



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 : FOURTH

DURATION : 16 WEEKS

PATTERN : FULL TIME - SEMESTER

SCHEME : I

S. N.	Course Title	Course Abbre viation	Course Code	Teaching Scheme			Credit (L+T+P)	Examination Scheme												Grand Total	
								Theory						Practical							
				L	T	P		Exam Duration in Hrs.	ESE		PA		Total		ESE		PA		Total		
									Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks		
1	Environmental Studies	EST	22447	3	-	-	3	90 Min	70*#	28	30*	00	100	40	--	--	--	--	100		
2	Instrumentation in Surface Coating Industries	PIN	24420	3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
3	Paints Technology-I	PTE	24421	4	-	4	8	3	70	28	30*	00	100	40	50#	20	50	20	100	40	200
4	Application and Evaluation of Paints-I	AEP	24422	3	-	4	7	3	70	28	30*	00	100	40	50#	20	50	20	100	40	200
5	Allied Surface Coating	DSC	24423	3	-	4	7	3	70	28	30*	00	100	40	50@	20	50	20	100	40	200
Total				16	-	14	30	--	350	--	150	--	500	--	175	--	175	--	350	--	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 Architecture Assistantship / Diploma in Food Technology/ Diploma in Medical Laboratory Technology/ Diploma in Printing technology/ Diploma in Surface Coating / Diploma in Travel and Tourism

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

Semester : Fourth

Course Title : Environmental Studies

Course Code : 22447

1. RATIONALE

The world today is facing the biggest challenge of survival. Degradation of ecosystem, depletion of natural resources, increasing levels of pollution pose major threat to the survival of mankind. The need of the hour, therefore, is to concentrate on the area of environmental aspects, which shall provide an insight into various environment related issues. Environmental studies are an interdisciplinary academic field that integrates physical, chemical and biological sciences, with the study of the environment. It provides an integrated, quantitative, and interdisciplinary approach to the study of environmental system & gives an insight into solutions of environmental problems.

2. COMPETENCY

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

- Diagnose and manage environment related issues

3. COURSE OUTCOMES (COs)

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

- Develop Public awareness about environment
- Select alternative energy resources for Engineering Practice
- Conserve Ecosystem and Biodiversity
- Apply techniques to reduce Environmental Pollution
- Manage social issues and Environmental Ethics as lifelong learning

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
L	T	P		Theory						Practical						
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	-	3	90 Min	70*#	28	30*	00	100	40	--	--	--	--	--	--

(#) Online Theory Examination.

(*): Under the theory PA. Out of 30 marks, 10 marks are for online 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.

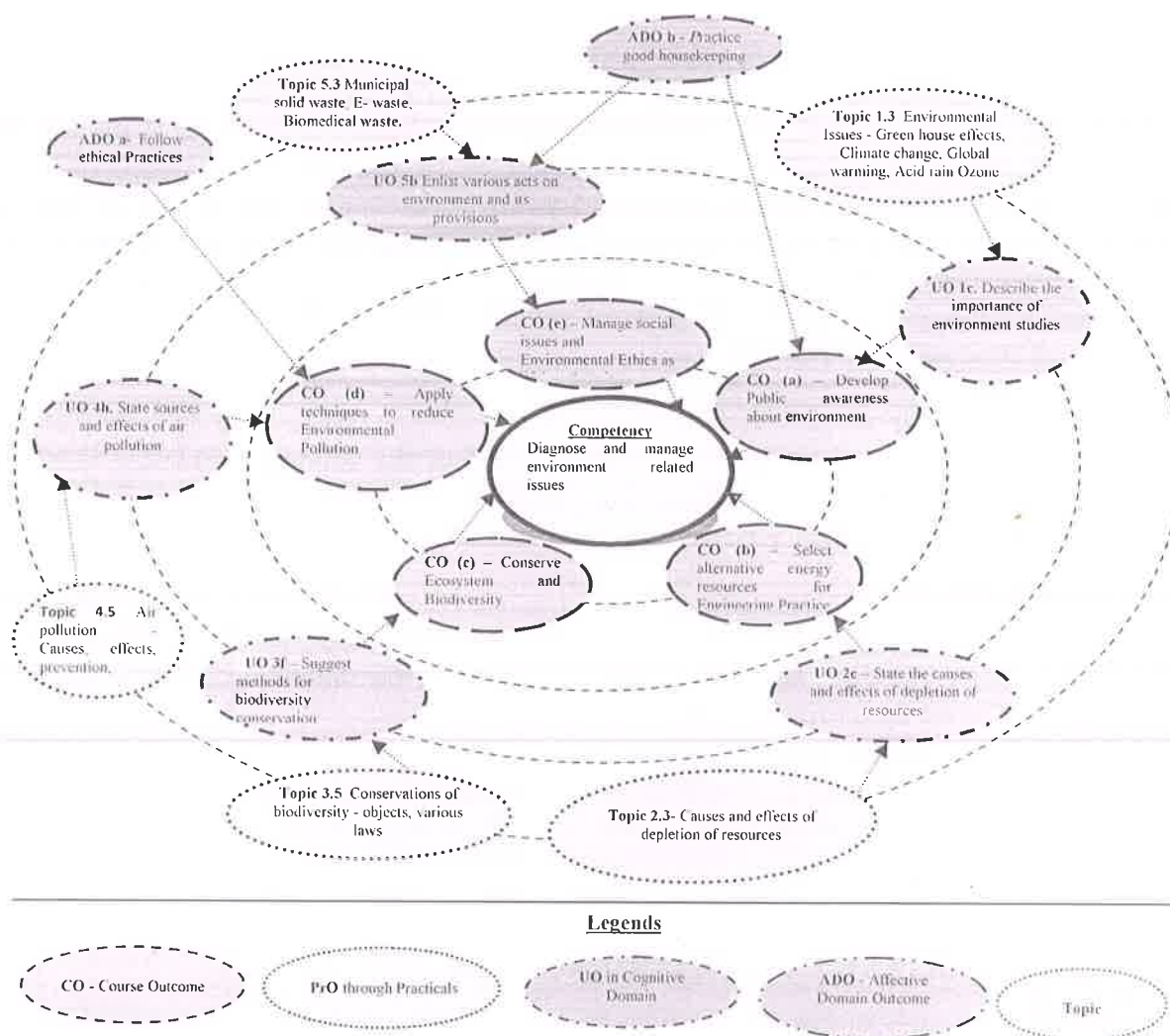


Figure 1 - Course Map

6. SUGGESTED EXERCISES

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

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	NIL		
	Total		

Note

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

S. No.	Performance Indicators	Weightage in %
1	NIL	
Total		

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

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	NIL	-

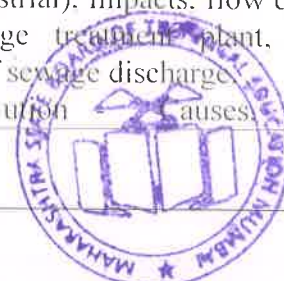
8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Environment	1a. Discuss the scope of Environment. 1b. Describe various types of environment 1c. Describe the importance of environment studies. 1d. Discuss about the need of	1.1 Definitions, need of environmental studies. 1.2 Segments of environment- Atmosphere, Hydrosphere Lithosphere, Biosphere. 1.3 Environmental Issues - Green house effects, Climate change, Global



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	public awareness about environment. 1e. Describe various environmental issues.	warming, Acid rain Ozone layer depletion, Nuclear accidents. 1.4 Concept of 4R (Reduce, Reuse, Recycle and Recover), 1.5 Public awareness about environment.
Unit– II Energy Resources	2a. List various natural resources. 2b. Describe Renewable, Nonrenewable and Cyclic resources. 2c. State the causes and effects of depletion of resources. 2d. State advantages and disadvantages of forms of energy. 2e. Select appropriate solutions of efficient use of energy. 2f. State the impacts of overuse of natural resources.	2.1 Natural Resources - Forest Resources, Water Resources, Energy Resources, Land resources, Mineral resources. 2.2 Renewable, Non-renewable and Cyclic Resources. 2.3 Causes and effects of depletion of resources. 2.4 Energy forms (Conventional and non-conventional). 2.5 Present global energy use and future demands. 2.6 Energy conservation. 2.7 Over use of natural resources and its impacts on environment.
Unit- III Ecosystem and Biodiversity	3a. State the aspects and division of ecosystem. 3b. State the general characteristics and function of ecosystem. 3c. List levels of biodiversity. 3d. Enlist the endangered species. 3e. Describe value of biodiversity. 3f. Suggest methods for biodiversity conservation.	3.1 Ecosystem - Definition, Aspects of ecosystem, Division of ecosystem, General characteristics of ecosystem, Functions of ecosystem. 3.2 Biodiversity - Definitions, Levels, Value and loss of biodiversity. 3.3 Biodiversity assessment initiatives in India. 3.4 Threats and Hotspots of biodiversity. 3.5 Conservations of biodiversity - objects, various laws.
Unit– IV Environmental Pollution	4a. Define pollution. 4b. State the sources of pollution. 4c. State the effects of land pollution on environment and lives. 4d. State various units and their functions of water treatment plant. 4e. State the needs of water conservation. 4f. State the impacts of sewage. 4g. State various units and their functions of sewage treatment plant. 4h. State sources and effects of air pollution. 4i. Describe various methods to	4.1 Definition of pollution, types- Natural & Artificial (Man-made). 4.2 Soil / Land Pollution – Causes and effects on environment and lives, preventive measures. 4.3 Water Pollution - Sources of water (surface and sub surface), sources of water pollution, effects on environment and lives, preventive measures, BIS water quality standards, flow diagram of water treatment plant, Water conservation. 4.4 Wastewater - Generation(domestic and industrial), Impacts, flow diagram of sewage treatment plant, CPCB norms of sewage discharge. 4.5 Air pollution causes, effects.



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	prevent air pollution. 4j. State sources and effects of noise pollution. 4k. Describe preventive measures for noise pollution. 4l. State characteristics of solid waste. 4m. State the impacts of solid waste. 4n. Describe incineration, RDF and sanitary landfilling. 4o. State the standards limiting/controlling values of various types of pollution.	prevention, Ambient air quality standards. 4.6 Noise pollution - Sources, effects, prevention, noise levels at various zones of the city. 4.7 Municipal Solid Waste, Bio-medical waste and E-waste - Sources, generation, characteristics, effects, and methods to manage.
Unit-V Social Issues and Environmental Education	5a. Elaborate article (48-A) and (51-A (g)) 5b. Enlist various acts on environment and its provisions. 5c. State the roles and responsibilities of CPCB. 5d. Define sustainable development, and EIA. 5e. Describe rain water harvesting and groundwater recharge. 5f. Differentiate between formal and non formal education.	5.1 Article (48-A) and (51-A (g)) of Indian Constitution regarding environment, Environmental protection and prevention acts, CPCB and MPCB norms and responsibilities, The role of NGOs. 5.2 Concept of sustainable development, EIA and environmental morality. 5.3 Management Measures - Rain Water harvesting, Ground water recharge, Green Belt Development, Use of Renewable energy, water shed management, interlinking of rivers. 5.4 Role of information technology in environment and human health.

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	Environment	06	4	6	-	10
II	Energy Resources	10	4	8	4	16
III	Ecosystem and Biodiversity	08	4	4	4	12
IV	Environmental Pollution	16	8	8	4	20
V	Social Issues and Environmental Education	08	4	4	4	12
Total		48	24	30	16	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:

- Plant and adopt a tree in your nearby locality/Polytechnic campus and prepare report about its growth and survival after six months with photos.
- Organize seminar on air pollutants of relevant MIDC area/vehicle
- Organize poster exhibition about global warming and ozone depletion.
- Visit a nearest water purification/effluent treatment plant.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

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

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 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

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

- Prepare a report on visit to PUC Center.



- b. Visit a near by RO plant and prepare detail technical report.
- c. Prepare report on Household water filtration unit
- d. Prepare a list of polluted natural resources which are responsible for pollution and collect information on how to manage them .
- e. **Collection of Data from Hospital: Collect** everyday information on percentage of solid hazardous and toxic waste for two month
- f. **Visit of Municipal Effluent Treatment Plant:** Visit effluent treatment plant and prepare report on waste management.
- g. **Visit of Water Treatment Plant:** Visit water treatment plant and prepare report on various units of water treatment and its management.
- h. **Preparation of report:** Prepare the chart of solid waste management showing effects on environment.
- i. **And any other relevant topic related to course**

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Basic Environmental Sciences	Michael Allaby	Routledge Publication, 2 nd Edition, 2000, ISBN: 0-415-21176-X
2	Environmental Science	Y. K. Singh	New Age International Publishers, 2006, ISBN: 81-224-2330-2
3	Environmental Studies	Erach Bharucha	University Grants Commission, New Delhi
4	Environmental Studies	Rajagopalan	Third Edition, Oxford University Press, USA, ISBN: 9780199459759, 0199459754
5	A text book of Environmental Science	Arvind Kumar	APH Publishing New Delhi
6	A text book of Environmental Studies	Shashi Chawla	Tata Mc Graw-Hill New Delhi

14. SOFTWARE/LEARNING WEBSITES

- a. www.eco-prayer.org
- b. www.teriin.org
- c. www.cpcb.nic.in
- d. www.indiaenvironmentportal.org.in
- e. www.whatis.techtarget.com
- f. www.sustainabledevelopment.un.org
- g. www.conserve-energy-future.com



Program Name : Diploma in Surface Coating Technology
Program Code : SC
Semester : Fourth
Couse Title : Instrumentation in Surface Coating Industries
Couse Code : 24420

1. RATIONALE

The subject will help to understand the process instruments used for various measurements like temperature, pressure, displacement, current, voltage etc., These instruments are the essential part of any chemical industry. All these measurements are as much required in surface coating industry to monitor and control process parameters in any paint manufacturing or of paint application.

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 instruments for monitoring processes of surface coating and allied industries.

3. COURSE OUTCOMES (COs)

Surface coating industries involves manufacturing of resins, pigments as chemical process while paint manufacturing requires wetting and dispersing. To control such process number of measuring instruments and gadgets are used. 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:

- Use different process instruments.
- Select relevant temperature and pressure measuring devices.
- Select relevant displacement and level measuring devices.
- Identify actuators and PLCs for different applications.
- Identify data monitoring and recording devices.

4. TEACHING AND EXAMINATION SCHEME

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

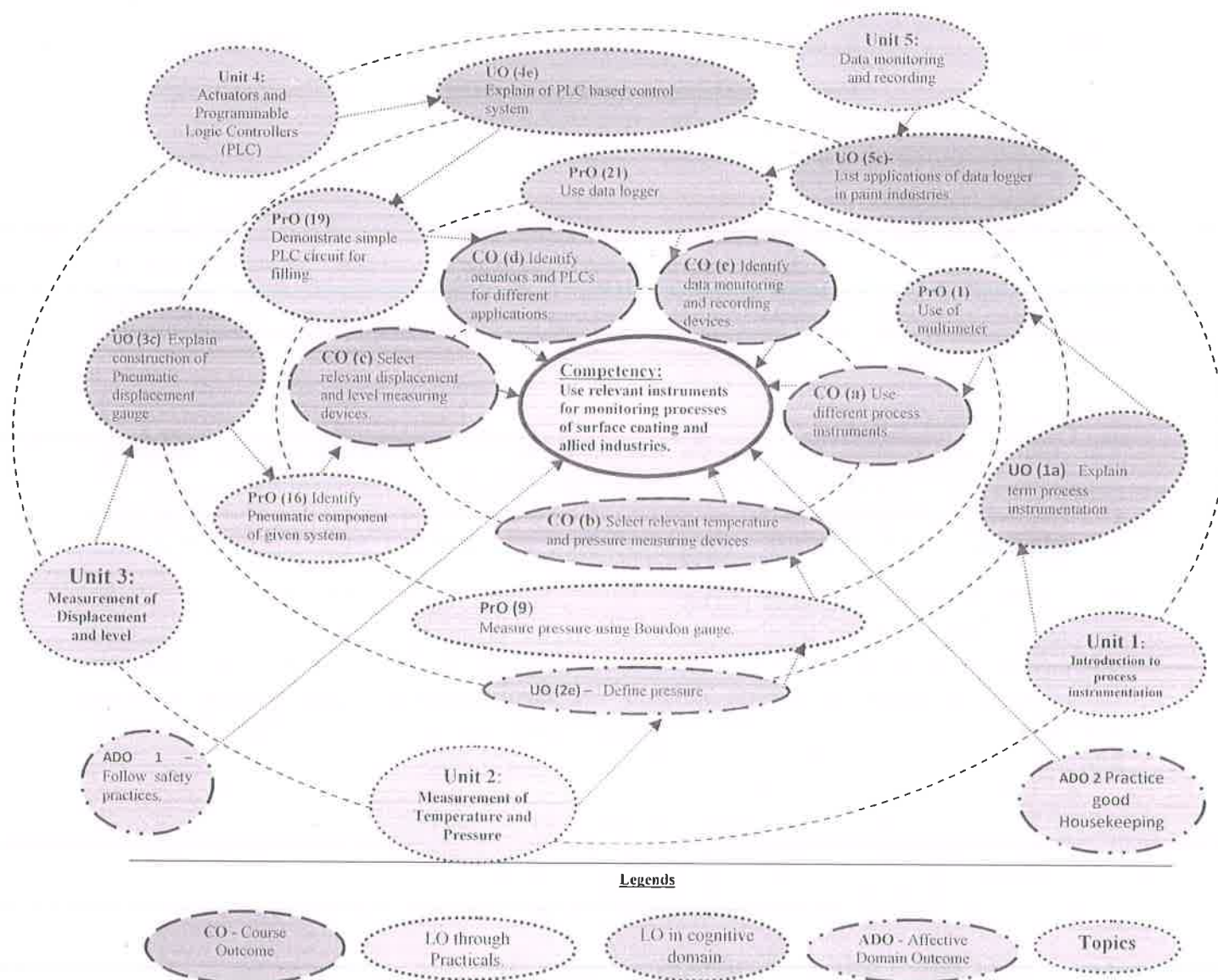


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The 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 Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
1	Use of multimeter.	I	2*
2	Calculate the resistance of a radial resistor using color code.	I	2*
3	Calculate the resistance of a radial resistor using multimeter.	I	2
4	Use tachometer	I	2
5	Use CRO.	I	2
6	Use of glass thermometer for different temperature ranges.	II	2
7	Plot resistance v/s temperature using "Resistance Temperature Detector" (RTD) PT 100.	II	2*

8	Plot voltage v/s temperature of “thermocouple” using PT 100.	II	2
9	Measure pressure using Bourdon gauge.	II	2*
10	Measure pressure using U Tube Manometer.	II	2
11	Measure displacement using linear variable displacement transducer. (LVDT)	III	2*
12	Measure liquid level using level controller.	III	2
13	Measure liquid level using bob and tape gauge.	III	2
14	Measure liquid level using float gauge.	III	2
15	Use load cell	III	2
16	Identify Pneumatic component of given system.	III	2*
17	Demonstrate hydraulic and pneumatic control valves.	IV	2
18	Demonstrate simple PLC circuit for mixing	IV	2
19	Demonstrate simple PLC circuit for filling	IV	2
20	Demonstrate simple PLC circuit for robotic applications in surface coating industries.	IV	2*
21	Use data logger	V	2*
22	Identify different interfacing devices for given application.	V	2
23	Demonstrate digital acquisition system.	V	2
24	Demonstrate microcontroller based system	V	2
Total			32

Note

- A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicious mix of minimum 12 or more practical needs to be performed, out of which, the 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 ‘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:

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



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

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Multimeter	1,3,7,8
2	Resistor	2,3
3	Tachometer	4
4	Cathode ray oscilloscope	5
5	Glass thermometer	6,7,8
6	Heating Mantle	6,7,8
7	Beaker	6,7,8
8	RTD (PT 100)	7
9	Thermocouple [(k type)	8
10	Bourdon gauge.	9
11	Air blower	9,10
12	U tube manometer	10
13	LVDT kit	11
14	level controller kit	12
15	Measuring cylinder	12, 13
16	Bob and tape	13
17	Container for water storage	14
18	Float gauge	14
19	Load Cell assembly	15
20	Pneumatic kit	16
21	Control valves	17
22	Data Scanner	21
23	Interfacing cables-USB	22
24	USB printer scanner cable	22
25	USB cable adapter	22

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 process instrumentation	1a. Explain term process instrumentation 1b. Enlist different process characteristics. 1c. Define different process dynamic terms. 1d. Explain construction of different measuring instruments. 1e. Calculate value of resistor using colour code.	1.1 Process instrumentation: 1.2 Basic concepts with examples 1.3 Process characteristics: 1.4 Process load, transient time, process lag, self regulation. 1.5 Process dynamics: 1.6 Resistance lag, capacitance lag, dead time, inertia. 1.7 Introduction to various measuring instruments: like Cathode Ray Oscilloscope, resistor, multimeter, tong meter, probes, tachometer.
Unit– II Measurement of Temperature and pressure	2a. Define temperature. 2b. Explain construction of temperature and pressure measuring devices. 2c. Differentiate various temperature measuring devices. 2d. Draw labeled diagram of temperature and pressure measuring devices. 2e. Define pressure. 2f. Classify pressure regulating devices.	2.1 Introduction to Temperature and its various scales. 2.2 Construction and working of temperature measuring devices: glass thermometer, resistance temperature detector, thermocouples, non contact type thermometer. 2.3 Introduction to pressure and vacuum and its units. 2.4 Construction and working of Pressure measuring devices: U Tube Manometer, Bourdon Tubes, 2.5 Introduction to pressure regulating devices and pressure surge suppressors.
Unit –III Measurement of Displacement and level	3a. Define displacement. 3b. Draw labelled diagram of Linear Variable Displacement transformer. 3c. Explain construction of Pneumatic displacement gauge. 3d. Explain construction of load cell. 3e. Explain different level measurement devices.	3.1 Introduction to displacement. 3.2 Construction and working of Linear Variable Displacement Transformer. (LVDT). 3.3 Construction and working of Pneumatic displacement gauge. 3.4 Construction and working of various load cell. 3.5 Level measurement devices: Sight Glass, Bob & Tape, Float gauge.
Unit –IV Actuators and Programmable Logic Controller (PLC)	4a. Define actuators. 4b. Classify control valves. 4c. Explain working of solenoid valve. 4d. Explain circuit diagram of microcontroller. 4e. Explain PLC based control system.	4.1 Actuators-pneumatic and hydraulic directional control valves. 4.2 Servo motor actuators. 4.3 Introduction to micro controller. 4.4 Introduction to PLC. 4.5 Working and application of PLC based control system. 4.6 Introduction to robotics.
Unit –V Data monitoring and recording	5a. Explain DAS. 5b. Write functions of data logger. 5c. List applications of data logger in paint industries. 5d. Explain interfacing and	5.1 Introduction to Digital acquisition system (DAS) 5.2 Introduction to data logger 5.3 Working and applications of data logger 5.4 Introduction to interfacing and recorder.



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	recording systems used in process industries.	

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 process instrumentation	10	2	4	10	16
II	Measurement of Temperature and Pressure	12	2	4	10	16
III	Measurement of Displacement and Level	10	2	4	10	16
IV	Actuators and Programmable Logic Controller (PLC)	10	2	2	8	12
V	Data monitoring and recording	06	2	2	6	10
Total		48	10	16	44	70

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

Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of 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:

- Visit resin/polymer/ paint manufacturing plant.
- Visit to fire station.
- Identify different electronic and electrical components of domestic appliances.
- Prepare model for measuring instruments.
- Prepare flowsheet/ circuit diagram of measuring instruments.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

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



- 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. Use Flash/Animations to explain working, construction and application of various measuring instruments in surface coating industries.
- g. Before starting practical, teacher should demonstrate the principle, working mechanism and experimental set up used for conducting practical.
- h. Instructions to students regarding care and maintenance of measuring equipments.
- i. Before starting practical, teacher should instruct various safety precaution need to take while handling instrument and chemicals,
- j. 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 is group-based. However, in the fifth and sixth semesters, it should be preferably being **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:

1. Compile data of various temperature measuring devices used in surface coating industries.
2. Compare data of various pressure measuring devices used in surface coating industries.
3. Draw diagrams for Pneumatic system for different applications. (min 5 applications)
4. Conduct market survey for various advancements in PLCs.
5. Draw neat labeled diagram of various flow measuring devices used in surface coating industries. (min 5 applications)
6. Collect data of various level measuring devices used in surface coating industries.
7. Draw neat labeled diagram of various displacement measuring devices used in surface coating industries. (min 5 applications)
8. Prepare album data of circuit diagram of various process control devices.
9. Collect information of different weighing machines.
10. Collect information of different conveyors used in coating industries.



13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Mechanical measurement & control	R V Jalgaonkar	Everest Publishing House ISBN:8186314261
2	Industrial Instrumentation & Control	S. K. Singh	Tata Mc Grow Hill Publishing Company Ltd ISBN:007451914X
3	Instrumentation	Kirk & Rimboi	D. B. Taraporwala Sons & Co. ISBN: 978-0826934222
4	Instrumentation Measurement & Analysis (3 rd Edition)	B.C. Nakra & K.K. Chaudhary	M Graw Hill Education (I) Pvt. Ltd ISBN:9780070151277
5	Instrumentation measurement and feedback	Barry E Jones	M Graw Hill Education (I) Pvt. Ltd ISBN: 0070993831
6	Electronic Instrumentation (3 rd Edition)	Sol D. Prensky Richard L. Castellucis	Prentice-Hall ISBN: 013251611X
7	Programmable Logic controllers and Industrial Automation	Madhuchhanda Mitra and Samarjit Sen Gupta	PENRAM International Publication Pvt Ltd ISBN: 9788187972631
8	Microcontroller principles and applications	Ajit Pal	PHI learning Publications ISBN: 9788120343924

14. SOFTWARE/LEARNING WEBSITES

- <https://www.youtube.com/watch?v=2EpFIhUHm28>- process control loop
- <https://www.youtube.com/watch?v=iDYWfBGwT1w>- lag factor
- <https://www.youtube.com/watch?v=ae0fy435zJA>- voltage lag, current lag
- <https://www.youtube.com/watch?v=85gm5aqeY44>-RTD
- <https://youtu.be/InAZWHvylr0> : Non contact type thermometer
- <https://www.youtube.com/watch?v=4mQ3o1t4Ssg>- temperature sensor
- <https://youtu.be/X2lqQzi4b9w> : CRO
- <https://youtu.be/1o20vzct5n0> : tong meter
- <https://youtu.be/8CcEVI7r9VA> :tachometer
- <https://youtu.be/n9ymkXo9OCU> :process dynamics
- <https://youtu.be/rUkvHeXsPWs> :multimeter
- <https://www.youtube.com/watch?v=W38x9RJs29I>- multimeter
- <https://www.youtube.com/watch?v=UTEQ8cKHKJI>- bourdon gauge
- <https://www.youtube.com/watch?v=LXFvAKqROP8>-U tube manometer
- <https://www.youtube.com/watch?v=anCnrtjNLQM> – Working of LVDT
- <https://www.youtube.com/watch?v=ugU-5SBxWZY>- Working of LVDT
- <https://youtu.be/e6Z0BjaHxPM>: data logger
- <https://youtu.be/aRae3h4bShU> :control valve
- <https://youtu.be/gfyhVq62AwE> : Surge suppressor
- <https://www.youtube.com/watch?v=y5Fd2m1ifxE>- working of hydraulic cylinder
- https://youtu.be/TPowbUhf0_Q : Data acquisition system
- <https://youtu.be/mGhVo81YgBo> : servomotor actuator
- https://www.youtube.com/watch?v=8_UPBYacUM0 – Pneumatic controller
- <https://www.youtube.com/watch?v=uSOChsPQQ8> – Float Gauge

- y. <https://www.youtube.com/watch?v=EVPR1M1z1GE> – Ultrasonic level measurement
- z. <https://www.youtube.com/watch?v=0du-QU1Q0T4>-Capaciatnce level measurement
- aa. <https://www.youtube.com/watch?v=ZZhuD78BLDk>- Servo motor
- bb. https://youtu.be/OOfXhz4In_w: robotics
- cc. <https://youtu.be/OKyZFuc4WKI> : Actuator
- dd. https://youtu.be/PbAGl_mv5XI : PLC basics
- ee. https://youtu.be/fS7FFOaC_iQ : Microprocessor
- ff. <https://www.youtube.com/watch?v=dcNk0urQsQM> – microcontroller and microprocessor
- gg. <https://www.youtube.com/watch?v=eo9dbnrpspM>- interfacing cables
- hh. https://www.youtube.com/watch?v=_3L_WtEvWRE- recorder chart



Program Name : Diploma in Surface Coating Technology
Program Code : SC
Semester : Fourth
Couse Title : Paints Technology-I
Couse Code : 24421

1. RATIONALE

This course introduces architectural paint as an organic coating prepared by careful selection of raw materials, making dispersion in suitable machine to withstand required physio-chemical properties when applied on different architectural surfaces. It includes selection of raw materials, understanding basic chemistry, manufacturing processes, evaluating properties and application of paints for architectural surfaces. The course explains the formulating principles of paint for particular architectural surface and thereby test properties during & post paint application.

2. COMPETENCY

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

- Prepare coating formulations for different architectural surfaces.

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:

- Select raw materials for preparation of architectural paints.
- Calculate various physical parameters of paint composition.
- Prepare coating formulations.
- Select relevant machine for processing of paint.
- Explain new trends in architectural paints.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme													
L	T	P		Theory								Practical					
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total		
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
4	--	4	8	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 center of this map.

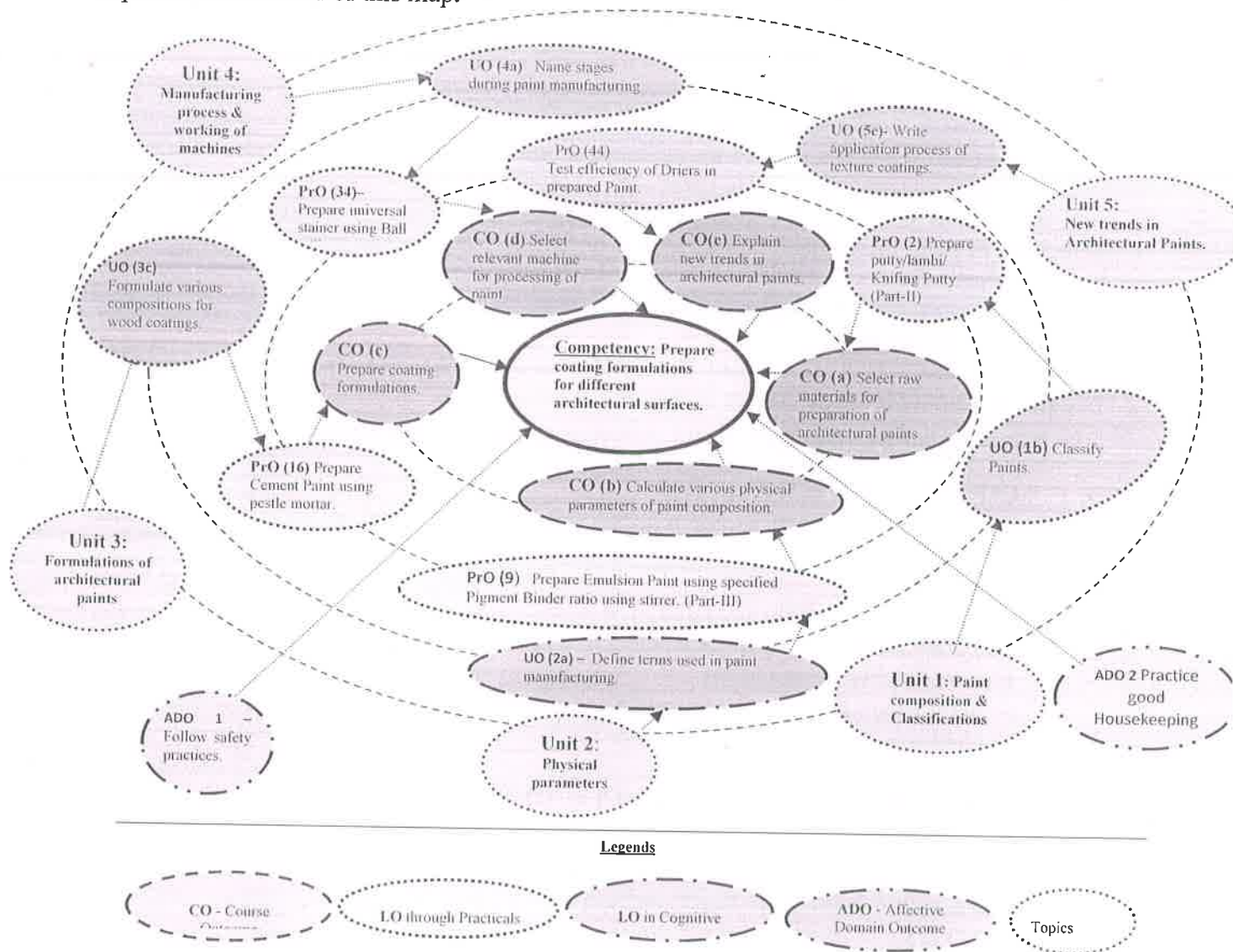


Figure 1 - Course Map

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	Prepare putty/lambi/Knifing Putty (Part-I: Formulate putty/lambi/ Knifing Putty)	I	
2	Prepare putty/lambi/ Knifing Putty (Part-II: Prepare putty/lambi/ Knifing Putty)	I	



3	Prepare putty/lambi/ Knifing Putty (Part-III: Test putty/lambi/ Knifing Putty)	I	2*
4	Prepare Dry Distemper using pestle mortar. (Part-I: Formulate Dry Distemper)	I	2
5	Prepare Dry Distemper using pestle mortar. (Part-II: Prepare Dry Distemper)	I	2
6	Prepare Dry Distemper using pestle mortar. (Part-III: Test Dry Distemper)	I	2
7	Prepare Emulsion Paint using specified Pigment Binder ratio using stirrer. (Part-I: Formulate Emulsion Paint)	II	2*
8	Prepare Emulsion Paint using specified Pigment Binder ratio using stirrer. (Part-II: Prepare Emulsion Paint)	II	2*
9	Prepare Emulsion Paint using specified Pigment Binder ratio using stirrer. (Part-III: Test Emulsion Paint)	II	2*
10	Prepare Cement Primer using concept of weight per liter, Pigment binder ratio, PVC using relevant method. (Part-I: Formulate Cement Primer)	II	2
11	Prepare Cement Primer using concept of weight per liter, Pigment binder ratio, PVC using relevant method. (Part-II: Prepare Cement Primer)	II	2
12	Prepare Cement Primer using concept of weight per liter, Pigment binder ratio, PVC using relevant method. (Part-III: Test Cement Primer)	II	2
13	Prepare Red Oxide Metal Primer using concept of weight per liter, Pigment binder ratio, PVC using relevant method. (Part-I: Formulate Red oxide Primer)	III	2*
14	Prepare Red Oxide Metal Primer using concept of weight per liter, Pigment binder ratio, PVC using relevant method. (Part-II: Prepare Red oxide Primer)	III	2*
15	Prepare Red Oxide Metal Primer using concept of weight per liter, Pigment binder ratio, PVC using relevant method. (Part-III: Test Red oxide Primer)	III	2*
16	Prepare Cement Paint using pestle mortar. (Part-I: Formulate Cement Paint)	III	2*
17	Prepare Cement Paint using pestle mortar. (Part-II: Prepare Cement Paint)	III	2*
18	Prepare Cement Paint using pestle mortar. (Part-III: Test Cement Paint)	III	2*
19	Prepare NC Lacquer using stirrer. (Part-I: Formulate NC Lacquer)	III	2
20	Prepare NC Lacquer using stirrer. (Part-II: Prepare NC Lacquer)	III	2
21	Prepare NC Lacquer using stirrer. (Part-III: Test NC Lacquer)	III	2
22	Prepare NC Lacquer Varnish using stirrer (Part-I: Formulate NC Lacquer)	III	
23	Prepare NC Lacquer Varnish using stirrer (Part-II: Prepare NC Lacquer Varnish)	III	



24	Prepare NC Lacquer Varnish using stirrer (Part-III: Test NC Lacquer Varnish)	III	2
25	Prepare Interior Enamel using concept of weight per liter, Pigment binder ratio, PVC using sand mill. (Part-I: Formulate Interior Enamel)	II, IV	2
26	Prepare Interior Enamel using concept of weight per liter, Pigment binder ratio, PVC using sand mill. (Part-II: Prepare Interior Enamel)	II, IV	2
27	Prepare Interior Enamel using concept of weight per liter, Pigment binder ratio, PVC using sand mill. (Part-III: Test Interior Enamel)	II, IV	2
28	Prepare Exterior Enamel using sand mill. (Part-I: Formulate Exterior Enamel)	IV	2
29	Prepare Exterior Enamel using sand mill. (Part-II: Prepare Exterior Enamel)	IV	2
30	Prepare Exterior Enamel using sand mill. (Part-III: Test Exterior Enamel)	IV	2
31	Prepare solvent based lusture paint using Ball mill. (Part-I: Formulate lusture paint)	IV	2*
32	Prepare solvent based lusture paint using Ball mill. (Part-II: Prepare lusture paint)	IV	2*
33	Prepare solvent based lusture paint using Ball mill. (Part-III: Test lusture paint)	IV	2*
34	Prepare universal stainer using Ball mill. (Part-I: Formulate universal Stainer)	IV	2
35	Prepare universal stainer using Ball mill. (Part-II: Prepare universal stainer)	IV	2
36	Prepare universal stainer using Ball mill. (Part-III: Test universal stainer)	IV	2
37	Test solar reflecting (heat insulation) paints for heat Insulation.	V	2
38	Prepare Road Marking Paint based on Emulsion.	V	2
39	Test Lotus effect of exterior Paints.	V	2
40	Prepare water based wall primer based on Re dispersible powder.	V	2
41	Prepare water based Paint using Re dispersible polymer powder. (Part-I: Preparation)	V	2
42	Prepare water based Paint using Re dispersible polymer powder. (Part-II: Test properties of prepared sample)	V	2
43	Test efficiency of Wetting & Dispersing agents in prepared Paint.	V	2
44	Test efficiency of Driers in prepared Paint.	V	2*
45	Test efficiency of Emulsifying agents.	V	2
Total (no. of hrs. to be engaged)			64

Note

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



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

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

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

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

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

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

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No	Equipment Name with Broad Specifications	PrO. No.
1	Digital weighing balance	All Pro
2	Pestle Mortar (15 ml capacity)	All Pro
3	Spatula	All Pro
4	Asbestos Panel (100 x 150 mm)	1,2,3,4,5,6,7,8,9,10,11,12,16,17,18,37,40,41,42
5	1.0 Inch Brush	All Pro
6	Ford Cup Viscometer (B4 number)	4,5,6,7,8,9,10,11,12,13,14,15,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,40,41,42
7	Specific gravity cup (100ml capacity)	All Pro
8	Glass Rod	All Pro

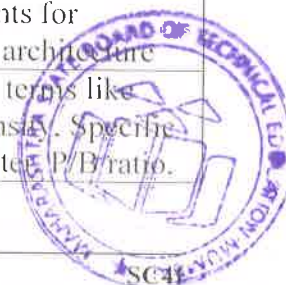


S. No	Equipment Name with Broad Specifications	PrO. No.
9	Morest Chart	13,14,15,25,26,27,28,29,30,31,31,33
10	8 mm transparent Glass panel	13,14,15,25,26,27,28,29,30,31,31,33
11	Paint film applicator [50, 100 microns]	13,14,15,25,26,27,28,29,30,31,31,33
12	Rough Cement Block	1,2,3,4,5,6,7,8,9,10,11,12,17,18,40,41,42
13	Smooth Cement Paving Block	37,39
14	Tooth brush	4,5,6,7,8,9,,10,11,12
15	Metal Panel (0.5 mm thickness)	13,14,15,18,19,20,21,22,23,24,25,26,27,28,29,30
16	Jar Mill Machine	13,14,15,31,32,33,34,35,36
17	Jar Mill grinding media	13,14,15,34,35,36
18	Sand Mill	13,14,15,25,26,27,28,29,30,34,35,36
19	Sand Mill grinding Media	13,14,15,25,26,27,28,29,30,34,35,36
20	Sand papers (120 to 320 number)	13,14,15,18,19,20,21,22,23,24,25,26,27,28,29,30
21	200 ml Glass beaker	34,35,36,43,44,45
22	Stirrer	19,20,21,22,23,24,34,35,36,43,44,45
23	Gardner Tube	19,20,21,22,23,24
24	Hegman Gauge	13,14,15,25,26,27,28,29,30,31,32,33
25	DFT meter	13,14,15,25,26,27,28,29,30,31,32,33,37
26	Gloss 'O' Meter	13,14,15,25,26,27,28,29,30,31,32,33
27	Humidity Chamber	13,14,15,25,26,27,28,29,30,31,32,33
28	Salt Spray Chamber	13,14,15
29	Heat reflectance test cabinet	37
30	Scratch Resistance tester	13,14,15,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33
31	Cross hatch tester	13,14,15,25,26,27,28,29,30
32	Cotton waste	All Pro

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 Paint composition & Classifications	1a. Explain functions of the Paints. 1b. Classify Paints. 1c. List raw materials for paints. 1d. State requirements of coating for different applications.	1.1 Introduction to Paint 1.2 Classification of Paints based on their functions, applications, curing methods & solvent content. 1.3 Selection of raw materials & their Significance. 1.4 Selection of solvents in paint manufacturing with respect to their properties. 1.5 Requirements of Paints for different Surfaces in architecture
Unit-II Physical parameter	2a. Define terms used in paint manufacturing. 2b. Calculate various physical	2.1 Introduction to basic terms like NVM, % Solids, Density, Specific gravity, weight per liter, P/B ratio.



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
s	parameters of paint composition. 2c. Calculate material requirement for a required batch size	PVC & CPVC in paint formulations 2.2 Calculation of P/B ratio, Specific gravity of Paint, PVC & CPVC 2.3 Volume of Paint, batch size calculation. 2.4 Calculate costing of prepared paint (based on raw materials)
Unit– III Formulations of architectural paints	3a. Classify architectural coatings. 3b. Formulate various compositions for architectural paints and coatings. 3c. Formulate various compositions for wood coatings.	3.1 Introduction to various types of architectural coatings. 3.2 Formulations of water based and solvent based primer, putty, enamel for different substrates. 3.3 Formulations of water based paints like oil bound distemper, acrylic distemper, cement putty, and emulsion paints, texture paints 3.4 Formulation of solvent based wood coatings such as shellac, alkyd & NC lacquer.
Unit –IV Manufacturing process & working of machines	4a. Name stages during paint manufacturing. 4b. Explain working of paint manufacturing machines. 4c. Draw neat labeled diagram of various paint manufacturing machines. 4d. Explain safety aspects of paint manufacturing machines.	4.1 Introduction to paint manufacturing stages. 4.2 Machines and other equipment used in manufacturing such as mixers, high speed stirrers, pug mill, ball mill, sand mill, attritors, dyno mill, basket Mill 4.3 Safety aspects of paint manufacturing machines.
Unit-V New trends in Architectural Paints	5a. Explain significance of solar reflectance paints. 5b. Explain types and significance of road marking paints. 5c. Explain working of lotus effect. 5d. State properties of Re-dispersible polymers. 5e. Write application process of texture coatings.	5.1 Introduction to solar/heat reflectance coating. 5.2 Types & formulations of road marking paint. 5.3 Introduction to lotus effect in coatings. 5.4 Properties & uses of Re-dispersible polymer powder. 5.5 Introduction to preparation and application process of texture coatings.

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	Paint composition & Classifications	11	02	04	06	12
II	Physical parameters	14	02	06	10	18
III	Formulations of architectural paints	20	04	04	12	20
IV	Manufacturing process & working of machines	11	02	04	06	12
V	New trends in Architectural Paints	08	02	02	04	08
Total		64	12	20	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:

- Visit to paint manufacturing plant.
- Prepare a report on safety practices followed in coating industries.
- Collect information of various resins available in market for architectural coatings.
- Use relevant IS specification of coatings.
- Prepare report on coating available for solar/heat reflectance coating.
- Prepare report on dust and water repellent using lotus effect.
- Visit to paint and coating exhibition/seminar

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

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



- f. Correlate properties and application of resins for Prepare Paints.
- 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 equipment.
- 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 reducible, water thinnable paints, water dispersible Paints.
- b. Calculate cost of raw material required for paint formulation.
- c. Compare data of products related architectural coatings of various industries available in market.
- d. Survey of architectural paint manufacturing industries.
- e. Draw paint manufacturing layout.
- f. Compile data of various IS Standards for architectural coatings.
- g. Prepare album of architectural finishes.
- h. Prepare report of various new techniques/machineries used in paint manufacturing.
- i. Prepare report on various safety practices followed in paint manufacturing industries.

13. SUGGESTED LEARNING RESOURCES

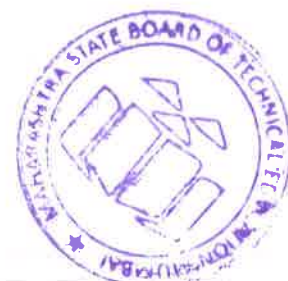
S. No.	Title of Book	Author	Publication
1	Outlines of Paint Technology (3rd Edition)	W. M. Morgan	CBS Publishers & Distributors Pvt. Ltd, 2000 ISBN: 9788123904306
2	Surface Paints, Vol I: Raw Materials and Their Usage	Oil and Colour Chemists Association of Australia St (OCCA)	Chapman & Hall, 1993 ISBN: 9780412552106
3	Organic Coating Technology	H. F. Payne	John Wiley & Sons Inc (1966) ISBN: 9780471673538
4	Basics of Paints	V.C. Malshe	Antar Prakash Centre for Yoga



S. No.	Title of Book	Author	Publication
	Technology Part I	and Meenal Sikchi	2004 ISBN: 9788190329859
5	Surface Paints: Science & Technology (2nd Edition)	Dr. Swaraj Paul	John Wiley and Sons Ltd.2014 ISBN:9788126552559
6	Modern Technology of Paints, Varnishes & Lacquers (2nd Edition)	NIIR Board	Asia Pacific Business Press Inc. 2007 ISBN: 8178330881

14. SOFTWARE/LEARNING WEBSITES

- a. <https://www.youtube.com/watch?v=CyfDPAK3OLU>
- b. <https://www.youtube.com/watch?v=OhXqvI9C8Ug>
- c. <https://www.youtube.com/watch?v=0KuKP2u347A>
- d. <https://www.youtube.com/watch?v=FWYoasb6oqo>
- e. <https://www.youtube.com/watch?v=prWqENxWjsU>
- f. <https://www.youtube.com/watch?v=lkHW-2vgFx0>
- g. <https://eramanath.wordpress.com/2012/04/>
- h. <https://www.youtube.com/watch?v=BKgU5yDZMws>
- i. <https://coatings.specialchem.com/tutorial/wetting-agents-pigments-fillers-waterborne-formulation>
- j. <https://www.bradthepainter.com/paint-and-primer-in-one-paint/>
- k. <https://www.youtube.com/watch?v=id0Uaf-MX-M>
- l. <https://www.youtube.com/watch?v=ICaZRLVi6EU>
- m. <https://www.youtube.com/watch?v=Z59LIEtA8Ww>
- n. <https://www.youtube.com/watch?v=IxpX7uyxRXo>
- o. <https://www.youtube.com/watch?v=TZyPJR4fYxo>
- p. <https://www.youtube.com/watch?v=L6sgGXXYdEU>
- q. <https://www.youtube.com/watch?v=aVQ9B3LiCPk>
- r. <https://www.youtube.com/watch?v=ES3Ls9u8cTA&t=107s>
- s. <https://www.youtube.com/watch?v=PzIGr-vdS9M>
- t. <https://www.youtube.com/watch?v=8gXx7HcCviw>
- u. <https://www.youtube.com/watch?v=4uCsActiRwM>
- v. <https://www.youtube.com/watch?v=EhCfkgcXGEA>
- w. <https://www.youtube.com/watch?v=XKopBrybSUE>
- x. <https://www.youtube.com/watch?v=1ol6de7-YjA>
- y. <https://www.youtube.com/watch?v=GnXv52fXxX8>
- z. <https://www.youtube.com/watch?v=Q67RNWnoI0E>
- aa. <https://www.youtube.com/watch?v=tdoHh6i0kQg>
- bb. https://www.youtube.com/watch?v=G9V_O27ICck
- cc. https://www.youtube.com/watch?v=l4s2y4_Oqul
- dd. <https://www.youtube.com/watch?v=NOw5av9of28>
- ee. <https://www.youtube.com/watch?v=se9QxKKqAcY>
- ff. <https://www.youtube.com/watch?v=DzFJ-eF0sug>
- gg. https://www.youtube.com/watch?v=6Py5ZU8F8_w
- hh. <https://www.youtube.com/watch?v=FQWH5BBZKcl>
- ii. <https://www.youtube.com/watch?v=GJvkdIFNt64>



Program Name : Diploma in Surface Coating Technology
Program Code : SC
Semester : Fourth
Couse Title : Application and Evaluation of Paints-I
Couse Code : 24422

1. RATIONALE

This course introduces students to importance of paint application, especially surface preparation, application methods and their testing. In addition, students will learn various standard specifications regarding liquid paint testing, dry paint films testing, functional properties of paint film and surface preparation. Students will learn various aspects of architectural surfaces such as concrete, metals and wood.

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 paint materials and painted surfaces as per relevant 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:

- Select relevant surface preparation methods for various architectural substrates.
- Select relevant paint application methods.
- Test liquid paint properties.
- Test dry film properties of coatings.
- Test functional properties of coatings.

4. TEACHING AND EXAMINATION SCHEME

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

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

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

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

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



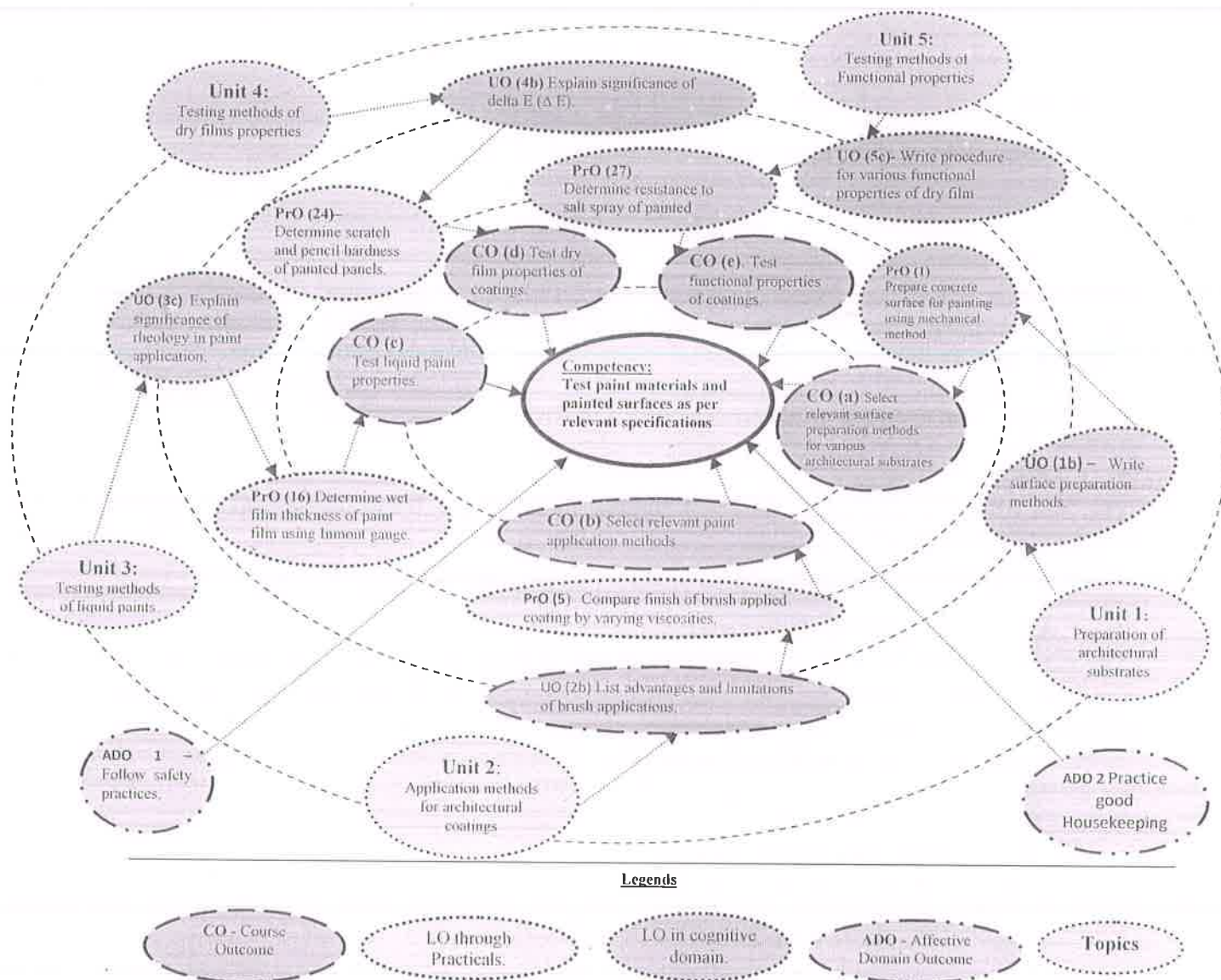


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

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

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
1	Prepare concrete surface for painting using mechanical method.	I	2*
2	Prepare wood surface for painting using mechanical method	I	2
3	Prepare metal surface for painting using chemical method.	I	2*
4	Test effect of surface contamination on coating properties.	I	2
5	Compare finish of brush applied coating by varying viscosities.	II	2*
6	Compare finish of roller applied coating by varying viscosities.	II	2*
7	Apply composite interior architectural paint system.	II	2
8	Apply composite exterior architectural paint system.	II	2*
9	Apply multi coat putty layers using putty knife.	II	2
10	Determine wet edge time for paint.	II	2
11	Determine weight per liter of paint using density cup.	III	2*

12	Determine fineness of grind of paint using Hegman gauge .	III	2*
13	Determine percentage non-volatile matter of paint using oven.	III	2
14	Observe skinning and settling of paint.	III	2
15	Determine wet film thickness of paint film using tooth gauge	III	2
16	Determine wet film thickness of paint film using Inmont gauge.	III	2*
17	Determine dilution ratio and drying time of paint.	III	2*
18	Determine hiding power of paint.	III	2*
19	Calculate coverage rate of paint.	III	2
20	Determine sagging index of paint by varying viscosity	III	2*
21	Determine Gloss of painted panel using Gloss-O-Meter	IV	2*
22	Determine dry film thickness using DFT meter and adhesion of painted panels.	IV	2*
23	Test flexibility of panels using conical mandrel.	IV	2
24	Determine scratch and pencil hardness of painted panels.	IV	2*
25	Determine impact hardness of painted panels.	IV	2
26	Determine cupping hardness of painted panels.	IV	2
27	Determine resistance to salt spray of painted panels.	V	2*
28	Determine resistance to water immersion of painted panels.	V	2
29	Determine resistance to humidity of painted panels.	V	2
30	Determine resistance to chemicals (Acid, Alkali and solvents) of painted panels.	V	2*
31	Determine resistance to lubricant oil using dipping method.	V	2
32	Determine resistance to heat of painted panels.	V	2
Total			64

Note

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

- Follow safety practices.
- 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 PrOs
2	Beaker (250 ml, 500ml)	All PrOs
3	Asbestos panel	1,6,7,8,9,10
4	Sand Paper (80, 120, 320)	1,2,3,4,5,6,7,8,9,10
5	Wooden panels	2
6	MS panels	3,4,5,15,16,17,20
7	Brush	4,5,7,8,10,15,16,17,18,19
8	Oven	4, 13,32
9	Ford Cup B-4	5,6,10,15,16,17,18,19,20
10	Putty knife	7,8,9
11	Rollers	6,7,8
12	Stop Watch	10,17,18,19,20,28
13	Weighing Balance	11,13,18,19
14	Wt/lit cup	11
15	Hegman gauge	12
16	Petri dish	13
17	Tooth gauge	15
18	Inmont gauge	16
19	Measuring cylinder (100ml)	17,27
20	Glass plate	18,19
21	Morest Chart	18,19
22	Sag index meter	20
23	Painted MS panel	21,22,23,24,25,26,27,28,29,30,31,32
24	Gloss-O-meter	21
25	DFT meter	22
26	Adhesion Tape	22
27	Cutter/Cutter guider	22/27
28	Conical Mandrel	23
29	Scratch Hardness Tester	24
30	Pencil hardness tester	24



S. No.	Equipment Name with Broad Specifications	PrO. No.
31	Impact tester	25
32	Cupping Tester	26
33	Salt Spray Chamber	27
34	Humidity Chamber	29

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.

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'.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit –I Preparation of architectural substrates	1a. Draw flow diagram of surface preparation procedure for various architectural substrates. 1b. Write surface preparation methods.	1.1 Need for Surface preparation. 1.2 Surface preparation methods: a) Mechanical- for different types of substrates such as concrete plaster, flooring, wood, Metal. b) Chemical- for different types of substrates such as concrete plaster, flooring, Metal.
Unit-II Application methods for architectural coatings	2a. Define wet edge time. 2b. List advantages and limitations of brush applications. 2c. Explain paint system for interior surfaces.	2.1 Types of brushes, rollers, putty knife used for paint application. 2.2 Advantages & limitations of brush & Roller applications. 2.3 Concept of wet edge time. 2.4 Architectural paint system for interior and exterior surfaces.
Unit- III Testing methods of liquid paints	3a. Explain importance of paint testing. 3b. Write test methods for various liquid paint testings. 3c. Explain significance of rheology in paint application. 3d. List different instruments for liquid paint testing.	3.1 Introduction to IS 101 (Paint testing). 3.2 Test methods of wt / lit, % NVM, fineness of grind, viscosity by flow cups, skinning, settling, wet film thickness, drying time, dilution ratio, covering power, hiding power, sagging index 3.3 Testing of wet sample of architectural paint like Rheology, In can stability, wet scrub and resistance to fungus.
Unit-IV Testing methods of dry films properties	4a. Write test methods for various dry film properties. 4b. Explain significance of delta E (ΔE).	4.1 Testing of architectural film like, wet scrub, dry scrub, mold growth. 4.2 Test methods for ΔE , Gloss, Distinctness of image (DOI), Dry film thickness, adhesion, flexibility, scratch hardness, pencil hardness, Impact, abrasion, cupping.



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit– V Testing methods of Functional properties	5a. Explain significance of salt spray test. 5b. Write procedure for various functional properties of dry film.	5.1 Test methods for salt spray, water immersion, humidity, 5.2 Chemical Resistances-acid, alkali, lubricating oil and solvent. 5.3 Heat resistance, Insulation resistance, breakdown voltage, pin hole testing (holiday test).

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	Preparation of architectural substrates	06	2	4	4	10
II	Application methods for architectural coatings	08	2	4	4	10
III	Testing methods of liquid paints	12	2	6	10	18
IV	Testing methods of dry films properties	12	2	6	10	18
V	Testing methods of Functional properties	10	2	4	8	14
Total		48	10	24	36	70

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

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

10. SUGGESTED STUDENT ACTIVITIES

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

- Visit paint application industry/paint testing Laboratory/computerized color dispensing machine.
- Establish laboratory set up at application site. (Automotive, coil, construction etc)
- Prepare album of various types of brushes, rollers, putty knife, wire brushes, sand papers etc.
- Collect the data of finish by varying grit size of sand papers.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

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



- b. '**L**' in **item No. 4** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
- c. About **15-20% of the topics/sub-topics** which is relatively simpler or descriptive in nature is to be given to the students for **self-directed learning** and assess the development of the 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 paint properties and application methods for architectural coatings.
- g. Use Flash/Animations to explain various surface preparation methods, application methods and paint testing methodologies.
- 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 measuring equipments.
- j. Before starting practical, teacher should instruct various safety precaution need to take while handling instrument and chemicals,
- k. 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 is group-based. However, in the fifth and sixth semesters, it should be preferably being **individually** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should **not exceed three**.

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

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

- a. Prepare a display model for surface preparation methods.
- b. Prepare display model of paint tested panels.
- c. Calculate paintable surface area using IS 1200.
- d. Conduct market survey of architectural painting process.
- e. Prepare report on automatic paint application techniques for architectural applications.
- f. Collect data of IS 101 standard test methods of mechanical properties. (5 tests/group)
- g. Collect data of IS 101 standard test methods of chemical properties. (5 tests/group)
- h. Collect data of IS 101 standard test methods of functional properties. (5 tests/group)
- i. Prepare a resin solvent mixture and establish relation of cutting power of solvents.
- j. Collect data of insulating varnishes, their specification and test methods.



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	Basics of Paints Technology (Part II) (1 st Edition)	V.C. Malshe and Meenal Sikchi	Antar Prakash Centre for Yoga, India, 2004 ISBN: 9788190329842
3	Organic Coatings: Properties and Evaluation	Felix Konstandt	Chemical Publishing Co, New York ISBN: 0820603066
4	Paint Handbook	Guy E. Weismantel	McGraw-Hill publication ISBN: 0070690618
5	Paint Testing Manual Physical and Chemical Examination (13 th Edition)	Gardner Henry and George Sward	American Society for Testing and Materials, 1972
6	Surface Coatings: Science & Technology (2nd Edition)	Dr. Swaraj Paul	John Wiley and Sons Ltd.2014 ISBN:9788126552559
7	Testing of Paints	Shreekant Patil	Color Publications (Pvt.) Limited

14. SOFTWARE/LEARNING WEBSITES

- <https://www.youtube.com/watch?v=TI4s34DZolc>- Wood Surface Preparation
- <https://www.youtube.com/watch?v=pKvCZ0mZQtc>- Wood staining
- <https://www.youtube.com/watch?v=yiFQHgIJ0QI>- Floor surface preparation
- <https://www.youtube.com/watch?v=WcRru0ebun4>- Floor surface Preparation
- <https://www.youtube.com/watch?v=4CHdKfOuy1w>- Concrete Surface Preparation
- <https://www.youtube.com/watch?v=2mqIrcvTnqU>- Roller Application
- <https://www.youtube.com/watch?v=3SQTVAv1gFM> – Brush Application
- https://www.youtube.com/watch?v=2OfqRb_LV-I – Roller Application
- <https://www.youtube.com/watch?v=hRkT9f7VoIM>- Paint touch up by roller application
- <https://www.youtube.com/watch?v=P4kmH3H3aoY>- Selection of roller
- <https://www.youtube.com/watch?v=yAqKoeNeqXs>- Putty Knife application
- <https://www.youtube.com/watch?v=TZdRC8ypmiw>- Importance of coating
- <https://www.youtube.com/watch?v=hcHS8MLAgpl>- Salt Spray test
- <https://www.youtube.com/watch?v=uvnNTA4jWpo>- Humidity resistance chamber
- <https://www.youtube.com/watch?v=nauJNsqm4Vw>- Rheology of paint
- <https://www.youtube.com/watch?v=5Wtxj14T2ew>- Rheology measurement
- <https://www.youtube.com/watch?v=6mxbrepm18w>- Sag index
- <https://www.youtube.com/watch?v=1j10cWTH8cl>- Working of Hegman gauge
- <https://www.youtube.com/watch?v=X0hwpjunD2k>- Conical Mandrel
- <https://www.youtube.com/watch?v=VNJqfo-gIns>- Impact Tester
- https://www.youtube.com/watch?v=4OYcks_mptA- Scratch Resistance



- v. <https://www.youtube.com/watch?v=XeKc1cwzb7Q>- Gloss-O-Meter
- w. <https://www.youtube.com/watch?v=FP-kQNt5Cv8>- Dry Film thickness
- x. https://www.youtube.com/watch?v=c-_4awdje94- Adhesion test
- y. https://www.youtube.com/watch?v=TuFY8_KI9lQ- Pull Off adhesion
- z. <https://www.youtube.com/watch?v=B0QkCWP4HJM>- Viscosity
- aa. <https://www.youtube.com/watch?v=VgSrWoEWtso>- Cupping Test
- bb. https://www.youtube.com/watch?v=-FIAkUnh_Gk- Cupping Test instrument
- cc. <https://www.youtube.com/watch?v=DFIPOGwAlI0>- Pendulum hardness
- dd. <https://www.youtube.com/watch?v=6lTrSyMi7AY>- Computerized color dispensing machine
- ee. <https://www.youtube.com/watch?v=EvDwmgSbnk>- Use of Spectrophotometer





Program Name : Diploma in Surface Coating Technology
Program Code : SC
Semester : Fourth
Couse Title : Allied Surface Coatings
Couse Code : 24423

1. RATIONALE

This course includes technology and applications of allied surface coatings such as industrial polishes, polishing equipment, printing inks, Waterproofing, Floor coating and Electroplating finishes. This course will provide knowledge of other type of surface coatings coming across in industrial life. This course also introduces students other connected field in surface coating industries.

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 Allied Surface coating for relevant industrial applications.**

3. COURSE OUTCOMES (COs)

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

- Select coating materials for preparation of allied coating industries.
- Apply polishing techniques for different applications.
- Test printing ink properties.
- Select electroplating process for different applications with justification.
- Apply water proofing techniques.

4. TEACHING AND EXAMINATION SCHEME

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



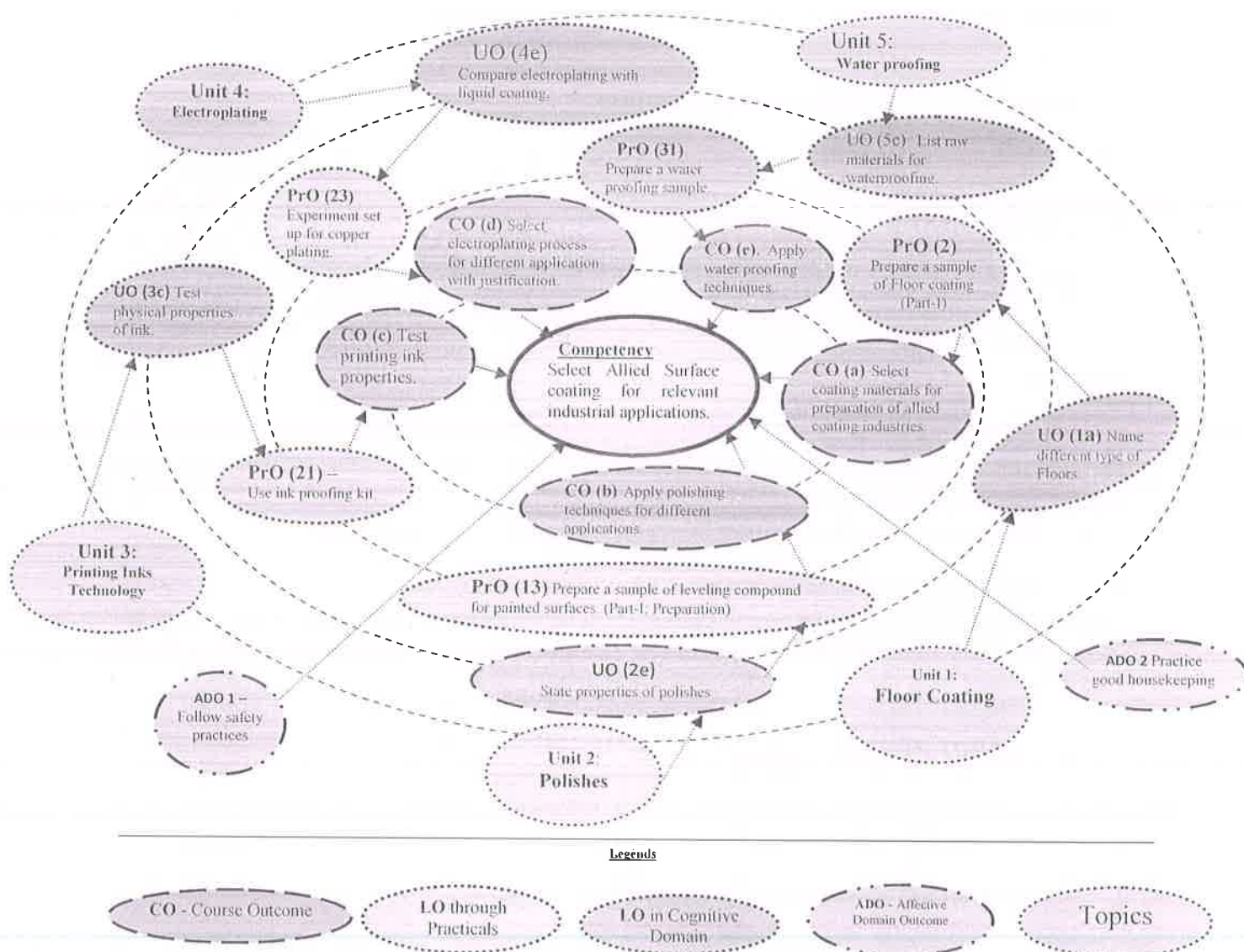


Figure 1 - Course Map

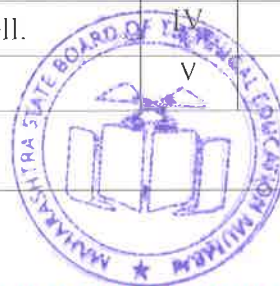
6. SUGGESTED PRACTICALS/ EXERCISES

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	Prepare surface for floor coating application.	I	02
2	Prepare a sample of Floor coating (part-I: Preparation)	I	02*
3	Prepare a sample of Floor Coating (part-II: Application)	I	02*
4	Prepare a sample of Floor coating (part-III: Testing)		02*



5	Calculate consumption of floor coating material (part-I: Preparation)	I	02
6	Calculate consumption of floor coating material (part-II: Application and calculation)	I	02
7	Determine pot life, gel time and exotherm.	I	02
8	Test effect of particle size of sand, mixing ratio of components on floor coating properties. (Part-I Preparation)	I	02
9	Test effect of particle size of sand, mixing ratio of components on floor coating properties. (Part-II Preparation)	I	02
10	Test effect of particle size of sand, mixing ratio of components on floor coating properties. (Part-III Preparation)	I	02
11	Prepare a sample of rubbing compound for painted surfaces. (part-I: Preparation)	II	02
12	Prepare a sample of rubbing compound for painted surfaces. (Part-II: Testing)	II	02
13	Prepare a sample of leveling compound for painted surfaces. (part-I: Preparation)	II	02*
14	Prepare a sample of leveling compound for painted surfaces. (Part-II: Testing)	II	02*
15	Test aesthetic property of polished surfaces by using gloss-o-meter.	II	02*
16	Determine physical properties of given sample printing ink.	III	02*
17	Determine specific Gravity of printing Ink using Coats micrometer Ink pipette.	III	02*
18	Determine Bulk value of printing Ink using Coats micrometer Ink pipette.	III	02
19	Determine viscosity of Printing Ink using falling bar Viscometer.	III	02*
20	Determine viscosity of Printing Ink using Brookfield Viscometer.	III	02
21	Use ink proofing kit.	III	02*
22	Prepare a surface for electroplating using buffing mops.	IV	02*
23	Experiment set up for copper plating.	IV	02*
24	Apply Copper electroplating on Metal surface.	IV	02
25	Apply Zinc electroplating on Metal surface.	IV	02*
26	Determine coating weight of electroplated film using chromic acid solution.	IV	02
27	Test parameters of electroplating bath.	IV	02
28	Test corrosion resistance of electroplated surface.	IV	02
29	Test film porosity of electroplated film using iron chloride solution.	IV	02
30	Test throwing power of electroplating bath using Hull Cell.	IV	02
31	Prepare a water proofing sample.	V	02*



32	Test physical properties water proofing materials.	V	02
33	Test water permeability of water proofing material.	V	02*
34	Test chemical resistance of proofing materials.	V	02*
Total			64

Note

- A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicious mix of minimum 24 or more practical needs to be performed, out of which, the 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.
- 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:

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

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

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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



S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Spatula	All PrOs
2	Beaker	All PrOs
3	Glass rod	All PrOs
4	Wire brushes	1,22
5	Marble Tiles	1
6	Weighing balance	2,7,8,11,13,17,18,23,24,25,26,31,33,34
7	Notches	3,6,8
8	Gloss-O-meter	3,15
9	Stirrer	2,5,9,31
10	Thermometer	7,27
11	Putty Knife	12
12	Glass Plate (1 X 1 ft)	16,17,18,19,20,21,34
13	Coats micrometer Ink pipette	17,18
14	Falling bar Viscometer.	19
15	Brookfield Viscometer.	20,32
16	Ink proofing kit	21
17	Buffing mops	22
18	Rheostat	23,24,25
19	MS panels	23,24,25,26,28,29,30
20	Heating mantle	26
21	pH Meter	27
22	Oven	27
23	Petri Dish	27
24	Salt Spray Chamber	28
25	Hull Cell	30
26	Test tubes	32
27	Flow cup B-4	32
28	Weight per lit cup 100 CC	32

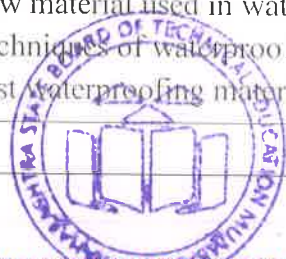
8. UNDERPINNING THEORY COMPONENTS

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 Floor Coating	1a. Name different type of Floors. 1b. List different floor coating materials. 1c. Write floor coating application methods. 1d. Explain the purpose of floor	1.1 Types of floors. 1.2 Purpose of floor coating. 1.3 Types of floor coating. 1.4 Onsite mixing of floor coating material



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	coating. 1e. Explain importance of mixing ratio of floor coating materials.	1.5 Application methods of floor coating.
Unit-II Polishes	2a. Enumerate types of polishes. 2b. List raw materials used for polishes. 2c. Explain process of polishing. 2d. Explain importance of polishing. 2e. State properties of polishes. 2f. State application of polishes. 2g. Write properties of rubbing compounds.	2.1 Composition accepts of Industrial Polishes. 2.2 Techniques of polishing. 2.3 Proprieties and application Industrial polishes, 2.4 Types, Proprieties and application of Rubbing and Leveling compound. 2.5 Test the properties like gloss, finish appearance and Distinctness of image. 2.6 Introduction to wood polishes. 2.7 Properties and applications of wood polishes.
Unit-III Printing Inks Technology	3a. List raw materials used for inks. 3b. Explain general methods of ink manufacturing. 3c. Test physical properties of ink. 3d. State requirement of inks for various application. 3e. Define various types of special purpose inks.	3.1 Raw materials for ink. 3.2 General methods of ink manufacturing. 3.3 Test physical properties of Inks. 3.4 Use of ink proofing kit. 3.5 Requirements of inks for offset, screen, flexography and gravure technology. 3.6 Introduction to Ink jet Inks, anti-forgery inks, fluorescent inks, food wrapper inks, photo-copier Inks, UV Curable Inks
Unit-IV Electroplating	4a. Define electroplating. 4b. State laws of electroplating. 4c. Write surface preparation process for electroplating. 4d. Explain process for bath preparation and electroplating. 4e. Explain effect of process parameters on electroplating. 4f. Write test procedures for electroplated surfaces. 4g. Compare electroplating with liquid coating.	4.1 Introduction to electroplating. 4.2 Laws underline electroplating. 4.3 Surface preparation for electroplating. 4.4 Bath solution preparation. 4.5 Process for electroplating. 4.6 Effect of process parameters on electroplating. 4.7 Test electroplated surfaces. 4.8 Protective aspects of electroplating.
Unit –V Water Proofing	5a. Define water proofing. 5b. Identify the need of waterproofing. 5c. List raw materials for waterproofing. 5d. Explain water proofing	5.1 Introduction to waterproofing. 5.2 Need of waterproofing. 5.3 Raw material used in waterproofing. 5.4 Techniques of waterproofing. 5.5 Test waterproofing materials.



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	techniques. 5e. Explain test methods for water proofing. 5f. Write application of water proofing. 5g. Explain various safety aspects of water proofing.	5.6 Applications of waterproofing. 5.7 Safety aspects during water proofing of buildings.

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	Floor Coating	10	02	04	08	14
II	Polishes	10	02	04	08	14
III	Printing Inks Technology	10	02	04	08	14
IV	Electroplating	10	02	04	08	14
V	Water proofing	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:

- Visit to electroplating industry / laboratory.
- Visit to printing press / laboratory.
- Collect different coated wood substrates samples.
- Collect different coil coating substrates samples.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

- Massive open online courses (**MOOCs**) may be used to learn 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 allied industries and testing equipment used.
- 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. Prepare a design of printing screen.
- b. Make album of floor coating finishes.
- c. Prepare album of wallpaper finishes.
- d. Conduct market survey of allied coatings for human beings.
- e. Prepare chart of advanced polishing tools available in the market.
- f. Compare polishing products available in the market.
- g. Collect data latest ink manufacturing techniques.
- h. Collect information of latest printing techniques.
- i. Prepare report on requirement of raw material for manufacturing of anti-forgery ink.
- j. Collect data of trivalent electroplating.
- k. Survey of electroplating industries.
- l. Compare zinc, aluminum flake coating with other coating.
- m. Prepare flowchart for electroplating bath solution disposal process.
- n. Collect information of waterproofing products and techniques available in market.
- o. Collect samples of waterproofing materials available in the market.



13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	Formulation and function of cosmetics	Joseph Stephan Jellinek	Wiley-Interscience.,1970 ISBN: 9780471441502
2	The Printing Ink Manual	R H Leach & M J Machezie	Van Nostrand Rein Hold Com. Ltd, 1988 ISBN 9789401170994
3	Printing ink Formulation Principles	Ronald E Todd	Pira International publication.,1994. ISBN: 9781858020273
4	Electroplating Engineering Handbook	Lawrence J Durney	CBS Publication, Delhi., 2987 ISBN: 9781461295877
5	Waterproofing Handbook Second Edition	Michael T. Kubal	The McGraw-Hill Companies, Inc., 2000 ISBN: 9780071489737

14. SOFTWARE/LEARNING WEBSITES

- a. <https://www.youtube.com/watch?v=gv7WSpKt4Zg>
- b. <https://www.youtube.com/watch?v=QLEdu8z2FL4>
- c. <https://www.youtube.com/watch?v=yv7SogmppJQ>
- d. <https://www.youtube.com/watch?v=Txolwml6Bmo>
- e. <https://www.youtube.com/watch?v=LkNtGVjdboM>
- f. <https://www.youtube.com/watch?v=h3t7jULUCpc>
- g. <https://www.youtube.com/watch?v=VPsUbYRFKKw>
- h. <https://www.youtube.com/watch?v=Fypi6dAJB8E&t=12s>
- i. <https://www.youtube.com/watch?v=RW1HJdW5XLs>
<https://www.youtube.com/watch?v=BGjogbtsLgw>
- j. https://www.youtube.com/watch?v=OxhCU_jBiOA
- k. <https://www.youtube.com/watch?v=aDkpbB31lek>
- l. <https://www.youtube.com/watch?v=G-PtnwtOR24>
- m. <https://www.youtube.com/watch?v=aDL3ekJwQd8>
- n. <https://www.youtube.com/watch?v=3lehA6IO56w>
- o. <https://www.youtube.com/watch?v=QIUZwwKDqXo>
- p. <https://www.youtube.com/watch?v=v4BPuil3S2o>
- q. <https://www.youtube.com/watch?v=N1vu0f6qgOA>
- r. <https://www.youtube.com/watch?v=GvOI0UHDi04>
- s. <https://www.youtube.com/watch?v=rkLUej6wJR0>

