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 : SECOND — **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
								Theory							Practical					
								Exam Duration in Hrs.	ESE		PA		Total		ESE		PA		Total	
				L	T	P			Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	
1	Safety in Coating Industries	SCI	24227	3	--	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
2	Resin Technology-II	RTE	24228	3	--	4	7	3	70	28	30*	00	100	40	50#	20	50	20	100	40	200
3	Pigment Technology-II	PTE	24229	3	--	4	7	3	70	28	30*	00	100	40	50#	20	50	20	100	40	200
4	Solvent and Additives Technology	SAT	24230	3	--	2	5	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	Material Synthesis	MSY	24019	--	--	4	4	--	--	--	--	--	--	--	50@	20	50~	20	100	40	100
			Total	**12**	**--**	**18**	**30**	**--**	**280**	**--**	**120**	**--**	**400**	**--**	**235**	**--**	**215**	**--**	**450**	**--**	**850**

Student Contact Hours Per Week: **30 Hrs.** Medium of Instruction: **English**

Theory and practical periods of 60 minutes each. Total Marks **: 850**

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

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

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

~ 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 Surface Coating Technology**

Program Code : **SC**

Semester : **Second**

Couse Title : **Safety in Coating Industries**

Couse Code : **24227**

1. RATIONALE

To learn techniques of hazard identification. Inculcate safety principles and techniques for accident prevention. Acquire knowledge, skills and mechanism of functioning and safe use of machines and tools. Acquire knowledge of ergonomics between man and machine to maintain hygiene and health while working to prevent exposure to hazards. To gain knowledge about factory legislation.

2. COMPETENCY

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

- **Follow safe working practices in surface coating industries.**

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 importance of safety at workplace.
2. Interpret legal requirements as per Factories Act.
3. Use safety tools and personal protective equipment for preventing accident.
4. Use various fire fighting appliances.
5. Apply first aid procedure for injury accident.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
				Theory							Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	--	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.

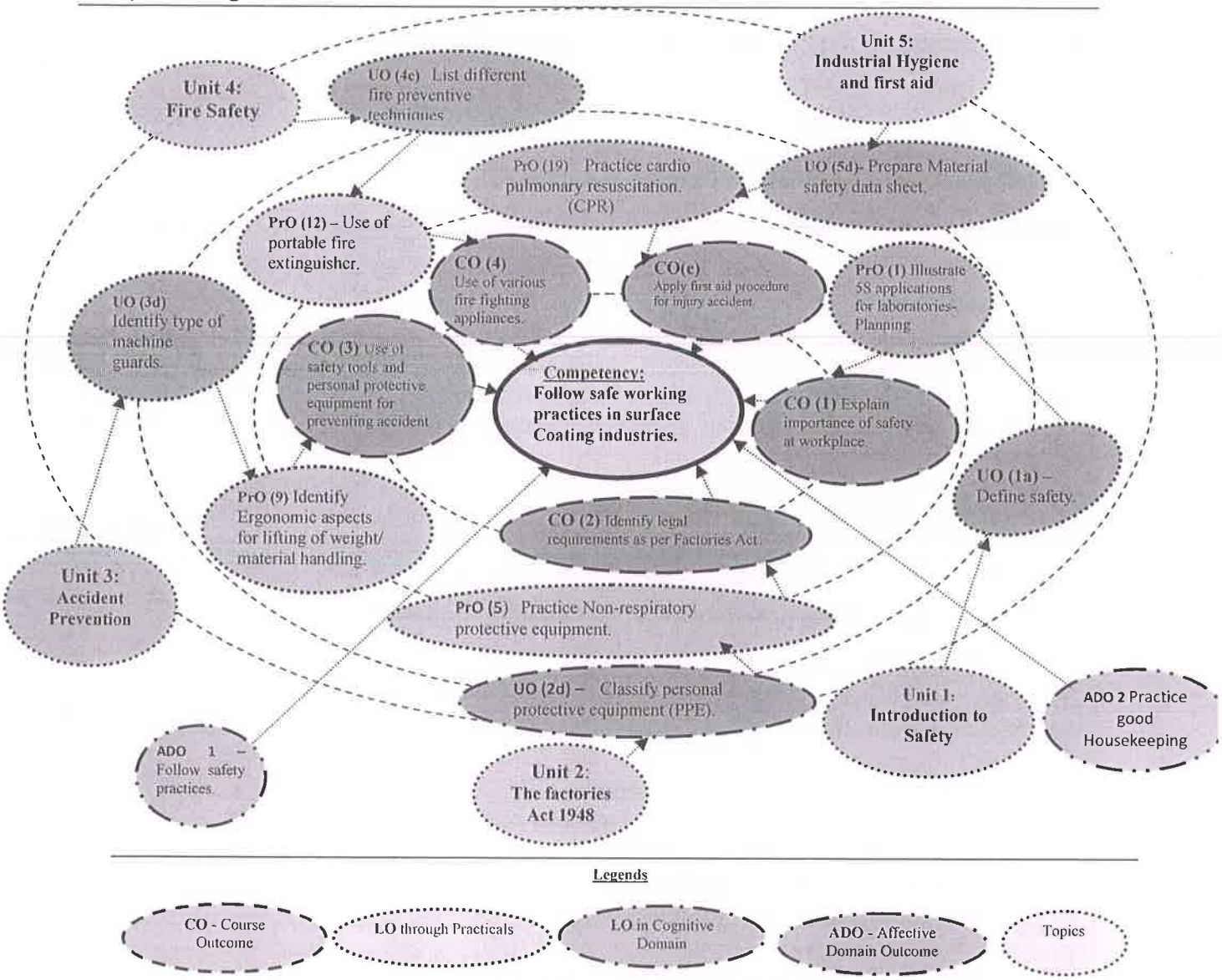

Figure 1 - Course Map

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 Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. Required
1	Illustrate 5S applications for laboratories- Planning	I	2*
2	Illustrate 5S applications for laboratories- Execution	I	2*
3	Prepare checklist for housekeeping.	I	2*
4	Practice respiratory protective equipment.	II	2
5	Practice Non-respiratory protective equipment.	II	2*
6	Prepare SOP for laboratory.	III	2*
7	Prepare maintenance chart for machine / Equipment.	III	2
8	Identify Ergonomic aspects of machine / Equipment.	III	2
9	Identify Ergonomic aspects for lifting of weight/ material handling.	III	2*
10	Practice hand / power tools for safe handling.	III	2
11	Identify guarding of machines.	III	2

12	Use of portable fire extinguisher.	IV	2*
13	Use of fire hydrant system.	IV	2
14	Use fire alarm system.	IV	2
15	Practice lung function test.	V	2
16	Use of sound level meter.	V	2
17	Use of lux meter.	V	2
18	Use of Anemometer.	V	2
19	Practice cardio pulmonary resuscitation (CPR)	V	2*
20	Practice of bandaging.	V	2
21	Prepare Material safety data sheet (MSDS) for chemicals.	V	2
	Total		**42**

Note

i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 practical 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 and accessories.	10
b.	Setting and operation	20
c.	Safety 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	Dust Masks	4
2	Canisters	4
3	Half face masks	4
4	Full Face masks	4
5	Safety shoes	5
6	Safety Belts (Harness)	5
7	Safety Goggles	5
8	Hand gloves	5
9	Carton Box (Weight 10kg approx)	9
10	Drilling machine	10
11	Screw drivers	10
12	Hammer	10
13	Dry Chemical powder (ABC types) Fire extinguisher	12
14	Fire hydrant system	13, 14
15	Spirometer	15
16	Sound level Meter	16
17	Lux meter	17
18	Anemometer	18
19	Types of bandages	20

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 Safety	1a. Define safety. 1b. Explain importance of housekeeping. 1c. Write concept of 5 S. 1d. Write concept of TLV. 1e. Explain structure and role of safety committee.	1.1 Introduction to Safety: Definition of Safety, Need of safety, Safety organization. 1.2 Importance of housekeeping in safety. 1.3 Concept of 5S. 1.4 Concept of TLV. 1.5 **Organizing safety:** Safety committee. Role of management. supervisors and workers. Role of Safety officer. Workplace air monitoring.
Unit-II The factories Act 1948	2a. Explain sections of factories acts and Maharashtra factories rule related to safety. 2b. Define terminologies of factories act. 2c. Write powers of factory inspectorate Director of Industrial	2.1 Introduction to factories act 1948. 2.2 Maharashtra factories rules 1963. 2.3 Definition of factories, occupier, competent person, hazards process and workers. 2.4 Power of Director of Industrial safety and Health (DISH).

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	safety and Health (DISH). 2d. Classify personal protective equipment (PPE).	2.5 Personal protective equipment.
Unit– III Accident Prevention	3a. Define accident. 3b. List causes and preventive measures of accident. 3c. Write Safe operating procedures. (SOPs) for given process. 3d. Identify type of machine guards. 3e. Define ergonomics. 3f. List safe practices for tools, machineries and processes. 3g. Classify maintenance.	3.1 Definition of accident. 3.2 Causes of accidents. 3.3 Prevention of accidents. 3.4 Safe operating procedures (SOPs). 3.5 Guarding of machineries. 3.6 Ergonomics. 3.7 Safety in use of tools and machineries. 3.8 Safe working practices. 3.9 Maintenance of equipment.
Unit –IV Fire Safety	4a. Define fire. 4b. Classify fires. 4c. List different fire preventive techniques. 4d. Write the importance of earthing and bonding for prevention of fire and explosion.	4.1 Definition of fire 4.2 Classification of fire. 4.3 Tetrahedron of fire. 4.4 Electric fire. 4.5 Fire preventing techniques: Fire extinguishers, Fire hydrant system, Smoke detectors, Water sprinklers. 4.6 Importance of earthing and bonding
Unit-V Industrial Hygiene and first aid	5a. Define industrial hygiene. 5b. Explain work place ventilation and illumination. 5c. Classify first aid procedure with respect to injury. 5d. Prepare Material safety data sheet. (MSDS).	5.1 Definition of industrial hygiene. 5.2 Workplace Ventilation, illumination. 5.3 Fundamentals of first aid. 5.4 First aid procedures for: Burn, Suffocation, Toxic ingestion. Insect and animal bites, Bandaging Fracturs, Cardio pulmonary resuscitation (CPR) 5.5 Material safety data sheet (MSDS)

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 Safety	08	02	02	06	10
II	The factories Act 1948	10	02	04	08	14
III	Accident Prevention	10	02	04	10	16
IV	Fire Safety	10	02	04	10	16
V	Industrial Hygiene and first aid	10	02	04	08	14
Total		48	**10**	**18**	**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: 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. Collect data from various industries regarding safety polices, practices, environmental health policies etc.
b. Report a various waste management procedure/practices.
c. Collect data of various uses of personal protective equipment.
d. Collect data for prevention of static charge (bonding and earthing).

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-projects are group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, 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 regarding safety measure on petrol pump.
b. Collect information regarding unsafe acts and condition on road.
c. Collect the information regarding traffic signs.
d. Collect the information of egronomical body postures to avoid body stress.
e. Identify the unsafe conditions in the premises.
f. Visit to fire station.
g. Collect the information about compatible chemicals.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Introduction Industrial Safety	K.T. Kulkarni	K.T. Kulkarni, Pune, 2002
2	Industrial Safety *Concepts and practices*	K.T. Kulkarni	K.T. Kulkarni, Pune, 2009
3	A Practical Guide on Safety, Health & environment Vol-II	National Safety Council, Mumbai	National Safety Council, Mumbai, 2010
4	A Practical Guide on Safety, Health & environment Vol-III	National Safety Council, Mumbai	National Safety Council, Mumbai, 2010
5	The Factories Act, 1948	Labor Law Agency, Mumbai	Labor Law Agency, Mumbai, 2018
6	Industrial Health and safety Management	A.M. Sarma	Himalaya Publishing House, Mumbai, 2008 ISBN No. : 9788178664514
7	Industrial Safety Management	D.M. Dhar	Everest Publishing House, Pune ISBN: 9788176601284

14. SOFTWARE/LEARNING WEBSITES

a. https://www.youtube.com/watch?v=wDjCnPmNKuc
b. https://www.youtube.com/watch?v=1zLD7fr8VHc
c. https://www.youtube.com/watch?v=MGW0JvUAmho
d. https://www.youtube.com/watch?v=dse9B9wlla4
e. https://www.youtube.com/watch?v=dvY3uPZ4jJw
f. https://www.youtube.com/watch?v=hRY0XjOp0Ws
g. https://www.youtube.com/watch?v=wGSwsaagWoY
h. https://www.youtube.com/watch?v=GpzsY8bwUWk
i. https://www.youtube.com/watch?v=N089MSgFOgE
j. https://www.youtube.com/watch?v=DfhmLyMF2W0
k. https://www.youtube.com/watch?v=vdbg6nJaoEU
l. https://www.youtube.com/watch?v=y6ZMqA6jcb8
m. https://www.youtube.com/watch?v=Qu0VrllKij4

n. https://www.youtube.com/watch?v=N_hDq4yf_fo
o. https://www.youtube.com/watch?v=1dmro_UgaLs
p. https://www.youtube.com/watch?v=0Pgxvw9TyPU
q. https://www.youtube.com/watch?v=d8WB25WV1x0
r. https://www.youtube.com/watch?v=EAdKk0swycU
s. https://www.youtube.com/watch?v=jrfqYEODXjw
t. https://www.youtube.com/watch?v=c7Q1s7ppSwc
u. https://www.youtube.com/watch?v=Be1ZKWTFd3g
v. https://www.youtube.com/watch?v=d9btBXMocsc
w. https://www.youtube.com/watch?v=1K8STobSufY
x. https://www.youtube.com/watch?v=xUaPveLOM6E
y. https://www.youtube.com/watch?v=aKlnifkcvE0
z. https://www.youtube.com/watch?v=8assGpZvwG4
aa. https://www.youtube.com/watch?v=5KlQN_p3upM
bb. https://www.youtube.com/watch?v=rxSL3pTUG5E
cc. https://www.youtube.com/watch?v=FUhEXMfvliI
dd. https://www.youtube.com/watch?v=znp4TWiJluQ
ee. https://www.youtube.com/watch?v=T7zq4TLxSEY

Program Name : **Diploma in Surface Coating Technology**

Program Code : **SC**

Semester : **Second**

Couse Title : **Resin Technology-II**

Couse Code : **24228**

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 and 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. Select resins for decorative and industrial applications.
2. Calculate base: hardener ratio of two pack systems.
3. Test different properties of resins.
4. Select resins for high performance and specialty applications.
5. Explain curing mechanism of resins.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory						Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	--	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.

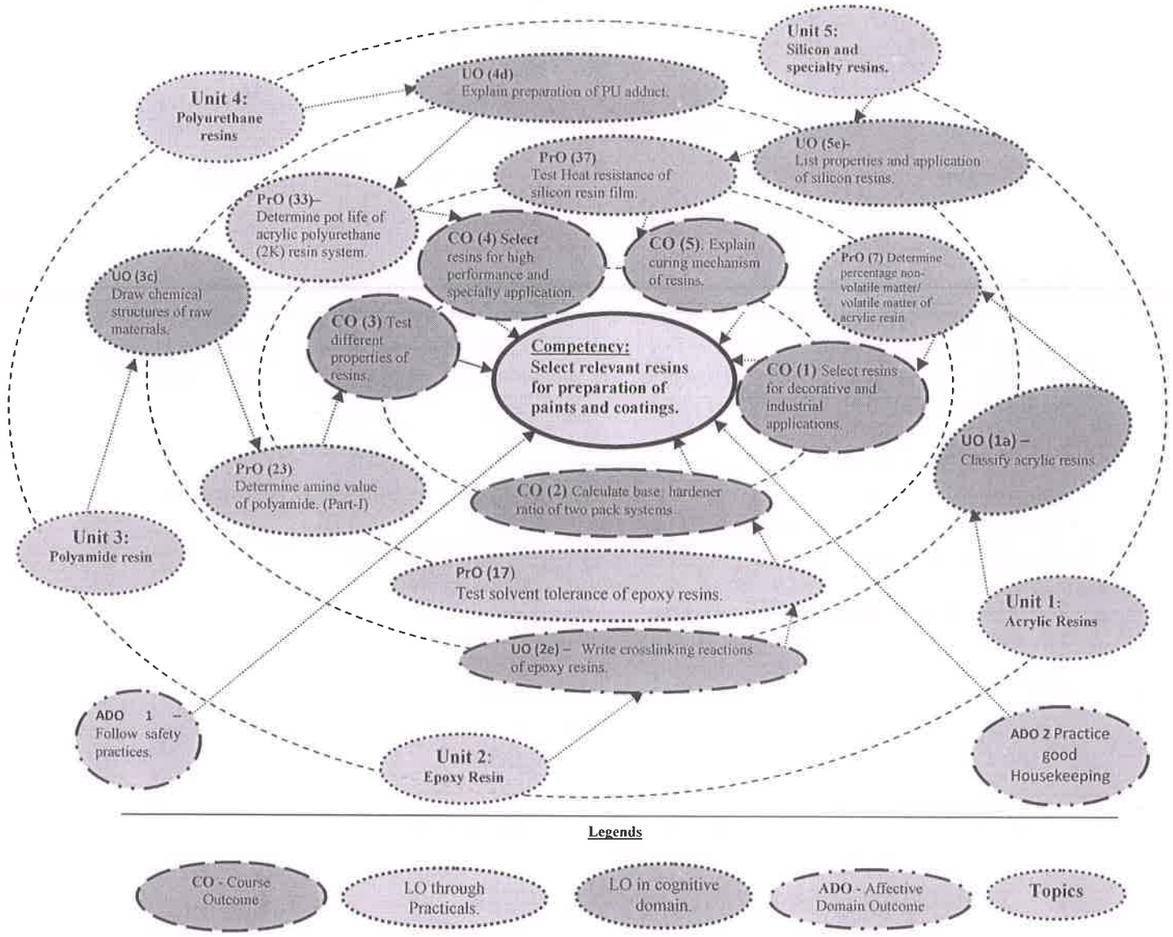

Figure 1 - Course Map

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	Determine acid value of acrylic resins using KOH solution. (Part-I: Preparation of reagents)	I	2*
2	Determine acid value of acrylic resins using KOH solution. (Part-II: Determination)	I	2*
3	Determine hydroxyl value of acrylic resins. (Part-I: Preparation of reagents)	I	2
4	Determine hydroxyl value of acrylic resin. (Part-II: Determination)	I	2
5	Test chemical resistance of thermosetting acrylic-MF resin film. (Part-I: Preparation of Panels)	I	2
6	Test chemical resistance of thermosetting acrylic-MF resin film.	I	2

	(Part-II: Testing)		
7	Determine percentage non-volatile matter/volatile matter of acrylic resin.	I	2*
8	Determine viscosity of acrylic resin by flow cup method.	I	2
9	Test solvent tolerance of acrylic resins sample.	I	2
10	Test compatibility of acrylic resin with other resins.	I	2
11	Determine Epoxy equivalent of epoxy resins. (Part-I: Preparation of reagents)	II	2*
12	Determine Epoxy equivalent of epoxy resins. (Part-II: Determination)	II	2*
13	Determine hydroxyl value of epoxy resins. (Part-I: Preparation of reagents)	II	2
14	Determine hydroxyl value of epoxy resins. (Part-II: Determination)	II	2
15	Determine percentage non-volatile matter/volatile matter of epoxy resin.	II	2
16	Determine viscosity of liquid epoxy resin by flow cup method.	II	2
17	Test solvent tolerance of epoxy resins.	II	2*
18	Test compatibility of epoxy resin with other resins.	II	2
19	Test Salt spray resistance of epoxy-polyamide resin system. (Part-I: Preparation of panels)	II	2
20	Test Salt spray resistance of epoxy-polyamide resin system. (Part-II: Testing of panels)	II	2
21	Determine amine value of polyamines. (Part-I: Preparation of reagents)	III	2
22	Determine amine value of polyamines. (Part-II: Determination)	III	2
23	Determine amine value of polyamides. (Part-I: Preparation of reagents)	III	2*
24	Determine amine value of polyamides. (Part-II: Determination)	III	2*
25	Determine the pot life of epoxy polyamide resin system.	III	2
26	Determine the gel time of epoxy polyamide resin system.	III	2
27	Test Chemical resistance of epoxy-polyamide resin system. (Part-I: Preparation of panels).	III	2
28	Test Chemical resistance of epoxy polyamide resin system. (Part-II: Testing of panels)	III	2
29	Test Solvent resistance of epoxy polyamide resin system. (Part-I: Preparation of panels)	III	2*
30	Test Solvent resistance of epoxy polyamide resin system. (Part-II: Testing of panels)	III	2*
31	Determine percentage " – NCO" content. (Part-I: Preparation of reagents)	IV	2*
32	Determine percentage " – NCO" content. (Part-II: Determination)	IV	2*
33	Determine pot life of acrylic polyurethane (2K) resin system.	IV	2*
34	Determine gel time of acrylic polyurethane (2K) resin system.	IV	2
35	Test Chemical resistance of acrylic polyurethane resin system. (Part-I: Preparation of panels)	IV	2

36	Test Chemical resistance of acrylic Polyurethane resin system. (Part-II: Testing of panels)	IV	2
37	Test Heat resistance of silicon resin film.	V	2*
38	Test Solvent tolerance of silicone resin.	V	2*
39	Determine percentage non-volatile content of silicon resin.	V	2*
40	Determine compatibility of silicon resin with other resins.	V	2
41	Determine hydroxyl value of silicon resins (Part-I: Preparation of reagents)	V	2
42	Determine hydroxyl value of silicon resins (Part-II: Determination)	V	2
43	Determine drying time of PUD film.	V	2
	Total		**86**

Note

i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 24 or more practical 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.	10
b.	Setting and operation	20
c.	Safety 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	Weighing Balance (500 gms, 0.1 gms)	1,3,5,7,11,13,15,21,23,25,26,31,33,34,39,41,43
2	Beaker (100ml, 250 ml)	1,3,5,6,11,13,19,21,23, 5,26,27,28,29,30,31, 33,34,35,36,37,39,40,41,43
3	Glass rod (8")	1,3,5,7,9,10,11,13,15,19,21,23, 25,26,27,28, 31,33,34,35,36,37,39,40,41,43
4	Volumetric flasks (250 ml 1000ml)	1,3,11,13,21,23,31,41
5	Burette (50ml)	2,4,12,14,22,24,32,42
6	Pipette (10 ml)	2,4,12,14,22,24,32,42
7	Conical Flasks (100 ml and 250 ml)	2,4,12,14,22,24,32,42
8	Metal Panels (7mm*15mm)	5,19,27,29,35,37,43
9	Brush (1")	5,19,27,29,35,37,43
10	Oven (300^{O}C)	7,15,19,27,29,35,37,39
11	Watch glass (3")	7,15,39
12	Flow Cup Method B-4	8,16, 25,26, 33,34
13	Thermometer (110^{O}C)	8,16
14	Stop Watch	8,16, 25,26,28,30, 33,34,43
15	Spatula (6")	8,10,16,18, 25,26, 33,34,40,43
16	Measuring Cylinder (100ml)	9,10,17,18,38,40
17	Salt Spray Chamber (IS 101)	20

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 Acrylic Resins	1a. Classify acrylic resins. 1b. Draw chemical structures of acrylic monomers. 1c. Calculate Tg of acrylic resins. 1d. Write chemical reactions of acrylic preparation. 1e. Explain Manufacturing techniques for acrylic resins. 1f. Write crosslinking reaction of acrylic resins. 1g. List properties and application of acrylic resins.	1.1 Introduction to Acrylic resins. 1.2 Classification of acrylic resins. 1.3 Raw materials for acrylic resins. 1.4 Calculation of glass transition temperature (Tg) 1.5 Manufacturing reactions of acrylic resins. 1.6 Manufacturing Techniques of acrylic resins. 1.7 Cross linking reactions of acrylic resins. 1.8 Properties and application of acrylic resins.
Unit-II Epoxy Resin	2a. Define epoxy resin. 2b. Draw Chemical structures of raw materials used for epoxy resins.	2.1 Introduction of Epoxy resins. 2.2 Raw materials for epoxy resins. 2.3 Formulating principles of epoxy

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	2c. Calculate "n" value of epoxy resins. 2d. Write manufacturing reactions of epoxy resins. 2e. Write crosslinking reactions of epoxy resins. 2f. Explain properties and application of epoxy resins.	resins. 2.4 Manufacturing of epoxy resins and reactions involved. 2.5 Curing reactions of epoxy resins. 2.6 Properties and application of epoxy resins.
Unit– III Polyamide resin	3a. Define polyamide resins. 3b. Classify polyamide resins. 3c. Draw chemical structures of raw materials. 3d. Write manufacturing reactions of polyamide resins. 3e. Write crossing reaction of polyamide resins. 3f. List properties and application of polyamide resins.	3.1 Introduction of Polyamide resin. 3.2 Classification of polyamide resins. 3.3 Raw materials of polyamide resins. 3.4 Introduction to amine adduct. 3.5 Manufacturing reactions of polyamide resins. 3.6 Manufacturing process for polyamide resins. 3.7 Curing reactions of polyamide resins. 3.8 Properties and applications of polyamide resin.
Unit –IV Polyurethane resins	4a. Classify polyurethane resins. 4b. Draw chemical structure of raw materials used for polyurethane. 4c. Write reactions of isocyanate. 4d. Explain preparation of PU adduct. 4e. Write crosslinking reactions of polyurethane. 4f. List properties and application of polyurethane resins.	4.1 Introduction to polyurethane resins. 4.2 Raw materials for polyurethane resins. 4.3 Reaction of Isocyanate. 4.4 Types of polyurethane resins. 4.5 Crosslinking reactions of polyurethane resins. 4.6 Properties and application of polyurethane resins.
Unit-V Silicon and specialty resins.	5a. Define silicon resins. 5b. Write manufacturing reactions of silicone resin. 5c. Explain importance of alkyl group. 5d. Explain modifications of silicon resins. 5e. List properties and application of silicon resins. 5f. List application of specialty resins.	5.1 Introduction to silicon resin. 5.2 Raw materials for silicon resins. 5.3 Manufacturing reactions of silicone resins. 5.4 Modifications of silicon resin. 5.5 Properties and application of silicone resin. 5.6 Introduction, properties and application of Teflon. 5.7 Special resin Cellulose acetate butyrate, Polyurethane dispersion, Re-dispersible powders.

***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	Acrylic resins	12	02	06	10	18
II	Epoxy resins	12	02	06	10	18
III	Polyamide resins	08	02	04	06	12
IV	Polyurethane resins	08	02	04	06	12
V	Silicon and specialty resins	08	02	02	06	10
Total		48	**10**	**22**	**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. Visit resin/polymer/ paint manufacturing plant.
b. Collect formulating principles of synthetic resins.
c. Plant utilities of resin manufacturing industries.
d. Collect legal aspects of resin manufacturing industries.

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 water base polymers.
b. Collect data for latest resin processing techniques.
c. Collect resin samples from different industries.
d. Survey of resin manufacturing industries.
e. Collect data of biodegradable materials used in surface coating industries.
f. Collect safety measures followed in resin manufacturing industries.
g. Collect data related to instruments used for resin testing.

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	Polymer Science	V.R.Gowariker, N.V.Viswanathan	New Age International Publisher (1986) ISBN: 9780852263075
5	Basics of Paints Technology Part I	V.C. Malshe and Meenal Sikchi	Antar Prakash Centre for Yoga, 2004 ISBN: 9788190329859
6	Waterborne and Solvent Based Acrylics and their end User Applications Vol-I	Oldring P	John Wiley and Sons, 1997 ISBN:0947798447

S. No.	Title of Book	Author	Publication
7	Surface Coatings: Science & Technology (2nd Edition)	Dr. Swaraj Paul	John Wiley and Sons Ltd.2014 ISBN:9788126552559
8	Waterborne and Solvent Based Epoxies and their end User Applications Vol II	Oldring P.	John Wiley and Sons, 1997 ISBN: 978-0471978831
9	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=fa-NyQQ1AY0 *:Emulsion polymerization.*
b. https://www.youtube.com/watch?v=e_TgUSioQFE *:Emulsion polymerization*
c. https://www.youtube.com/watch?v=71VRD2ecjSI *:Emulsion polymerization*
d. https://www.youtube.com/watch?v=42_LPoWVJ1Q *:Nitrogen reflux*
e. https://www.youtube.com/watch?v=Z6rCE8alv3g *:Polymerization process*
f. https://www.youtube.com/watch?v=lJRdxxln_PA *:Resin reactor*
g. https://www.youtube.com/watch?v=zjSXXNC4sWw *: Epoxy resin*
h. https://www.youtube.com/watch?v=oD2Cio0m3TM *: Epoxy resin*
i. https://www.youtube.com/watch?v=AtcqFtd_ccA : *Epoxy resin*
j. https://www.youtube.com/watch?v=_Eh6TjAJ-DA *:Reaction of epoxy resins*
k. https://www.youtube.com/watch?v=M0ERRJ885GI *: Synthetic resin*
l. https://www.youtube.com/watch?v=TYXP6jgOIr0 *: Polyurethane resin*
m. https://www.youtube.com/watch?v=4DSCNlgU2RY *:Polyurethane resin*
n. https://www.youtube.com/watch?v=nhs947JrrnU *: Polyurethane resin*
o. https://www.youtube.com/watch?v=KbKZR-WeLbU *:Silicon resin*
p. https://www.youtube.com/watch?v=usRnJP8lDxM *:Condensation polymers*
q. https://www.youtube.com/watch?v=B0QkCWP4HJM *:Viscosity by ford cup*
r. https://www.youtube.com/watch?v=aYGg3isGkWI *:Chemical reactor*
s. https://www.youtube.com/watch?v=mIKdQG5Mp9k *:Polyamide resin*
t. https://www.youtube.com/watch?v=tTfCx9nCDz4 *:Addition polymers*
u. https://www.youtube.com/watch?v=UjMbwS0LOkU *:Conductive polymers*
v. https://www.youtube.com/watch?v=RaFo5q1U1A0 *:PU dispersion*
w. https://www.youtube.com/watch?v=xO35zAFWLH8 *: Polymer modification*

Program Name : **Diploma in Surface Coating Technology**

Program Code : **SC**

Semester : **Second**

Couse Title : **Pigment Technology - II**

Couse Code : **24229**

1. RATIONALE

This course gives basic knowledge about colour, colour pigments and their role in paints. The course includes names of pigments, types of pigments, processing, their properties and uses. The course gives knowledge about test methods of pigments.

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 pigments for different types of coatings**.

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. Explain color theory.
2. Determine properties of pigment.
3. Classify pigments.
4. Interpret structure-property relations for pigment selection.
5. Use of novelty pigments in surface coating industries.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
				Theory							Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	--	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.

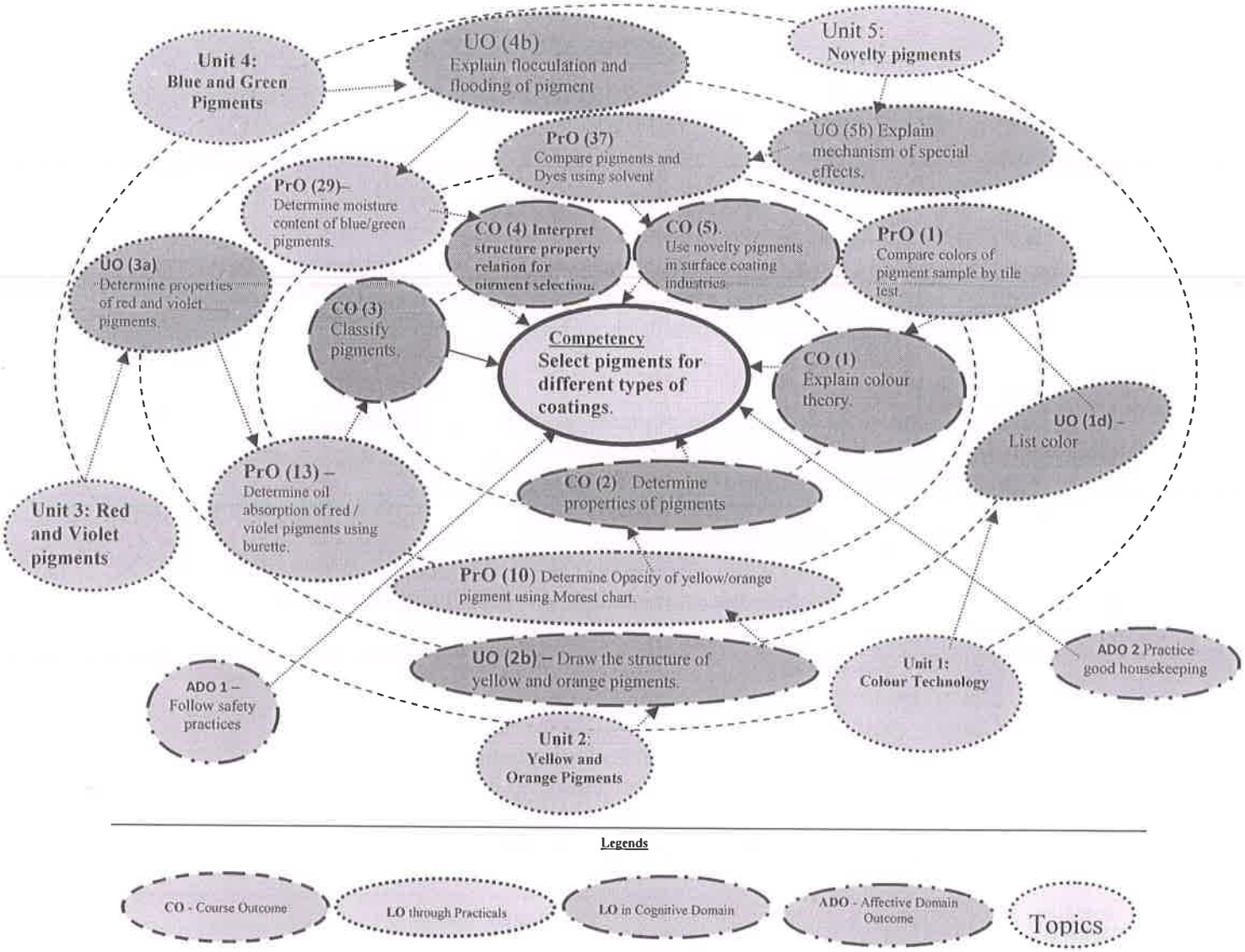

Figure 1 - Course Map

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	Compare colors of pigment samples by tile test.	I	02*
2	Compare Mass tone and Under tone of pigment using draw down method.	I	02*
3	Determine tinting strength of pigment using draw down method.	I	02*
4	Determine reducing strength of pigment using draw down method.	I	02
5	Compare opacity of organic and inorganic yellow/orange pigments by Morest chart.	II	02*
6	Compare tinting strength of organic and inorganic yellow/orange pigments by Morest chart.	II	02*

7	Determine moisture content of organic and inorganic yellow/orange pigment using oven.	II	02
8	Determine bleeding behavior of organic and inorganic yellow/orange pigment by filtration.	II	02*
9	Determine Heat resistant of organic and inorganic yellow/orange pigment using oven.	II	02
10	Determine Opacity of yellow/orange pigment using Morest chart.	II	02
11	Determine optimum loading of organic and inorganic yellow/orange pigments in given resin by Daniel flow point method.	II	02
12	Determine residue on sieve of Red/Violet using sieve analysis.	III	02*
13	Determine oil absorption of red/violet pigments using burette.	III	02*
14	Determine pH of red/violet pigments using pH paper.	III	02*
15	Determine bulk density of red/violet pigments using taping method.	III	02
16	Determine Specific gravity of red/violet pigments using specific gravity bottle.	III	02
17	Determine bleeding behavior of organic and inorganic red/violet pigment using aliphatic solvents.	III	02
18	Determine bleeding behavior of organic and inorganic red/violet pigment using aromatic solvents.	III	02
19	Determine bleeding behavior of organic and inorganic red/violet pigment using ketone solvents.	III	02
20	Determine pH of organic and inorganic red/violet pigments using pH paper.	III	02
21	Determine acid resistance of organic and inorganic red/violet pigment.	III	02
22	Determine alkali resistance of organic and inorganic red/violet pigment.	III	02
23	Prepare shade using organic pigments	III	02*
24	Prepare shade using inorganic pigments	III	02
25	Determine residue on sieve of blue/green using sieve analysis.	IV	02
26	Determine oil absorption of blue/green pigments using burette.	IV	02
27	Determine pH of blue/green pigments using pH paper.	IV	02*
28	Determine bulk density of blue/green pigments using taping method.	IV	02*
29	Determine moisture content of blue/green pigments.	IV	02*
30	Determine Specific gravity of blue/green pigments using specific gravity bottle.	IV	02
31	Determine bleeding behavior of organic and inorganic blue/green pigment.	IV	02
32	Determine acid resistance of organic and inorganic blue/green pigment.	IV	02
33	Determine alkali resistance of organic and inorganic blue/green pigment.	IV	02
34	Determine flocculation of blue/green pigment by rub out method.	IV	02*

35	Determine bleeding of blue/green pigment using water.	IV	02
36	Compare pigment and dyes using hiding power	V	02*
37	Compare pigment and dyes using solvent solubility.	V	02*
38	Test shear resistance of metallic pigments by stirring.	V	02
39	Compare shade of special effect pigments on black and white substrate.	V	02
	Total		**78**

Note

i. *A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 24 or more practical 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	All PrO
4	Stirrer assembly	38
5	Puller Spatula	2,3,4,5,6,9,10,21,22,23,24,32,33,34,36,39
6	pH meter	14,20
7	Petri dish	7,9,21,22,29,32,33
8	Beaker (50 ml, 100 ml)	3,4,5,6,9,11,13,14,16,17,18,19,20,21,22,27, 30,31,32,33,35,36,38,39
9	Conical Flask	8,17,18,19,20,21,22,27,31,32,33,35,36
10	Oven	7,9,12,16,21,22,25,29,30,32,33
11	Thermometer (0-100 ^{0}C, 0-360 ^{0}C range)	7,9,12,
12	Sieve analysis set	12,25
13	Funnel	8,14,17,27
14	Measuring Cylinder (50 CC, 100 CC)	15,28
15	Conical Flask (50 ml, 100 ml)	17,18,19,31,35
16	Sp. Gr. Bottle	16,30
17	Test tube set	8,17,18,19,31,35,36
18	Morest chart	5,6,10,36
19	Glass slate	23,24
20	Glass Rod	8,14,17,20,21,22,27,32,33
21	Burette	11,13,23,24,26,34

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 Colour Technology	1a. Define Color index. 1b. List origin of colors. 1c. Explain color theory. 1d. List color.	1.1 Concept of Color. 1.2 Origin of colors: Chromophore & Auxochrome. 1.3 Color theory: Hue, Chroma, Value, Undertone & Mas-tone, Tinting strength, Reducing power and Shade, Additive and subtractive color mixing, Complimentary colors. 1.4 Colour perception.
Unit-II Yellow and Orange pigments	2a. Explain properties and applications of yellow and orange pigments. 2b. Draw the structure of yellow and orange pigments.	2.1 Properties & Applications Inorganic Pigments: Yellow iron Oxide, Zinc Chromes, Barium Chromates & Lead Chromates. 2.2 Properties & Applications Organic Pigments: Benzidine Yellows, Hansa Yellows.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit– III Red and Violet Pigments	3a. Determine properties of red and violet pigments. 3b. Draw the structure of Red and Violet Pigments.	3.1 Properties & Applications Inorganic Pigments: Red oxide, Mixed metal oxide 3.2 Properties & Applications Organic Pigments: Toluidine Red, Signal Red, Red Lake C, Lithol Red, Rubine, Toner, Permanent Red. Quinacridone Red.
Unit-IV Blue & Green Pigments	4a. Test properties of blue and green inorganic and organic pigments. 4b. Explain flocculation and flooding of pigment. 4c. Draw the structures of blue and green pigments.	4.1 Properties & Applications Inorganic Pigments: Prussian blue, Ultramarine blue, Chrome green, Chrome oxide green. 4.2 Properties & Applications Organic Pigments: Phthalocyanine blue, Phthalocyanines green. 4.3 Flocculation and flooding of Blue and green pigments.
Unit –V Novelty pigments	5a. List novelty pigments. 5b. Explain mechanism of special effects. 5c. Explain properties and application of novelty pigments.	5.1 **Special effect pigments:** Fluorescent, phosphorescent and pearlescent pigment. 5.2 Properties and application of metallic pigments: Aluminum and Copper pigments. 5.3 Basic introduction to dyes and toner Pigments. 5.4 Properties and uses of PMA and PTMA toners (pink, violet and blue)

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	Colour Technology	10	02	04	08	14
II	Yellow and Orange pigments	10	02	04	08	14
III	Red and Violet Pigments	10	02	04	08	14
IV	Blue & Green Pigments	10	02	04	08	14
V	Novelty pigments	08	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:

a. Visit to pigment manufacturing /testing industry/lab.
b. Collect ASTM standards for pigment testing
c. Collect Indian standard (IS) standards for pigment testing.
d. Collect Analytical testing methods for evaluation of pigment properties.
e. Report latest pigment manufacturing techniques.

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 CI (Color index) names of pigments.
b. Collect latest developments in pigments.
c. Collect regulations regarding uses of pigments.
d. Prepare report on application of pigments in non-coating industries.
e. Collect data surface modifications of pigments.
f. Survey of pigment industries.
g. Collect the data of pigment defects.
h. Collect MSDS for Organic pigments.
i. Collect MSDS for In-Organic 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 (3rd Edition)	W M Morgan	CBS Publishers & Distributors Pvt. Ltd, 2000 ISBN: 9788123904306
3	Essentials of Pigments Application and Selection (1st Edition) 2009	Dr. Ashok B. Karnik	Mrs. Prabha A. Karnik publishing co.,2009. ISBN: 978-81-901087-0-6
4	Industrial Organic Pigments, Production, Properties, Application	W. Herbst, K. Hunger	WILEY-VCH Verlag GmbH & Co. KGaA ISBN: 3-527-30576-9
5	Application Properties of Pigments (1st Edition) 1999	Dr. Ashok B. Karnik	Mrs. Prabha A. Karnik, publishing co., 1999 ISBN: 81-901087-0-0

14. SOFTWARE/LEARNING WEBSITES

a. https://www.youtube.com/watch?v=L1CK9bE3H_s&t=182s colour theory
b. https://www.youtube.com/watch?v=i5V2vCRUvA4
c. https://www.youtube.com/watch?v=poL7nDmqjmk colour perception
d. https://www.youtube.com/watch?v=PdwtCFgFEeU tinting strength
e. https://www.youtube.com/watch?v=7Y0yGaT3EZQ&t=81s reducing strength
f. https://www.youtube.com/watch?v=QS3l-BKUl3g complementary colour
g. https://www.youtube.com/watch?v=5-x4bpnr9-o iron oxide yellow
h. https://www.youtube.com/watch?v=x6e2CxFlVJw&t=101s iron oxide red
i. https://www.youtube.com/watch?v=lKy2Vr9XkRw chrome pigments
j. https://www.youtube.com/watch?v=4SQcfMuTSBs
k. https://www.youtube.com/watch?v=4VspOqaJ3gc&t=129s iron oxide
l. https://www.youtube.com/watch?v=4VspOqaJ3gc&t=129s Automatic muller
m. https://www.youtube.com/watch?v=mF4CT-EuHgs pH
n. https://www.youtube.com/watch?v=HXKsPb2kl84 heat stability
o. https://www.youtube.com/watch?v=cvs1-8-V0ng Prussian blue
p. https://www.youtube.com/watch?v=Mnx6PBFBGik phthalocyanine
q. https://www.youtube.com/watch?v=v90I7lTEWDs glow pigments
r. https://www.youtube.com/watch?v=_DRMBAQyIXc Dyes
s. https://www.youtube.com/watch?v=O-eeLWWBTBE

Program Name : **Diploma in Surface Coating Technology**

Program Code : **SC**

Semester : **Second**

Couse Title : **Solvent and Additives Technology**

Couse Code : **24230**

1. RATIONALE

This course introduces basic knowledge of solvents and additives used in paints and coatings. It includes testing and understanding of test methods and results. In addition to this it will also explore working mechanism and functional behavior of materials to students. Students also get awareness about safe handling of materials.

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 relevant solvents and additives for surface coating applications.**

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. Classify solvents and additives.
2. Select relevant solvent and additives for coatings.
3. Test properties of solvents and additives.
4. Explain working mechanism of additives.
5. Explain importance of additive dosage.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
				Theory							Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	--	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.

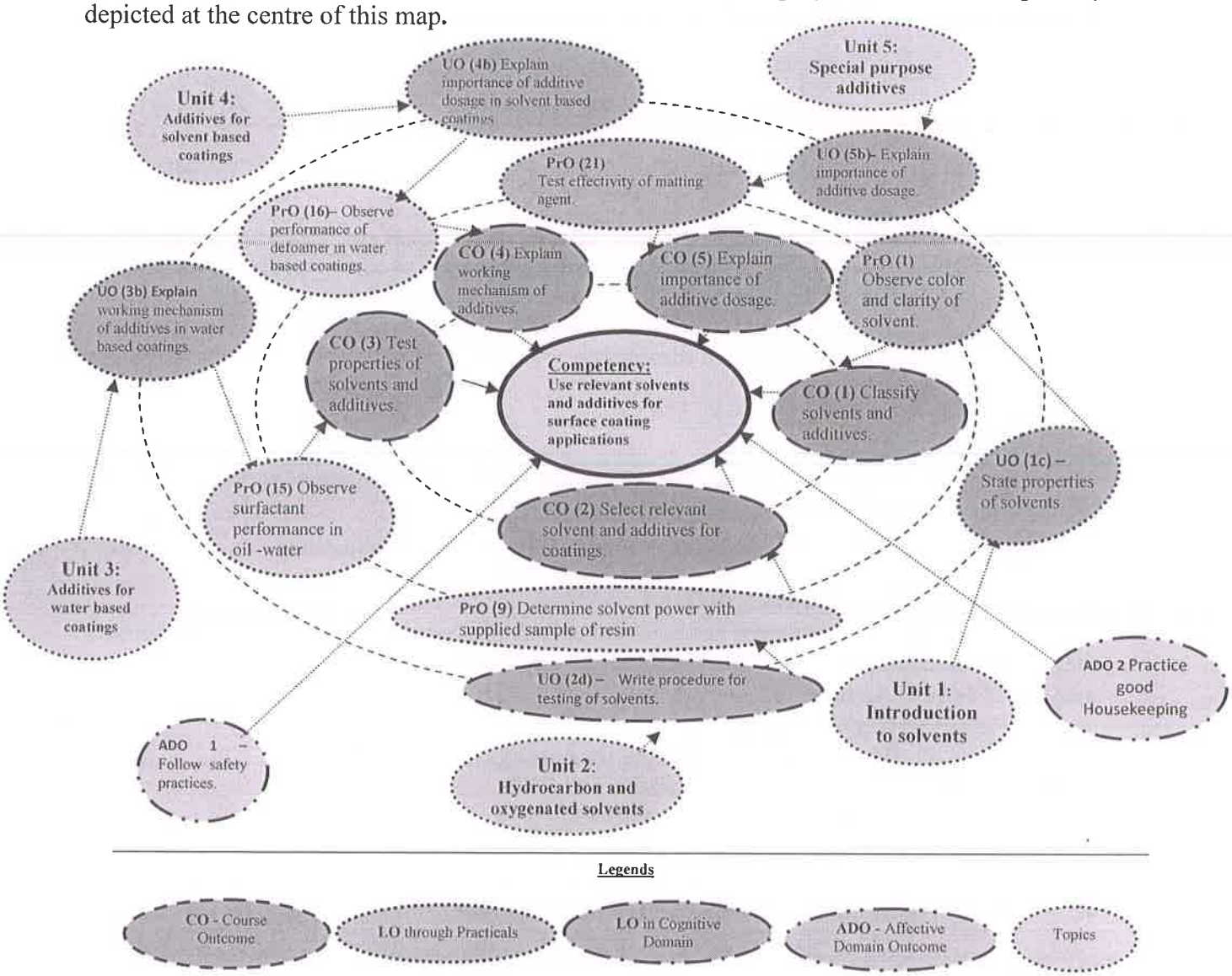

Figure 1 - Course Map

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 Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
1	Observe color and clarity of solvent.	I	2*
2	Determine flash point of solvent using Able's apparatus.	II	2
3	Determine specific gravity of solvent using Hydrometer.	II	2*
4	Determine specific gravity of solvent using specific gravity bottle.	II	2
5	Determine refractive index of solvent using Refractometer.	II	2
6	Determine distillation range of solvent using distillation apparatus.	II	2
7	Determine moisture content of solvent using Dean & Stark method.	II	2

8	Determine residue on evaporation of solvent.	II	2
9	Determine solvent power with supplied sample of resin.	II	2*
10	Determine evaporation rate of solvent.	II	2
11	Measure viscosity by Ostwald's viscometer.	II	2*
12	Determine conductivity of solvent by conductivity meter.	II	2*
13	Determine % non volatile content of additives by oven method.	III	2
14	Measure viscosity of thickener in water at different concentration.	III	2
15	Observe surfactant performance in oil-water mixture.	III	2*
16	Observe performance of defoamer in water based coatings.	IV	2*
17	Determine effectivity of curing accelerators.	IV	2
18	Determine effectivity of oil base plasticizer.	V	2
19	Determine conductivity of paints by using polar solvents and non-polar solvent.	V	2
20	Test effectivity of silicon additive in hammer tone finish.	V	2
21	Test effectivity of Matting agent.	V	2*
	TOTAL		**42**

Note

i. *A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical 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.	10
b.	Setting and operation	20
c.	Safety 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.

Sr. No	Equipment Name with Broad Specifications	PrO. No.
1	Weighing Balance (0.01 gm,Digital)	4,8,13
2	Beaker (50,100,250 ml)	All Practicals
3	Glass Rod (8")	9,15,16,17,18,19,20,21
4	Stirrer	9,15,16,17,18,20,21
5	Petri Dish (3")	8,13
6	Round Bottom Flask (500ml)	6,7
7	Oven (300^{O}C)	8,13,16,17,18,20,21
8	Metal Panel (7*15)	17,18,20,21
9	Paint Brush	17,18,20,21
10	Dropper	10
11	Able's Apparatus	2
12	Hydrometer	3
13	Specific Gravity Bottle (10 ml, 25 ml)	4
14	Refractometer	5
15	Water Condenser	6
16	Dean & Stark Condenser	7
17	Ford Cup (B-4)	9
18	Ostwald's Viscometer	11
19	Conductivity Meter	12,19
20	Brookfield Viscometer	14
21	Gloss Meter	21
22	Conical Mandrel	18

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 Solvents	1a. Define Solvents and diluents. 1b. Classify solvents. 1c. State properties of solvents. 1d. Write application of solvents. 1e. List different precautions for storage and handling of solvents.	1.1 Introduction to solvents and diluents. 1.2 Classification of solvents. Aliphatic, Aromatic, Alcohols Esters, Ketone, Ethers, Water 1.3 Physical properties of solvents. 1.4 Application of Solvents. 1.5 Safe handling and storage of solvents.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit-II Hydrocarbon and Oxygenated solvents	2a. List properties of solvents. 2b. Define properties of solvents. 2c. Draw molecular structures of solvents. 2d. Write procedure for testing of solvents. 2e. Differentiate solvents. 2f. Write applications of solvents.	2.1 Properties and application of; MTO, Xylene, Toluene, C-9, Butanol, Isopropyl alcohol, Di-acetone alcohol, Propylene glycol MEK, MIBK, Butyl acetate, Cellosolve acetate, Ethyl acetate Pine oil, Dipentene 2.2 Testing of solvents: Color and Clarity, Flash point, Specific gravity, Solvent power, Distillation range, Evaporation rate, Refractive index Conductivity, Acidity and alkalinity, Boiling point
Unit– III Additives for water based coatings	3a. Define additives. 3b. Explain working mechanism of additives in water based coatings. 3c. Explain importance of additive dosage in water based coatings.	3.1 Introduction to additives for water based systems. 3.2 Working mechanism, physical and functional properties of; Thickeners, wetting agents, Dispersing agents, Emulsifier, Coalescent agents, Antisettling agents, Antifoamers and defoamers. Perseverative, Biocides, Adhesion promoters.
Unit –IV Additives for solvents based coatings	4a. Explain working mechanism of additives in solvent based coatings. 4b. Explain importance of additive dosage in solvent based coatings. 4c. Explain significance of active content of additives.	4.1 Introduction to additives for Solvent based systems. 4.2 Working mechanism, physical and functional properties of; Rheology modifiers, wetting agents, dispersing agents, Antisettling agents, Antiskinning agents, Driers, Antifoamers and defoamers, Flow and leveling agents, UV Stabilizers, Adhesion promoters., Curing accelerates, Moisture scavengers, Slip and mar resistance.
Unit-V Special purpose additives	5a. Explain functional properties of special purpose additives. 5b. Explain importance of additive dosage.	5.1 Working mechanism of additives physical and functional properties of; Plasticizers, Photoinitiators, Wax additives, Silicon additives, Anti-gel/Stabilizing additives, Anti floating/anti flooding agents, Flame retardant additives, Matting agents, Conductivity modifiers (Antistatic agents), Corrosion inhibitors.

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 Solvents	08	02	02	06	10
II	Hydrocarbon and Oxygenated solvents	12	02	04	14	20
III	Additives for water based coatings	10	02	05	08	15
IV	Additives for solvents based coatings	10	02	05	08	15
V	Special purpose additives	08	02	02	06	10
Total		48	**10**	**18**	**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: 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. Compile standard test methods for solvent testing.
b. Visit to testing laboratories.
c. Collect information about latest developments in paint raw materials.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

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

f. Correlate properties and application of solvents for preparation of coatings.
g. Use Flash/Animations to explain working mechanism of additives in solvent and water based coatings.
h. Before starting practical, teacher should demonstrate the principle, working mechanism and experimental set up used for conducting practical.
i. Instructions to students regarding care and maintenance of equipments.
j. Before starting practical, teacher should instruct various safety precaution need to take while handling instrument and chemical.
j. Teacher should ask students to go through instruction, technical specification &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 Material Safety Data sheet of solvents.
b. Collect Technical Data sheet for solvents.
c. Collect Material Safety Data sheet of additives.
d. Collect Technical Data sheet for additives.
e. Compare properties of solvents in their respective families.
f. Compare data of optimum dosing of various additives from various industries.
g. Collect safety norms, safety practices for solvent storage and handling in industries.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Technology of Paints, Varnishes and Lacquers	Charles R Martens	Robert Kriger Publishing Company Malbar, Florida
2	Outlines of Paint Technology (3rd Edition)	W. M. Morgan	CBS Publishers & Distributors Pvt. Ltd, 2000 ISBN: 9788123904306
3	Handbook of Solvents	George Wypych	Chem Tec Publishing Earswick Drive, Toronto, Ontario, Canada, ISBN : 1-895198-24-0
4	Paint and surface Coatings	R Lambourne and T A Strivens	Woodhead Publishing Ltd, Abington Hall, Abington, Cambridge CB1

S. No.	Title of Book	Author	Publication
			6AH, England ISBN 1 85573 348 X
5	Additives for Coatings	Johan Bieleman	WILEY-VCH Verlag GmbH, D-69469 Weinheim (Federal Republic of Germany), 2000 ISBN-10: 3527297855

14. SOFTWARE/LEARNING WEBSITES

a) https://www.youtube.com/watch?v=QDMHz5tpCKo
b) https://www.youtube.com/watch?v=ddCuWX4vtOA
c) https://www.youtube.com/watch?v=prWqENxWjsU
d) https://www.youtube.com/watch?v=NUr4mAqR6sU
e) https://www.youtube.com/watch?v=94_4gO8TT60
f) https://www.youtube.com/watch?v=vNEyaniqY5w
g) https://www.youtube.com/watch?v=iEoADLYj-Os
h) https://www.youtube.com/watch?v=Zw2n1eSuswo
i) https://www.youtube.com/watch?v=5fxuX6M3jgQ
j) https://www.youtube.com/watch?v=s95hjxHCajA
k) https://www.youtube.com/watch?v=kq1CIg3nxBY

Program Name: Diploma in Food Technology / Diploma in Surface Coating Technology / Diploma in Printing Technology / Diploma in Travel & Tourism / Diploma in Medical Laboratory Technology

Program Code : FC/ SC / PN / TR / ML

Semester : Second

Course Title : Business Communication Using Computers

Course Code : 22009

1. RATIONALE

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

2. COMPETENCY

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

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

3. COURSE OUTCOMES (COs)

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

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

4. TEACHING AND EXAMINATION SCHEME

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

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

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

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

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

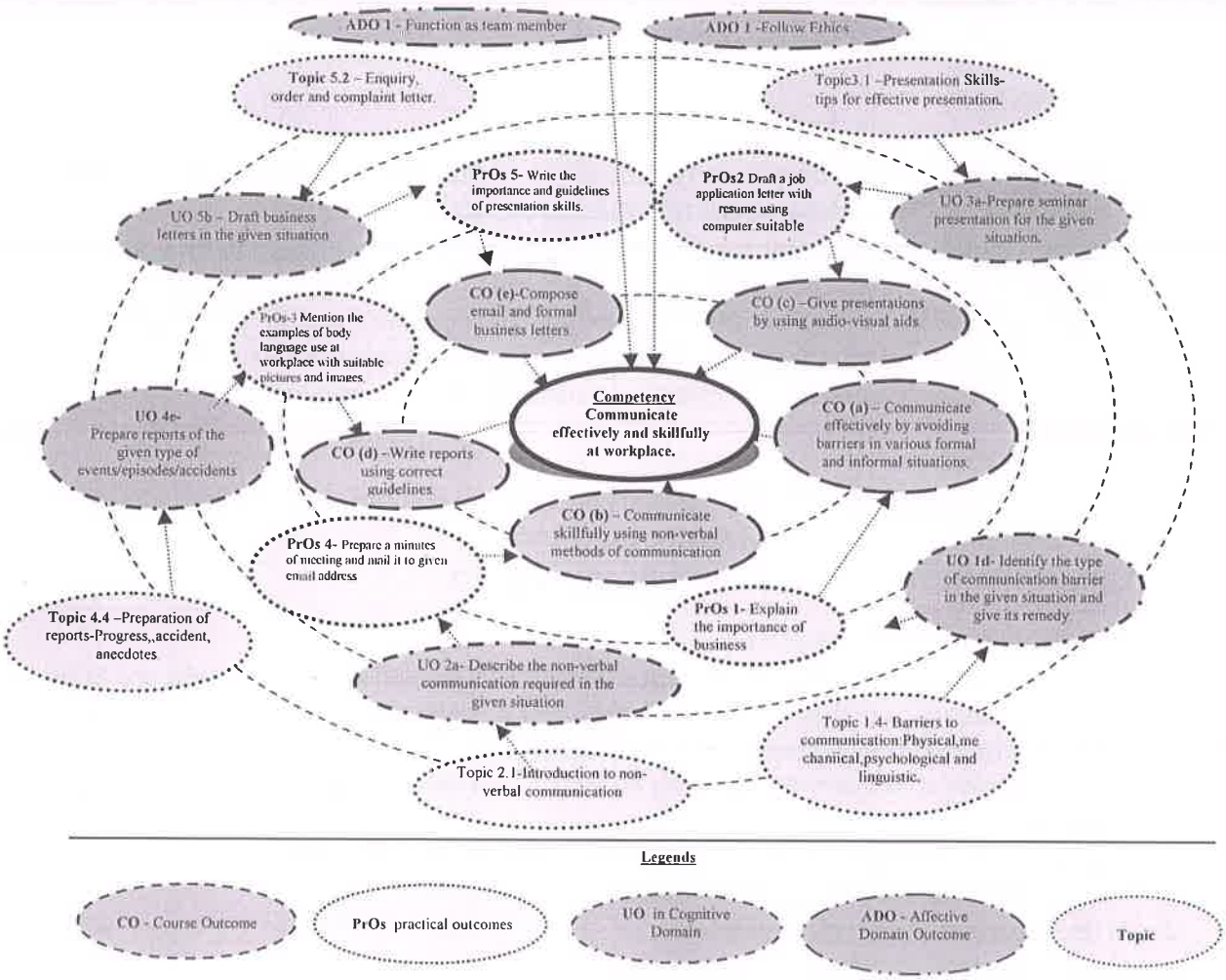

Figure 1 - Course Map

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

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

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

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

Note

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

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

7. MAJOR EQUIPMENTS / INSTRUMENTS REQUIRED

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

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

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Unit Outcomes (UOs) (in cognitive domain)		Topics and Sub-topics
	Writing Skills	Speaking Skills	
Unit – I Introduction to Business Communication	1a. Describe the importance of the business communication in the given situation. 1b. Identify the missing element in the given communication process. 1c. Identify the type of communication in the given situation. 1d. Identify the type of communication barrier in the given situation and its remedy.	1e. Use different types of verbal and non–verbal communication for the given situation.	1.1 Introduction to Communication- Elements, Importance, Functions. 1.2 Types (meaning and importance) –Verbal (Oral-Written), Formal, Informal, Vertical, Horizontal and Diagonal communication. 1.3 Principles of effective communication. 1.4 Barriers to communication - Physical, mechanical, psychological and linguistic. 1.5 Business communication: Meaning, characteristics and importance.
Unit– II Non-Verbal Communication	2a. Describe the non-verbal communication required in the given situation. 2b. Describe personal appearance required in the given communication situation. 2c. Describe the given facial expressions.	2d. Use relevant facial expressions in the given situation. 2e. Answer questions after listening to presentations.	2.1 Introduction to Non-Verbal communication (Meaning and importance) 2.2 Body Language: Aspects of body language: gestures, eye contact, posture, facial expressions, personal appearance (dressing and grooming) vocalics. 2.3 Body language - positive and negative body language.
Unit– III Presentation skills	3a. Prepare seminar presentation for the given situation. 3b. Prepare debate points 'for' and 'against' the given topic. 3c. Prepare the points for computer presentation for the given topic.	3d. Make seminar presentation 3e. Participate in debate speaking 'for' or 'against' the given topic. 3f. Make effective computer	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	
		presentations	
Unit– IV Office Drafting	4a. Draft the given notice using the relevant format. 4b. Draft the given memorandum using the relevant format. 4c. Prepare agenda for the given type of meetings. 4d. Prepare minutes of the given type of meetings. 4e. Prepare reports of the given type of events/episodes/ accidents	4f. Read the agenda of the given meeting. 4g. Read the report of the given event. 4h. Initiate telephone calls for given situation. 4i. Answer official phone calls for given situation.	4.1. Office drafting: Formats and Guidelines. 4.2. Formulating notices and memoranda. 4.3. Preparation of agenda and writing minutes of meetings. 4.4. Preparation of reports- progress reports, Accident reports, case study. 4.5. Summarizing techniques.
Unit-V Business Correspondence	5a. Respond to given job advertisements by writing your CV/ Resume. 5b. Draft business letters in the given situations. 5c. Draft complaint letters for the given situations. 5d. Compose E- mails with relevant for the given situation.		5.1 Business correspondence. 5.2 Enquiry, order and complaint letters. 5.3 E-mails- netiquettes. 5.4 Difference –Curriculum Vitae, Bio-data and Resume. 5.5 Job application and resume writing

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

9. SUGGESTED SPECIFICATION TABLE FOR INTERNAL END SEMISTER EXAMINATION

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

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

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

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

SUGGESTED STUDENT ACTIVITIES

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

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

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

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

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

12. SUGGESTED TITLES OF MICRO-PROJECTS

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

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

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

13. SUGGESTED LEARNING RESOURCES

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

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

14. SOFTWARE/LEARNING WEBSITES

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

Program Name : **Diploma in Surface Coating Technology**

Program Code : **SC**

Semester : **Second**

Couse Title : **Material Synthesis**

Couse Code : **24019**

1. RATIONALE

This course introduces basic principles of synthesizing of various materials used in coatings. Students will be introduced to various working practices in an industrial laboratories and shop floor. Students will learn safe handling of materials, equipment maintenance of equipment. Students will able to understand various aspects raw materials and finished products.

2. COMPETENCY

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

- **Test raw materials as per given specifications.**

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. Prepare practical set up for synthesis of materials.
2. Test samples of paint raw materials.
3. Record the results.
4. Prepare data report.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme													
				Theory							Practical						
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total		
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
--	--	4	4	3	--	--	--	--	--	--	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.

(~): Under practical PA 60% (30 marks) are for practical assessments and 40% (20Marks) for micro projects.

***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.

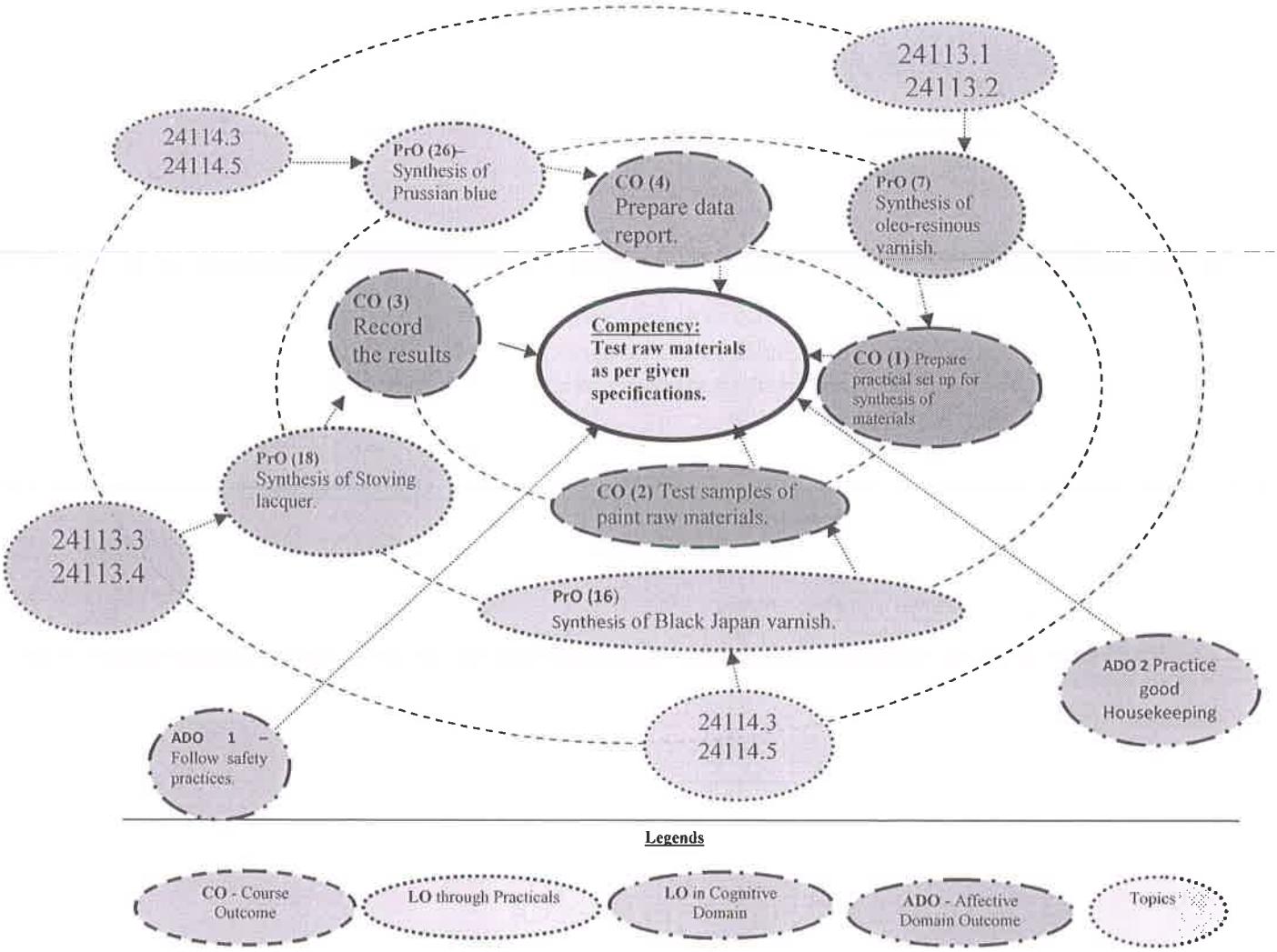

Figure 1 - Course Map

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	Synthesis of ester gum. (Part-I: Preparation of sample)	24113. 1,2	2
2	Synthesis of ester gum. (Part-II: Evaluation of sample)	24113. 3,4	2
3	Synthesis Calcium rosinate. (Part-I: Preparation of sample)	24113. 1,2	2
4	Synthesis Calcium rosinate. (Part-II: Evaluation of sample)	24113. 3,4	2
5	Synthesis of Penta ester gum. (Part-I: Preparation of sample)	24113.1 24113.2	2
6	Synthesis of Penta ester gum. (Part-II: Evaluation of sample)	24113.3 24113.4	2

7	Synthesis of oleo-resinous varnish. (Part-I: Preparation of sample)	24113.1 24113.2	2*
8	Synthesis of oleo-resinous varnish. (Part-II: Evaluation of sample)	24113.3 24113.4	2*
9	Synthesis of Alkyd resin varnish. (Part-I: Preparation of sample)	24113.1 24113.2	2
10	Synthesis of alkyd resin varnish. (Part-II: Evaluation of sample)	24113.3 24113.4	2
11	Synthesis of Shellac varnish. (Part-I: Preparation of sample)	24113.1 24113.2	2
12	Synthesis of Shellac varnish. (Part-II: Evaluation of sample)	24113.3 24113.4	2
13	Synthesis of NC lacquer. (Part-I: Preparation of sample)	24113.2	2
14	Synthesis of NC lacquer. (Part-II: Evaluation of sample)	24113.3 24113.4	2
15	Synthesis of Black Japan varnish. (Part-I: Preparation of sample)	24113.2	2*
16	Synthesis of Black Japan varnish. (Part-II: Evaluation of sample)	24113.3 24113.4	2*
17	Synthesis of Stoving lacquer. (Part-I: Preparation of sample)	24113.2	2*
18	Synthesis of Stoving lacquer. (Part-II: Evaluation of sample)	24113.3 24113.4	2*
19	Synthesis of bodied oil. (Part-I: Preparation of sample)	24113.2	2
20	Synthesis of bodied oil. (Part-II: Evaluation of sample)	24113.3 24113.4	2
21	Synthesis of two pack polyurethane lacquer. (Part-I: Preparation of sample)	24228.2 24228.3	2*
22	Synthesis of two pack polyurethane lacquer. (Part-II: Evaluation of sample)	24228.2 24228.3	2*
23	Synthesis of Lead chromate. (Part-I: Preparation of sample)	24114.3 24114.5	2
24	Synthesis of Lead chromate. (Part-II: Filtration and drying)	24114.5	2
25	Synthesis of Lead chromate. (Part-III: Evaluation of sample)	24114.4	2
26	Synthesis of Prussian blue. (Part-I: Preparation of sample)	24229.2 24229.3	2*
27	Synthesis of Prussian blue. (Part-II: Filtration and drying)	24229.2 24229.3	2*
28	Synthesis of Prussian blue. (Part-III: Evaluation of sample)	24229.2 24229.3	2*
29	Synthesis of Blanc fixe. (Part-I: Preparation of sample)	24114.3 24114.5	2
30	Synthesis of Blanc fixe. (Part-II: Filtration and drying)	24114.5	2
31	Synthesis of Blanc fixe. (Part-III: Evaluation of sample)	24114.4	2

32	Prepare sample of GP thinner for synthetic enamels.	24230.1 24230.3	2*
33	Prepare sample of NC thinner for NC paints.	24230.1 24230.3	2
34	Prepare sample of Stoving thinner for stoving paints.	24230.1 24230.3	2*
35	Prepare sample of Degreasing thinner for surface cleaning.	24230.1 24230.3	2
36	Prepare sample of Epoxy thinner for epoxy paints.	24230.1 24230.3	2*
37	Prepare sample of PU thinner for PU paints.	24230.1 24230.3	2
38	Prepare sample of Electrostatic thinner for electrostatic application.	24230.1 24230.3	2
39	Prepare emulsion sample (oil in water). Part-I: Preparation of emulsion sample	24230.1 24230.3	2*
40	Prepare emulsion sample (oil in water). Part-II: Evaluation of	24230.1 24230.3	2*
41	Prepare alkyd emulsion	24230.1 24230.3	2
	Total		**82**

Note

i. *A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 24 or more practical 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 %
1	Arrangement of available equipment, raw materials, reagents etc.	10
2	Setting and operation	20
3	Safety and housekeeping	10
4	Observations and Recording	20
5	Interpretation of result and Conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
	Total	**100**

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

a. Follow safety practices.
b. Practice good housekeeping.
c. 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	Weighing balance (max 500gms, 0.1gms)	All PrOs
2	Heating Mantel (300^{O}C)	1,3,5,7,9,11, 15, 19
3	Steel Cup (500ml)	1,3,5,7,9,11,15, 39, 41
4	Spatula (6")	1,3,5,7,9,11, 15,19, 39, 41
5	Thermometer (360^{O}C)	1,3,5,7,9,11, 15,19, 39, 41
6	Burette (50ml)	2,4,6,8,10,12
7	Pipette (10ml)	2,4,6,8,10,12
8	Conical Flasks (100ml & 250 ml)	2,4,6,8,10,12
9	Beaker (100 ml and 500 ml)	2,4,6,8,10,12, 13, 17, 21, 32, 33,34, 35, 36, 37, 38, 39, 41
10	Glass rod (8")	13,14,15, 17, 21, 32, 33,34, 35, 36, 37, 38
11	Glass plate (12"*12")	14, 15, 21
12	Block applicator (Varying DFTs)	14, 15, 22
13	Flow cup B-4	14, 15, 18, 20, 22,32, 33,34,35, 36, 37, 38
14	Metal Panel	18, 35
15	Brush (1")	18
16	Adhesion tape (1")	18, 22
17	Two neck Flask (500ml)	19
18	Measuring Cylinder (100ml)	32, 33,34, 36, 37, 38,40, 41
19	Conductivity meter	38
20	High Speed stirrer	39, 41

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
Theory content Prerequisite related to 1. Resin Technology-I, (24113) 2. Pigment Technology-I (24114) 3. Solvent and additives (24230)		

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

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Not Applicable

10. SUGGESTED STUDENT ACTIVITIES

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

a. Compile a data of testing equipment/manufacturing machines used for raw materials synthesis.
b. Visit to raw materials manufacturing plants/testing laboratories.
c. Conduct a technical paper and poster presentation.
d. Deliver a presentation on technical topic.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the 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 information related specialty pigments/special purpose pigment.
b. Collect information related to functional resins.
c. Collect information of nano materials.
d. Collect information about sustainable raw materials used in coatings.
e. Collect information about latest developments in resins and pigments.

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	Essentials of Pigments Application and Selection (1st Edition) 2009	Dr. Ashok B. Karnik	Mrs. Prabha A. Karnik publishing co.,2009. ISBN: 978-81-901087-0-6
5	Industrial Organic Pigments, Production, Properties, Application	W. Herbst, K. Hunger	WILEY-VCH Verlag GmbH & Co. KGaA, ISBN: 3-527-30576-9
6	Handbook of Synthetic Dyes and Pigments	Kishore M. Shah	Edu-tech publishing co.,1994 ISBN: 9788192666006
7	Handbook Of Solvents	George Wypych	Chem Tec Publishing Earswick Drive, Toronto, Ontario, Canada, ISBN : 1-895198-24-0
8	Paint And Surface Coatings	R Lambourne and T A Strivens	Woodhead Publishing Ltd, Abington Hall, Abington, Cambridge CB1 6AH, England ISBN 1 85573 348 X
9	Additives for Coatings	Johan Bieleman	WILEY-VCH Verlag GmbH, D-69469 Weinheim (Federal Republic of Germany), 2000 ISBN-10: 3527297855

14. SOFTWARE/LEARNING WEBSITES

a. https://www.youtube.com/watch?v=OFzlOP2u2WI
b. https://www.youtube.com/watch?v=2ISPqlQjWXE
c. https://www.youtube.com/watch?v=_maDE0Rmjf0
d. https://www.youtube.com/watch?v=pQKUE2sZYAU
e. https://www.youtube.com/watch?v=R2tLPLt6_Vw
f. https://www.youtube.com/watch?v=MQ2X1GFHhAM
g. https://www.youtube.com/watch?v=zmIY5QCTs7s
h. https://www.youtube.com/watch?v=TLVkfyLybE4
i. https://www.youtube.com/watch?v=lVN-ZbJ_GQA
j. https://www.youtube.com/watch?v=a1OCibJNAcg
k. https://www.youtube.com/watch?v=oFwWrAq47io
l. https://www.youtube.com/watch?v=MxRIPkzgUTM
m. https://www.youtube.com/watch?v=RYMxRMEmmJk
n. https://www.youtube.com/watch?v=lKy2Vr9XkRw
o. https://www.youtube.com/watch?v=lzv3Nr4kCks
p. https://www.youtube.com/watch?v=tQYmWVvsMYA
q. https://www.youtube.com/watch?v=KaUgI12qfXE
r. https://www.youtube.com/watch?v=CkXhZeqPhMU
s. https://www.youtube.com/watch?v=bC_czAL24zY