systems.
- Partition/format hard disk drives.
- Troubleshoot peripherals and networks.
- Test power supplies.

4. TEACHING AND EXAMINATION SCHEME

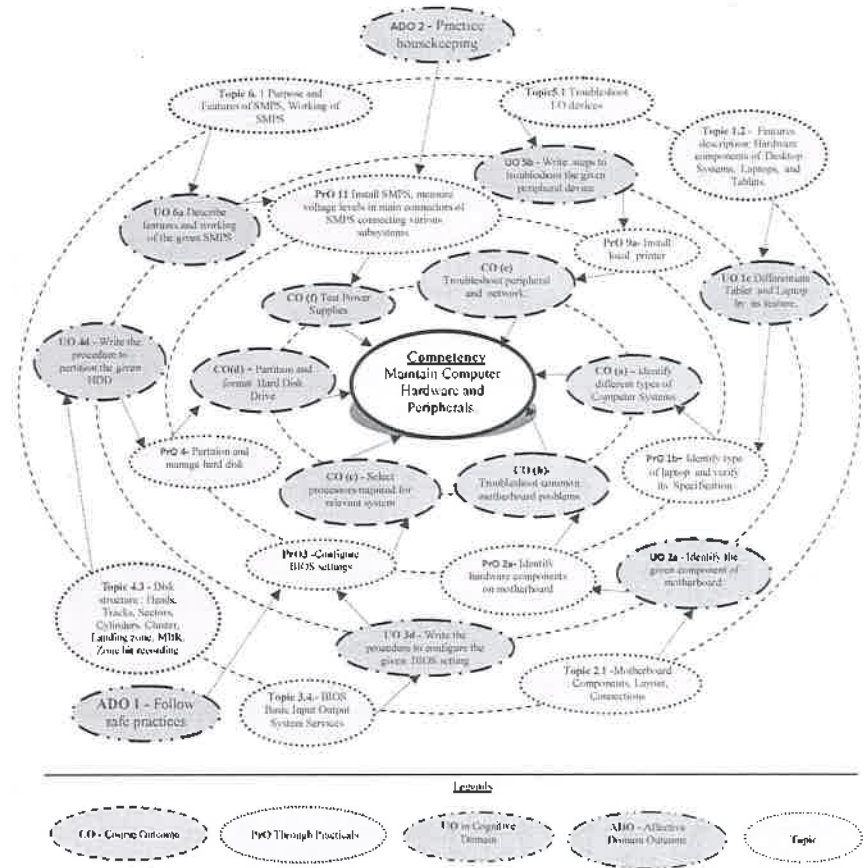
Teaching Scheme				Examination Scheme											
L	T	P	Credit (L+T+P)	Theory						Practical					
				ESE		PA		Total		ESE		PA		Total	
				Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
2	-	2	4	--	--	--	--	--	--	50#	20	50~	20	100	40

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

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

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

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



S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	specifications		
	b. Identify type of laptop and verify its Specification		
2	a. Identify hardware components on motherboard	II	2*
	b. Troubleshoot common problems of motherboard		
3	Configure BIOS settings	III	2*
4	Partition and manage hard disk: format hard drives with different file systems. (Part-I)	IV	2*
5	Partition and manage hard disk, format hard drives with different file systems. (Part-II)	IV	2
6	Install Operating System – Windows family (such as Windows 7/ Windows 10, Windows server 12)	IV	2
7	Install Operating System –Unix family (such as Linux/Ubuntu/Centos)	IV	2
8	Troubleshoot Hard disk problems.	IV	2
9	a. Install local printer (Software configuration settings on printer and troubleshooting)	V	2*
	b. Share Printer in Network (Software configuration settings on printer and troubleshooting)		
10	Set keyboard, mouse, monitor, Speaker, Microphone and LCD Projector	V	2
11	Install SMPS, measure voltage levels in main connectors of SMPS connecting various subsystems.	VI	2*
12	Assemble and Disassemble Desktop System (Part-I)	VI	2
13	Assemble and Disassemble Desktop System (Part-I)	VI	2
14	Troubleshoot computer system by diagnosing the problem	VI	2
15	Use diagnostic software for fault finding and viruses	VI	2
16	Undertake Preventive Maintenance of PC using vacuum cleaner and simple tools	VI	2
	Total		32

Note

- i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. All the above listed practical need to be performed compulsorily, so that the student reaches the 'Applying Level' of Bloom's 'Cognitive Domain Taxonomy' as generally required by the industry.
- ii. The 'Process' and 'Product' related skills associated with each PrO 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	10
b.	Operate equipment skillfully	30
c.	Follow Safety measures	10
d.	Completed the exercise in stipulated time	30
e.	Answer to sample questions	10
f.	Submit report in time	10
	Total	100

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

- Follow safety practices.
- Practice good housekeeping.
- Demonstrate working as a leader/a team member.
- Follow ethical practices.

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

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Exp. 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	All
2	LCD/DLP Projector	Student Activity
3	Mouse :Mechanical, Optical, Opto-Mechanical	8
4	Laptop	All
5	Bluetooth based wireless mouse and keyboard or any other device	8
6	Dot Matrix Printer, Laser Printer, Inkjet Printer	7
7	Computer Maintenance kit	All
8	Logic probe, logic pulser, current tracer	11
9	Digital voltmeter	9
10	Operating systems	5,6,7,8,11,12
11	Power Supply	All
12	Diagnostics Software	12
13	Vacuum Cleaner/Blower	13

Note: There are no specifications fixed for the above listed equipments, 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 are to be taught and assessed in order to develop UCs for achieving the COs to attain the identified competency:



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Features of Computer Hardware	1a. Explain characteristics of the given type of computer systems. 1b. Describe features of the given desktop systems. 1c. Describe features of the given Tablet systems. 1d. Describe features of the given server systems.	1.1 Computers: Desktop Computers, Tablet, Laptop, Mainframe, Supercomputer, 1.2 Features description: Hardware components of Desktop Systems, Laptops, and Tablets. 1.3 Types of Servers, Server Feature descriptions and its applications.
Unit– II Motherboard	2a. Identify the given component of motherboard. 2b. Describe features of the given motherboard. 2c. Differentiate hardware based and software based problems of motherboard. 2d. Describe the procedure to identify the given type of motherboard problems.	2.1 Motherboard : Components, Layout, Connections 2.2 Motherboards : Types and Features 2.3 Enhancing features of motherboard: Adding and or replacing components. 2.4 Troubleshooting problems of a motherboard.
Unit– III Processor and BIOS	3a. Describe architecture of given type of Multi-core processors. 3b. Explain the purpose of the given type of co-processors. 3c. Explain the level and purpose of cache memory. 3d. Write the procedure to configure the given BIOS setting.	3.1 Processor : Common Features, Types of Processors, Basic Structure of CPU, Different levels of cache, system bus, clock speed, packaging 3.2 Multiple Core Processors: Description, Two core processor architecture and multi-core processor architecture 3.3 Co-processors: Graphics, Math. 3.4 BIOS: Basic Input Output System Services, Bios Interaction, date and time, Boot device priority, boot setting configuration, password security.
Unit– IV Hard Disk	4a. Describe features of the given type of hard disk interface. 4b. Describe features of the given type of disk structure. 4c. Explain characteristics of the given disk performance parameter. 4d. Write the procedure to partition the given HDD. 4e. Describe the given type of file system.	4.1 Hard Disk Drive 4.2 Hard Disk Interfaces: EIDE, Serial ATA, SCSI, USB and IEEE 1394 (Firewire), RAID, Solid State Drive (laptop) 4.3 Disk structure : Heads, Tracks, Sectors, Cylinders, Cluster, Landing zone, MBR, Zone bit recording 4.4 Disk performance parameters Characteristics: Seeks and Latency, Data Transfer Rate 4.5 File system: FAT16, FAT32, NTFS, Unix file system, EXT2/EXT3, RAID

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit– V I/O and Modem	5a. Describe features of the given I/O device. 5b. Write steps to troubleshoot the given peripheral device 5c. Explain use of the given I/O cable. 5d. Explain features of given type of Interface. 5e. Describe the procedure to troubleshoot the given network problem.	5.1 Troubleshoot I/O devices: Keyboard, Switches, Mouse, Scanners, Webcam, Monitors, Printers, Speaker and Mike, LCD Projector 5.2 I/O Cables: Specification of I/O Cables, Types of I/O cables, Types of I/O Ports, Internal and External modem, Block diagram and specifications. 5.3 Network Interface: Definition of network interface, Types of network interface, troubleshooting of network connectivity, Antivirus
Unit–VI Power Supply	6a. Describe features and working of the given SMPS 6b. Describe features and working of the given UPS. 6c. Differentiate the salient features of the specified type of UPS. 6d. Describe the steps to troubleshoot the given tpe of SMPS.	6.1 Purpose and Features of SMPS, Working of SMPS 6.2 Fault finding in power supply 6.3 Uninterrupted Power Supply: Characteristics of UPS, Types of UPS, online and offline 6.4 Preventive Maintenance of Power Supply

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

9. SUGGESTED SPECIFICATION TABLE 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 specification chart of different types/family of processors (Ex. Intel/AMD)
- Prepare journal of practical.
- Prepare a presentation to display Layout of different motherboards and different System components and present it in groups.

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 COs through classroom presentations (see implementation guideline for details).

- d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*
- e. Guide student(s) in undertaking micro-projects.
- f. Demonstrate students thoroughly before they start doing the practice
- g. Show video/animation films to explain handling/functioning of different instruments.
- h. Continuously observe and monitor the performance of students in Lab/Workshop

12. SUGGESTED MICRO-PROJECTS

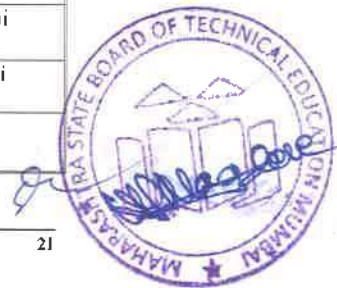
Only one micro-project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs,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

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

- a. **SMPS:** List down the components available in SMPS. Measure different output voltages from SMPS.
- b. **Computer motherboard:** Prepare brief report by identifying different electronics components in a given motherboard. Classify them in passive and active components.
- c. **Microprocessor:** Prepare a small report of different microprocessors being used in industry (Any four) by doing market survey.
- d. **Computer Specifications:** Prepare a small report on major specification of different types of computer systems available in your lab.
- e. **Peripheral Specifications:** Prepare a small report based on technological differences and installation procedure of printers and scanners.
- f. **Network Layout:** Prepare a small report by doing survey of computer labs. List various networking devices/components with its application.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1.	The computer hardware installation, interfacing, troubleshooting and maintenance	James, K.L.	PHI Learning, New Delhi, 2014 ISBN: 978-81-203-4798-4
2.	Comdex: Hardware and Networking Course Kit	Gupta, Vikas	Dreamtech Press, New Delhi ISBN: 978-93-5119-265-7
3.	The Complete PC Upgrade And maintenance Guide	Minasi, Mark	BPB Publication, New Delhi ISBN:978-81-265-0627-9
4.	Computer Architecture and Maintenance Vol 1	Kadam, Sachin	Shroff Publication, Mumbai ISBN: 978-9350230244



14. SOFTWARE/LEARNING WEBSITES

- a. <http://www.howstuffworks.com/>
- b. [http://www.gcflearnfree.org/computerbasics/keeping-your-computer-clean/1/](http://www.gcflearnfree.org/computerbasics/keeping-your-computer-clean/)
- c. <https://www.youtube.com/watch?v=4iaxOUYalJU>
- d. <http://www.instructables.com/id/Computer-Assembly/>

Program Name : Computer Engineering Program Group
Program Code : CO/CM/IF/CW
Semester : Second
Course Title : Web Page Designing With HTML
Course Code : 22014

1. RATIONALE

Website design is a broad term that encompasses a wide variety of tasks, all involved in the formation of web pages. There are essentially two types of web design approaches, which are dynamic and static design. Static web design is typically based on basic HTML code. It is essential for diploma student to learn HTML since the task of static website design is performed by using HTML coding. Even in dynamic websites, the task of presentation of content is handled through HTML coding. This course introduce web page design using HTML5 and also give emphasis on learning Cascading Style Sheets (CSS) which is a style sheet language used for describing the presentation of a document written in a markup language for formatting and styling of content. This learning enables students to design static web sites and host it on Internet/Intranet.

2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:
 • Develop static interactive web-sites.

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 block level formatting tags to present content on web page.
- Use text level formatting tags to present content on web page.
- Apply hyper linking on web page.
- Organize the content using table and frames.
- Apply presentation schemes on content using CSS.
- Publish websites on Internet or Intranet.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
L	T	P		Theory						Practical					
				Paper Hrs.	ESE Max	ESE Min	PA Max	PA Min	Total Max	Total Min	ESE Max	ESE Min	PA Max	PA Min	Total Max
2	-	2	4	--	--	--	--	--	--	50@	20	50~	20	100	40

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



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

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

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

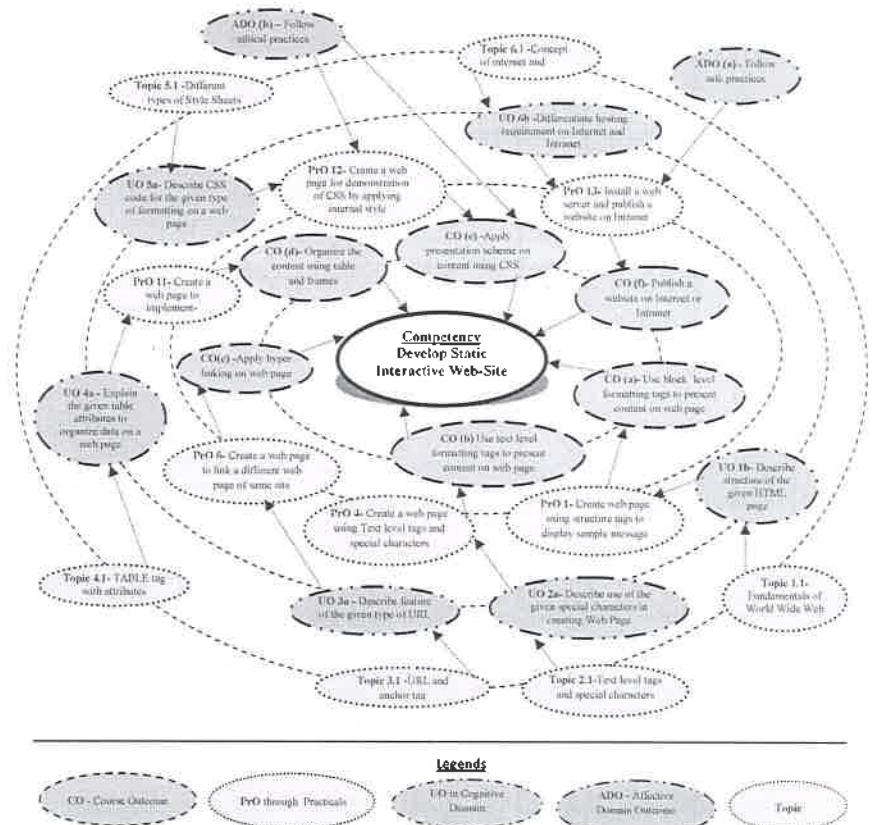


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

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

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs.

			Required
1	Create web page using structure tags to display sample message.	I	02
2	Create a web page for displaying a paragraph using block level tags, HR tags (Part-I).	I	02*
3	Create a web page for displaying a paragraph using block level tags, HR tags (Part-II).	I	02
4	Create a Web Page using Text level tags and Special Characters.	II	02
5	Create a web page for implementing different types of Lists.	II	02*
6	Create a web page to link- a) A different web page of same site. b) A different location on the same web page. c) A specific location on different web page of same site.	III	02
7	i) Create a web page to link- a) An external page of different web site. b) To an email ID. ii) Write tags to change colors of links	III	02*
8	Insert images on web page using various attributes.	III	02
9	Implement image as a button and set image as background.	III	02
10	Create a web page to implement Frame tags.	IV	02*
11	Create a web page to implement Table tags	IV	02
12	Create a web page for demonstration of CSS by applying Internal style.	V	02*
13	Create a web page for demonstration of CSS by applying External style.	V	02
14	Create a web page for demonstration of CSS by applying Inline style.	V	02
15	Install a web server and publish a website on Intranet.	VI	02
16	Publish a website on Internet by acquiring space on free hosting site.	VI	02*
Total			32

Note

- i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicious mix of practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Applying Level' of Blooms's 'Cognitive Domain Taxonomy' as generally required by the industry.
- ii. The 'Process' and 'Product' related skills associated with each PrO are to be assessed according to a suggested sample given below.

S. No.	Performance Indicators	Weightage in %
a.	Debugging ability	20
b.	Quality of output achieved (Product)	40
c.	Complete the practical in stipulated time	10
d.	Answer to sample questions	20
e.	Submit report in time	10
Total		100



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

- Follow safety practices
- Practice good housekeeping
- Demonstrate working as a leader/a team member.
- Follow ethical practices.

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

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Exp. S. No.
1	Computer with a text editor and browser	ALL
2	Scanner : A4 size, supporting image quality 200 DPI or higher	7
3	Computer system with Internet connection	12
4	Web server.	12

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Basics of HTML	1a. Differentiate characteristics of the given type of web sites. 1b. Describe structure of the given HTML page. 1c. Explain use of head tag and body tag in the given web page. 1d. Describe the procedure of using the given block level tag on a web page.	1.1 Fundamentals of World Wide Web(www): Information about Web Browsers, Web Servers and types of sites. Static vs. dynamic web sites Web page structure: DOCTYPE, head, body, title and other meta tags with attributes. 1.2 Block Level Tags And Horizontal Rules: Headings, Paragraphs, Breaks, Divisions, Centered Text, Block Quotes, Preformatted text, types of Address, HR tag
Unit – II Text	2a. Describe use of the given special characters in creating	2.1 Text Level Tags And Special Characters: Bold, Italic, Teletype.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Level Tags and List	Web Page. 2b. Use relevant tag to display the given special characters. 2c. Explain use of the given type of list in Web Pages. 2d. Describe the procedure of using the given text level tags in creating a Web Page.	Underline, Strikethrough, Superscript, Subscript, DIV tag, displaying special characters. 2.2 Lists: Ordered Lists, Unordered Lists, Definition Lists, Nested Lists.
Unit- III URL And Images	3a. Describe feature of the given type of URL. 3b. Describe the given image attribute on a web page. 3c. Explain process of using the given colors/images as page background on a Web Page. 3d. Describe the procedure for creating the given type of hyper linking.	3.1 URL And Anchor Tag: URL : Types of URLs, Absolute URLs, Relative URLs, pros and cons of relative and absolute URLs, Anchor Tag: Linking various documents for internal and external links. 3.2 Images, Colors And Backgrounds: Inserting Images, formatting image for sizing, alignment, Border and using other attributes with IMG tag. Inserting image as page background. Creating solid color page background.
Unit-IV Table And Frames	4a. Explain the given table attributes to organize data on a web page. 4b. Use the given table attribute to change default table setting. 4c. Describe the given type of 'frame' with examples. 4d. Describe the procedure to organize display as per given screen layout using frames.	4.1 Table: Table tag with attributes. TABLE, TR, TH, TD tags. Border, cell spacing, cell padding, width, align, bgcolor attributes. 4.2 Frames : Types of Frames with their attributes, Creating frames: FRAMESET tag – rows, cols attributes.
Unit –V Cascading Style sheets	5a. Describe CSS code for the given type of formatting on a web page. 5b. Describe the given style sheet properties. 5c. Explain the given property of CSS. 5d. Describe the procedure to create CSS for applying the given presentation scheme on a web page.	5.1 Cascading Style Sheets: Different types of Style Sheets, Benefits of using CSS. Adding style to the document: Linking to style sheets, Embedding style sheets, Using inline style, Selectors: CLASS rules, ID rules. 5.2 Style sheet properties: Font, text, box, color and background properties; Creating and Using a simple external CSS file; Using the internal and inline CSS; background and color gradients in CSS Setting font and text in style sheet using table layout.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit-VI Website Hosting	6a. Describe the procedure to configure a webserver. 6b. Differentiate hosting requirement on Internet and intranet 6c. Describe the procedure for hosting the given website. 6d. Explain process of uploading the given files on a website.	6.1 Website Hosting: Concept of Internet and Intranet. Publishing website on Intranet. Installing and configuring web server, uploading files on intranet site, access intranet based website; Publishing website site on Internet, hiring Web space, uploading files using FTP, Virtual Hosting, access internet based website

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

9. SUGGESTED SPECIFICATION TABLE 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 journals based on practical performed in laboratory.
- Browse and Observe features of different types of website.
- Identify different host servers for hosting static website.

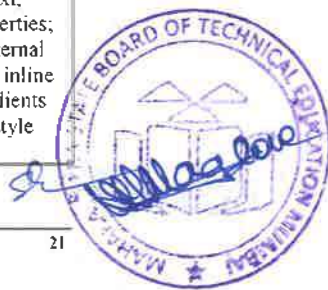
11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

- 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 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 students thoroughly before they start doing the practice.
- Encourage students to refer different websites to have deeper understanding of the subject.
- Observe continuously and monitor the performance of students in Lab.

The practical exercises as listed in point no. 6 above may be undertaken keeping in mind to develop a sample web site as final output. Some sample topics/domains are suggested below.

12. SUGGESTED MICRO-PROJECTS



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

In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty: Create sample website with minimum ten web pages Containing text, images, colors & background, frames, tables, and CSS with suitable hyper linking

- a. Website for Universities or Colleges
- b. Web site for books shops, grocery store, others
- c. Web site for any Vehicle Showroom.
- d. Website for Hospital facilities
- e. Web site for Travel and Tourism Agency
- f. Web site related to any Sports (Ex. Cricket, Tennis,)

Any other suggested topic by subject teacher.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1.	HTML and XHTML – The complete reference	Powell, Thomas	Tata McGraw Hill, New Delhi, 2014, ISBN: 9780070701946
2.	Learning Web Design	Robbins	O'Reilly, London, 2012 ISBN 10:1-4493-1927-0
3.	Teach Yourself HTML & CSS in 24 Hours	SAMS	Pearson Education Publication, New Delhi, 2015, ISBN: 978-672336140
4.	HTML,XHTML and CSS	Bohem, Anne	Murach's Publication, New York, 2013, ISBN 13: 978-1890774578
5.	HTML 5 Black Book(second edition)	DT Editorial services	Dreamtech Publication, New Delhi, ISBN: 978-9350040959

14. SOFTWARE/LEARNING WEBSITES

- a. <http://www.w3schools.com/html>
- b. <http://www.html.net/>
- c. <http://www.2createawebsite.com>
- d. <http://webdesign.about.com>

