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 : FIFTH **DURATION : 16 WEEKS**

PATTERN : FULL TIME - SEMESTER **SCHEME : I**

S. N.	Course Title	Course Abbreviation	Course Code	Teaching Scheme			Credit (L+T+P)	Examination Scheme												Grand Total
								Theory							Practical					
								Exam Duration in Hrs.	ESE		PA		Total		ESE		PA		Total	
				L	T	P			Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	
1	Management	MAN	22509	3	-	-	3	90 Min	70*#	28	30*	00	100	40	--	--	--	--	--	--	100
2	Paints Technology-II	PTE	24524	3	-	4	7	3	70	28	30*	00	100	40	50#	20	50	20	100	40	200
3	Application and Evaluation of Paints-II	AEP	24525	3	-	4	7	3	70	28	30*	00	100	40	50#	20	50	20	100	40	200
4	Chemical Technology for Paint Industries	CTP	24526	3	-	4	7	3	70	28	30*	00	100	40	50#	20	50	20	100	40	200
5	Novelty Finishes and Aesthetics	NFA	24050	-	-	2	2	--	--	--	--	--	--	--	25@	10	25~	10	50	20	50
6	Enterprenureship Development	EDE	22032	2	-	2	4	--	--	--	--	--	--	--	50@	20	50~	20	100	40	100
			Total	**14**	**-**	**16**	**30**	--	**280**	--	**120**	--	**400**	--	**225**	--	**225**	--	**450**	--	**850**

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

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

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

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

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

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

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

Program Name : **Diploma in Mechanical Engineering / Diploma in Electrical Engineering Group / Diploma in Chemical Engineering / Diploma in Plastic Engineering / Diploma in Food Technology / Diploma in Medical Laboratory Technology/ Diploma in Surface Coating Technology**

Program Code : **ME / EE / EP / EU / CH / PS / FC / ML / SC**

Semester : **Fifth**

Course Title : **Management**

Course Code : **22509**

1. RATIONALE

An engineer has to work in industry with human capital and machines. Therefore, managerial skills are essential for enhancing their employability and career growth. This course is therefore designed to provide the basic concepts in management principles, safety aspects and Industrial Acts.

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 managerial skills for ensuring efficient and effective management.**

3. COURSE OUTCOMES (COs)

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

a. Use basic management principles to execute daily activities.
b. Use principles of planning and organising for accomplishment of tasks.
c. Use principles of directing and controlling for implementing the plans.
d. Apply principles of safety management in all activities.
e. Understand various provisions of industrial acts.

4. TEACHING AND EXAMINATION SCHEME

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

(#) Online Theory Examination.*

(*): 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.(#): Online examination*

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.

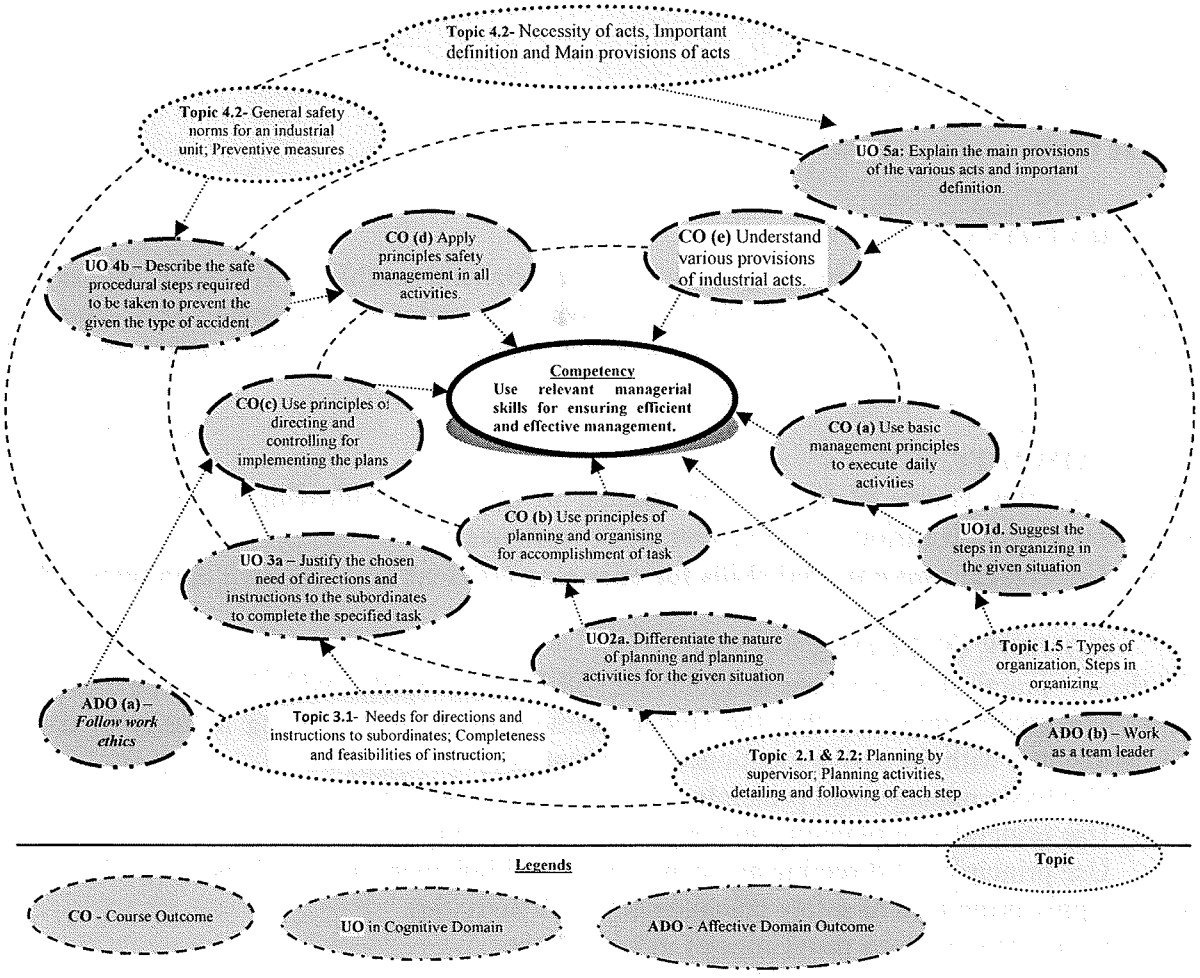


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

- Not applicable -

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

- Not applicable -

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 Introduction to management concepts and managerial skills	1a. Differentiate the concept and principles of management for the given situation. 1b. Explain functions of management for given situation. 1c. Compare the features of the given types of planning 1d. Suggest the steps in organizing in the given situation. 1e. Suggest suitable type of organization for the given example. 1f. Identify the functional areas of management for the given situation 1g. Suggest suitable managerial skills for given situation with justification	1.1 Definitions of management, role and importance of management. 1.2 Management characteristics and principles, levels of management and their functions; management, administration and organization, relation between management and administration. 1.3 Functions of management: planning, organizing, leading/directing, staffing and controlling. 1.4 Types of planning and steps in planning 1.5 Types of organization, Steps in organizing 1.6 Functional areas of management. 1.7 Managerial skills.
Unit – II Planning and organizing at supervisory level	2a. Differentiate the nature of planning and planning activities for the given situation. 2b. Suggest the step wise procedure to complete the given activity in the shop floor. 2c. Prepare materials and manpower budget for the given production activity. 2d. Describe with block diagrams the organization of the physical resources required for the given situation. 2e. Describe the human needs to satisfy the job needs for the specified situation. 2f. List the tasks to be done by the concerned individuals for completing the given activity.	**Planning at supervisory level** 2.1 Planning by supervisor. 2.2 Planning activities, detailing and following of each step. 2.3 Prescribing standard forms for various activities. 2.4 Budgeting for materials and manpower. **Organizing at supervisory level** 2.5 Organizing the physical resources. 2.6 Matching human need with job needs. 2.7 Allotment of tasks to individuals and establishing relationship among persons working in a group
Unit– III Directing and Controlling at supervisory level	3a. Justify the chosen need of directions and instructions to the subordinates to complete the specified task. 3b. Select the feasible set of instructions to complete the given simple task, with justification 3c. Predict the possible mistakes for completing the given simple activity. 3d. Describe the managerial control	**Directing at supervisory level** 3.1 Needs for directions and instructions to subordinates; Completeness and feasibilities of instructions 3.2 Personal counselling advanced predictions of possible mistakes. 3.3 Elaborating decisions, laying disciplinary standards in overall working **Controlling at supervisory level**

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	actions and remedial measures required to be taken for completing the given task successfully.	3.4 Managerial control; Understanding team and link between various departments in respect of process and quality standards; Steps in control process 3.5 Controlling methods; Control over the performance in respect of quality, quantity of production, time and cost. Measuring performance, comparing with standards, correcting unfavorable deviations.
Unit – IV Safety Management	4a. State the general safety norms required to be taken in the given case. 4b. Suggest preventive measures of plant activities in the given situation. 4c. Describe the safe procedural steps required to be taken to prevent the given the type of accident. 4d. Prepare a work permit in to conduct the given maintenance activity. 4e. Explain the causes of the specified type of accident in the given situation. 4f. Prepare the specifications of the firefighting equipment required for the given type of fire.	4.1 Need for safety management measures 4.2 General safety norms for an industrial unit; Preventive measures. 4.3 Definition of accident, types of industrial accident; Causes of accidents; 4.4 Fire hazards; Fire drill. 4.5 Safety procedure 4.6 Work permits.
Unit – V Legislative Acts	5a. Explain the purpose of the act 5b. Explain the main provisions of the various acts and important definition.	5.1 Necessity of acts, Important definition and Main provisions of acts. 5.2 Industrial Acts: a. Indian Factory Act b. Industrial Dispute Act c. Workman Compensation Act d. Minimum Wages Act

***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 management concepts and managerial skills	12	06	06	04	16

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
II	Planning and organizing at supervisory level	08	04	06	04	14
III	Directing and controlling at supervisory level	08	04	06	04	14
IV	Safety Management	08	04	06	04	14
V	Legislative Acts	12	02	06	04	12
	Total	**48**	**20**	**30**	**20**	**70**

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

10. SUGGESTED STUDENT ACTIVITIES

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

a. Write assignments based on the theory taught in classrooms. Assignments consist of ten questions having long answers including charts, symbols, drawing, observations etc.
b. Prepare/Download information about various industrial acts.
c. Visit to any Manufacturing industry and prepare a report consisting of:
    i. Organization structure of the organization/ Dept.
    ii. Safety measures taken in organization.
    iii. Mechanism to handle the disputes.
    iv. Any specific observation you have noticed.
d. Give seminar on relevant topic.
e. Undertake micro-projects.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

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

g. Encourage students to refer different websites to have deeper understanding of the subject.
h. Observe continuously and monitor the performance of students in Lab.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student 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 are given here. Similar micro-projects could be added by the concerned faculty:

a. Study of management principles applied to a small scale industry.
b. Study of management principles applied to a medium scale industry.
c. Study of management principles applied to a large scale industry.
d. Prepare case studies of Safety measures followed in different types of organization.
e. Study of measures to be taken for ensuring cyber security.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Management and entrepreneurship	Veerabhadrappa, Havinal	New age international publishers, New Delhi, 2014: ISBN: 978-81-224-2602-1
2	Principles of management	Chaudhry omvir Singh prakash	New Age international publishers, 2012, New Delhi ISBN: 978-81-224-3039-4
3	Industrial Engineering and management	Dr. O. P. Khanna	Dhanpath ray and sons, New Delhi
4	Industrial Engineering and management	Banga and Sharma	Khanna Publication, New Delhi

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. https://www.versesolutions.com/
b. https://www.books.google.co.in/books?isbn=817758412X
c. https://www. www.educba.com › Courses › Business › Management

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

Program Code : **SC**

Semester : **Fifth**

Couse Title : **Paints Technology-II**

Couse Code : **24524**

1. RATIONALE

This course introduces industrial paints and coatings as organic coatings prepared by careful selection of raw materials, manufacturing using suitable machines to acquire required physio-chemical properties when used for different industrial applications. It includes selection of raw materials, understanding basic chemistry, manufacturing processes, evaluating properties and application of paints for industrial applications. The course explains the formulating principles of paints/powder coatings for particular industrial applications and test required liquid paint and dry film properties during and 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 Industrial coating formulations for Industrial applications.**

3. COURSE OUTCOMES (COs)

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

a. Select corrosion resistance coatings.
b. Prepare industrial coatings.
c. Select chemical resistance and speciality coatings.
d. Demonstrate new trends in industrial coatings.

4. TEACHING AND EXAMINATION SCHEME

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

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

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

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

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

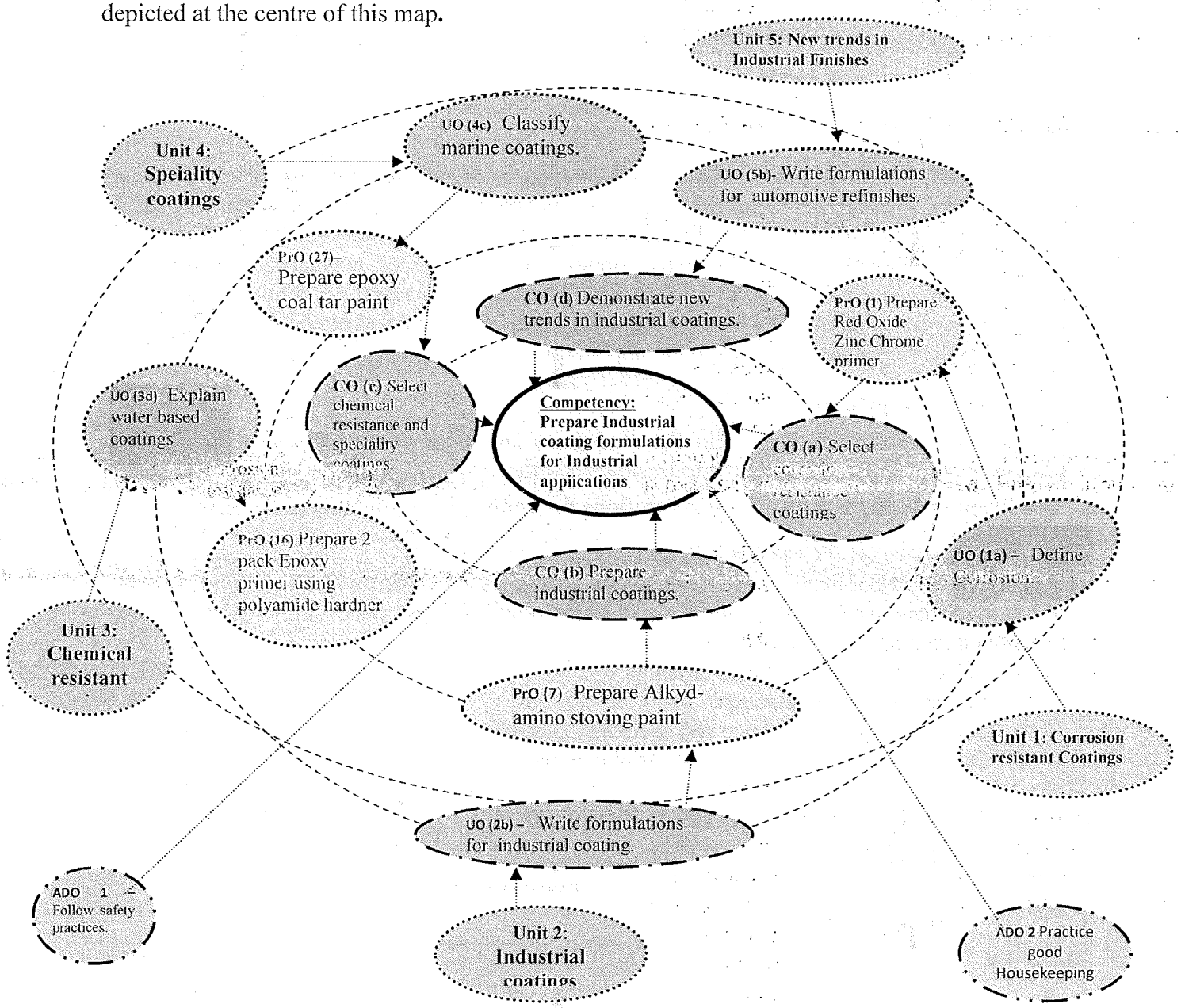


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

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

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
1	Prepare Red Oxide Zinc Chrome primer (ROZC) (Part-I: Formulate ROZC as per IS 2074)	I	2*
2	Prepare Red Oxide Zinc Chrome primer (ROZC) (Part-II: Prepare ROZC using pebble mill)	I	2*
3	Prepare Red Oxide Zinc Chrome primer (ROZC) (Part-III: Testing-Hegman Gauge, Viscosity, Wt/lit)	I	2*
4	Prepare Yellow primer Part-I: Formulate Yellow primer as per IS 104)	I	2
5	Prepare Yellow primer (Part-II: Prepare Yellow primer using pebble mill)	I	2
6	Prepare Yellow primer (Part-III: Test- Hegman Gauge, Viscosity, Wt/lit)	I	2
7	Prepare Alkyd-amino stoving paint (Part-I: Formulate Alkyd-amino stoving paint)	II	2*
8	Prepare Alkyd-amino stoving paint (Part-II: Prepare Alkyd-amino stoving paint using sand mill)	II	2*
9	Prepare Alkyd-amino stoving paint (Part-III: Test-Hegman Gauge, Viscosity, Wt/lit, Xylene rub, Gloss, pencil hardness)	II	2*
10	Prepare Acrylic-amino stoving paint (Part-I: Formulate Acrylic-amino stoving paint)	II	2
11	Prepare Acrylic-amino stoving paint (Part-II: Prepare Acrylic-amino stoving paint using sand mill)	II	2
12	Prepare Acrylic-amino stoving paint (Part-III: Test- Hegman Gauge, Viscosity, Wt/lit, Xylene rub, Gloss, pencil hardness)	II	2
13	Test particle size distribution (PSD) of powder used for powder coating using sieve analysis.	II	2
14	Prepare 2 pack Epoxy primer using polyamide hardner (Part-I: Formulate 2 pack epoxy primer)	III,V	2*
15	Prepare 2 pack Epoxy primer using polyamide hardner (Part-II: Prepare 2 pack epoxy primer using sand mill)	III,V	2*
16	Prepare 2 pack Epoxy primer using polyamide hardner (Part-III: Test- Hegman Gauge, Viscosity, Wt/lit, Xylene rub, pencil hardness, cross cut adhesion)	III,V	2*
17	Prepare 2 pack Polyurethane enamel with different finish. (Part-I: Formulate 2 pack Polyurethane primer)	III,V	2
18	Prepare 2 pack Polyurethane enamel with different finish. (Part-II: Prepare 2 pack Polyurethane primer using sand mill)	III,V	2
19	Prepare 2 pack Polyurethane enamel with different finish. (Part-III: Test-Hegman Gauge, Viscosity, Wt/lit, Xylene rub, pencil hardness, cross cut adhesion)	III,V	2
20	Prepare thermosetting acrylic (TSA) enamel using concept of weight per liter, Pigment binder ratio, PVC.	IV	2*

	(Part-I: Formulate TSA Enamel)		
21	Prepare thermosetting acrylic (TSA) enamel using concept of weight per liter, Pigment binder ratio, PVC using sand mill. (Part-II: Prepare TSA Enamel)	II, IV	2*
22	Prepare thermosetting acrylic (TSA) enamel using concept of weight per liter, Pigment binder ratio, PVC. (Part-III: Test- Hegman Gauge, Viscosity, Wt/lit, Xylene rub, pencil hardness, cross cut adhesion)	II, IV	2*
23	Prepare Aluminium heat resistant paint. (Part-I: Formulate heat resistant paint)	IV	2
24	Prepare Aluminium heat resistant paint (Part-II: Prepare heat resistant paint using stirrer.)	IV	2
25	Prepare Aluminium heat resistant paint. (Part-III: Test-Quenching and non quenching test)	IV	2
26	Prepare epoxy coal tar paint (Part-I: Formulate epoxy coal tar paint)	IV	2
27	Prepare epoxy coal tar paint (Part-II: Prepare epoxy coal tar paint using stirrer)	IV	2
28	Prepare epoxy coal tar paint (Part-III: Test-cross cut adhesion, pencil hardness)	IV	2
29	Prepare epoxy ester primer (Part-I: Formulate epoxy ester paint)	II,III ,V	2*
30	Prepare epoxy ester primer (Part-II: Prepare epoxy ester paint using sand mill)	II,III ,V	2*
31	Prepare epoxy ester primer (Part-III: Test-Drying time, cross cut adhesion, pencil hardness)	II,III ,V	2*
32	Prepare fire retardant paint (Part-I: Formulate fire retardant paint)	V	2
33	Prepare fire retardant paint (Part-II: Prepare fire retardant paint using stirrer)	V	2
34	Prepare fire retardant paint (Part-III: Test for Fire retardancy of coated object)	V	2
35	Test Coil coating primered panels for physical resistance properties.	V	2
36	Test Coil coating painted panels for chemical resistance properties.	V	2
37	Plot the graph of viscocity pick up against time for 2 pack epoxy paint.	V	2*
38	Plot the graph of viscocity pick up against time for 2 pack PU paint.	V	2
	Total (no. of hrs. to be engaged)		48

Note

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

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

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

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

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

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

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Digital weighing balance	Pro 1 to 34
2	Pestle Mortar (15 ml capacity)	Pro 1 to 34
3	Spatula	Pro 1 to 38
4	Glass Rod	Pro 1 to 38
5	1.0 Inch Brush	Pro 1 to 34
6	Ford Cup Viscometer (B4 number)	3,6,9,12,16,19,22
7	Specific gravity cup (100ml capacity)	3,6,9,12,16,19,22
8	200 ml Paper Glass	Pro 1 to 38
9	Pebble Mill Machine	2,5
10	Pebble Mill grinding media	2,5

S. No.	Equipment Name with Broad Specifications	PrO. No.
11	Sand Mill	8,11,15,18,21,30
12	Sand Mill grinding Media	8,11,15,18,21,30
13	Stirrer	24,27,33,
14	Sand papers (120 to 320 number)	9,12,16,19,22,28,34
15	Metal Panel (0.5 mm thickness)	9,12,16,19,22,28,34
16	Aluminum Panel (0.5 mm thickness)	6,25
17	Oven (250^0C)	9,12,22,25
18	Muffel furnace (800^0C)	25
19	200 ml Glass beaker	Pro 1 to 34
20	Stainless steel pot (2 liters capacity)	13,27
21	Heating mantel (150^0C)	27
22	Laboratory Gas burner	27,34
23	Glass beakers of 500 ml capacity	35,36
24	Glass panels (100 x 50 mm)	35,36
25	Gardner Tube	3,6,9,12,16,19,22
26	Hegman Gauge	3,6,9,12,16,19,22
27	DFT meter	9,12,16,19,22,28,31,35,36
28	Gloss 'O' Meter	9,12
29	Pencil Hardness tester	9,12,16,19,22,28,31,35,36
30	Seives of different mesh size	13
31	Cross hatch tester	16,19,22,28,31
32	Cotton waste	Pro 1 to 36
33	Brookfield Viscometer	37,38

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 Corrosion resistant Coatings	1a. Define Corrosion. 1b. Explain different corrosion mechanisms. 1c. Describe properties & applications of corrosion resistant coatings. 1d. Justfy formulation for corrosion resistant coatings.	1.1 Introduction to corrosion & types of corrosion reactions. 1.2 Classification of corrosion resistant coating as clear & pigmented coating. 1.3 Formulation of corrosion resistant paints such as red oxide primer red oxide zinc chrome primer, yellow primer, etch primer, Zinc dust primer 1.4 Properties and applications of Zinc silicate primer.
Unit-II Industrial coatings	2a. Write the requirements of industrial coatings. 2b. Write formulations for industrial coating. 2c. Explain manufacturing processes of industrial coatings.	2.1 Introduction to industrial coatings & its principle of development 2.2 Formulation of industrial coatings, such as white goods, metal

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	2d. Explain applications of industrial coatings.	furniture, hospital equipment, laboratory furniture. 2.3 Formulation of automotive coatings with properties and applications. 2.4 Introduction and manufacturing of powder coatings. 2.5 Formulations of powder coatings.
Unit– III Chemical resistant paints	3a. Write compositions for epoxy and polyurethane paints . 3b. Explain properties of epoxy and polyurethane paints. 3c. Write applications of epoxy and polyurethane paints. 3d. Explain water based coatings.	3.1 Introduction to chemical resistant coatings & it's significance 3.2 Formulations of one pack, 2 pack epoxy primers, paints & its applications 3.3 Formulations of Poly urethane primers, paints & its applications 3.4 Significance and calculations of mixing ratio of hardner & base polymer 3.5 Introduction to water based coatings-epoxy and polyurethanes.
Unit - IV Speiality coatings	4a. Classify marine coatings. 4b. Explain properties of marine coatings. 4c. Write composition for heat resistant coatings. 4d. List applications of coil coatings.	4.1 Introduction to marine coatings & it's requirement. 4.2 Classification of coatings like paint for hull of ship, paint for boot top area, paint for deck area 4.3 Formulation of marine paints like antiskid and antifouling coatings. 4.4 Formulation of heat resistant coatings with properties and applications. 4.5 Introduction to coil coating for properties & applications.
Unit-V New trends in Industrial Finishes	5a. Classify industrial floor coatings. 5b. Describe applications of fire retardant coatings. 5c. Write formulations for automotive refinishes. 5d. Write applications of PVDF, PTFE and Zinc flake coatings. 5e. Describe requirement of coatings for space, defence, aeroplane and nano coatings.	5.1 Introduction to floor coating and its type. 5.2 Applications of fire retardant coatings. 5.3 Formulation & properties of automotive refinishes 5.4 Properties & uses of coatings based on PVDF, PTFE Zinc flake coatings. 5.5 Introduction to coating for space shuttle, aeroplane and missile. 5.6 Introduction to nano coatings. 5.7 Introduction to monocoat system (Direct to metal)

Note:

1. *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'*
2. *Formulations mentioned in curriculum are only guidline formulatios.*

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	Corrosion resistant Coatings	10	02	04	08	14
II	Industrial paints	10	02	04	08	14
III	Chemical resistant paints	10	02	04	08	14
IV	Speciality coating	10	02	04	08	14
V	New trends in Industrial finishes	08	02	04	08	14
Total		**48**	**10**	**20**	**40**	**70**

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

10. SUGGESTED STUDENT ACTIVITIES

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

a. Visit to Automobile/paint application plant.
b. Prepare a report on developments in corrosion resistant coatings .
c. Collect information of various resins used for corrosion resistant coatings.
d. Collect information of types of Industrial coatings used for different applications.
e. Prepare a report on developments in chemical resistant coatings.
f. Prepare a report on developments in marine/powder coatings.
g. Use relevant IS specification of Industrial coatings.
h. Prepare report on market status of Industrial coating
i. Collect Information about types of coatings for space applications.
j. 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:

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

d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.
f. Correlate properties and application of industrial paints. .
g. Use relevant raw materials calculations for formulating paint systems.
h. Use Flash/Animations to explain various reactions, manufacturing methods of paint 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 market share/status of various Industrial coatings
b. Prepare report on emerging trends in Industrial coatings
c. Prepare report on development of new polymer for Industrial coating applications
d. Prepare report on modified Industrial coatings.
e. Compile data of water reducible PU dispersion
f. Prepare data on Industrial wood coatings
g. Calculate cost of raw material required for Industrial paint formulation.
h. Compare data of products related to Industrial coatings for various industries available in market.
i. Survey of Industrial paint manufacturing industries.
j. Compile data of various IS Standards for Industrial coatings.
k. Prepare report on scope & growth potential for Industrial coatings
l. Prepare album of Industrial finishes.
m. Prepare report on various safety equipments used in paint manufacturing industries.
n. Collect information on Water proofing methods and process based on acrylic
o. Collect information on Water proofing methods and process based on polyurethane.
p. Prepare reports for available nano coatings in market.
q. Prepare a report on new development in industrial water base coating
r. Collect information on Wood coating.

s. Collect information on Glass coating.
t. Prepare report on Global scenario of coating industry.
u. Collect information on Self cleaning coating.
v. Collect information on Antibacterial coating
w. Collect information on Antiviroal coating.
x. Case study on automobile refinishes coating.

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 (1961) ISBN: 9780471673538
4	Basics of Paints Technology Part 1	V.C. Malshe and Meenal Sikchi	Antar Prakash Centre for Yoga, 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

1. https://www.youtube.com/watch?v=TKMgUCq3npg
2. https://www.youtube.com/watch?v=Im23nVpB0bE
3. https://www.youtube.com/watch?v=LM4VOW6xZ5Y
4. https://www.youtube.com/watch?v=I3QLMl1AK9Y
5. https://www.toppr.com/guides/chemistry/environmental-chemistry/oxides-of-sulphur-and-nitrogen/
6. https://www.youtube.com/watch?v=tXnMNFk_r4w
7. https://www.youtube.com/watch?v=Fb__KLI7D0s
8. https://www.youtube.com/watch?v=b6Q6VWoUGE0
9. https://coatings.specialchem.com/coatings-properties/corrosion-resistance
10. https://www.rawlinspaints.com/blog/discover-rust-inhibiting-metal-primers/
11. https://www.youtube.com/watch?v=X6EVMSNOWXw
12. https://www.youtube.com/watch?v=XrY2eW2GroM
13. https://www.silcotek.com/blog/how-to-make-a-new-coating
14. https://www.youtube.com/watch?v=T5lsSr_Dp4o
15. https://www.nipponpaint-holdings.com/en/rd/technology/20201111/
16. https://www.viscosity.com/automotive-industrial-paint-solutions
17. https://www.youtube.com/watch?v=YIGHH1edHyA
18. https://www.youtube.com/watch?v=_r_gQ9hIcng

19. https://www.youtube.com/watch?v=ChVK8J1-has
20. https://paint.cosmetius.com/en/kraski/vidy/na-epoksidnoj-osnove.html
21. https://polyurethane.americanchemistry.com/How-Polyurethane-is-Made/
22. https://finishing.tips/catalyzed-polyurethane-finish/
23. https://paintsandcoatingsexpert.com/2018/07/28/wo2018136488-waterborne-polyurethane-coatings/
24. https://www.youtube.com/watch?v=eb8VAnLH1bg
25. https://nauticalclass.com/paints-and-types-of-paints-used-on-ships/
26. https://www.westmarine.com/WestAdvisor/DIY-Bottom-Painting
27. https://safety4sea.com/hull-coatings-technologies/
28. https://www.silcotek.com/coatings-for-energy-blog/what-is-the-heat-resistance-of-silicon-coatings
29. https://www.wacker.com/cms/en-us/products/applications/industrial-coatings/heat-resistance/heat-resistance-coatings.html
30. https://www.silcotek.com/blog/high-temperature-coatings-whats-the-maximum-temperature
31. https://www.youtube.com/watch?v=arUbCGHOSAc
32. https://www.youtube.com/watch?v=CS3Hx4Kl3bE
33. https://www.concretenetwork.com/products-concrete-coatings/
34. https://www.youtube.com/watch?v=RMXX2XCOy9M
35. https://www.youtube.com/watch?v=oD2Cio0m3TM
36. https://www.youtube.com/watch?v=RMXX2XCOy9M
37. https://www.youtube.com/watch?v=pBBnYlln_TU
38. https://www.youtube.com/watch?v=alMKdUbE7vI
39. htttps://www.outube.com/watch?v=8NC79e0oztM
40. https://www.youtube.com/watch?v=YD_cqCxSLRI
41. https://www.youtube.com/watch?v=ofKWfeqzGBY
42. https://www.youtube.com/watch?v=q2CFwxuwFsM
43. https://www.youtube.com/watch?v=2YbR-mOSZro
44. https://www.youtube.com/watch?v=BXFkTUlOJhM
45. https://linetec.com/2012/09/07/what-are-high-performance-pvdf-kynar-paints/
46. https://www.youtube.com/watch?v=X9GA9Ahuu9A
47. https://www.youtube.com/watch?v=4Boaw5TAnns
48. https://www.hylite.co.in/ptfe-coating/
49. https://www.pfonline.com/articles/how-zinc-flake-systems-ensure-high-corrosion-protection
50. https://www.youtube.com/watch?v=z6ZZwqLkWHg
51. https://www.youtube.com/watch?v=vidwsuL9-7g
52. https://insulationcoatings.com.au/super-therm-nasa-test-results/
53. https://www.youtube.com/watch?v=u6IS24U85WU
54. https://insulationcoatings.com.au/what-is-super-therm-ceramic-insulation-coating/
55. https://www.youtube.com/watch?v=Pp9Yax8UNoM
56. https://www.youtube.com/watch?v=0AaMUqKyM4k
57. https://www.coatings.org.uk/admin/aerospace-coatings.aspx
58. https://inside.battelle.org/blog-details/how-conductive-coatings-are-changing-aviation
59. https://cen.acs.org/articles/93/i26/Airplane-Coatings-Help-Recoup-Fuel.html
60. https://www.ppgaerospace.com/Products/Coatings-Removers-Cleaners/PPGs-Aerospace-Coatings-Academy.aspx

61. https://ceramicpro.com/aviation-industry/
62. https://materion.com/markets/defense
63. https://www.avantorsciences.com/pages/en/nusil-silicone-coatings-dispersions
64. https://www.turi.org/Our_Work/Research/Aerospace_and_Defense
65. https://www.telegraph.co.uk/education/stem-awards/defence-technology/thermal-paint-for-aircraft-carriers/
66. https://www.aerodefensetech.com/component/content/article/adt/features/articles/34530
67. https://www.paintsquare.com/news/?fuseaction=view&id=13059
68. https://www.sbir.gov/news/air-force-develop-green-coating-missile-launchers
69. https://nanoslic.com/about-nanocoatings/
70. https://www.nanowerk.com/nanocoatings.php
71. https://www.sciencedirect.com/topics/chemistry/nanocoating
72. https://www.sciencedirect.com/topics/engineering/nanocoatings
73. https://www.businesswire.com/news/home/20150121006513/en/Axalta-Coating-Systems%E2%80%99-2-Wet-Monocoat-Paint-System-Selected-as-a-2015-Automotive-News-PACE-Award-Finalist
74. https://www.sae.org/publications/technical-papers/content/2019-28-2541/
75. https://www.paint.org/coatingstech-magazine/articles/taking-direct-to-metal-coatings-to-the-next-level/
76. https://saemobilus.sae.org/content/2019-28-2541/
77. https://www.thefreelibrary.com/UV+monocoat%3A+an+advanced+coating+technology+for+consumer+electronics.-a0331004044
78. https://www.pcimag.com/articles/104107-new-class-of-specialty-polyester-polyols-enables-highly-weatherable-and-durable-automotive-and-industrial-coatings
79. http://metconcoatings.com/whatsnew/MCC-4702.php

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

Program Code : **SC**

Semester : **Fifth**

Couse Title : **Application and Evaluation of Paints-II**

Couse Code : **24525**

1. RATIONALE

This course will introduce student various surface preparation methods, industrial paint application methods such as conventional spraying, airless/air-assisted airless spraying, robotic spraying, electrodeposition, coil coating etc. This course will also give insight to various paint shop process and equipment like spray booths, ovens, sludge collecting units, VOC management etc. This course will expose to students to paint fil defects, their causes, and remedies. This course also introduces powder coating application methods with powder coating quality control.

2. COMPETENCY

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

- **Apply liquid paint and powder coating as per specification.**

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:

a. Use relevant surface preparation method.
b. Apply paint using relevant paint application method.
c. Explain paint shop processes.
d. Analyze paint film defects.
e. Apply powder coating using relevant methods.

4. TEACHING AND EXAMINATION SCHEME

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

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

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

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

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

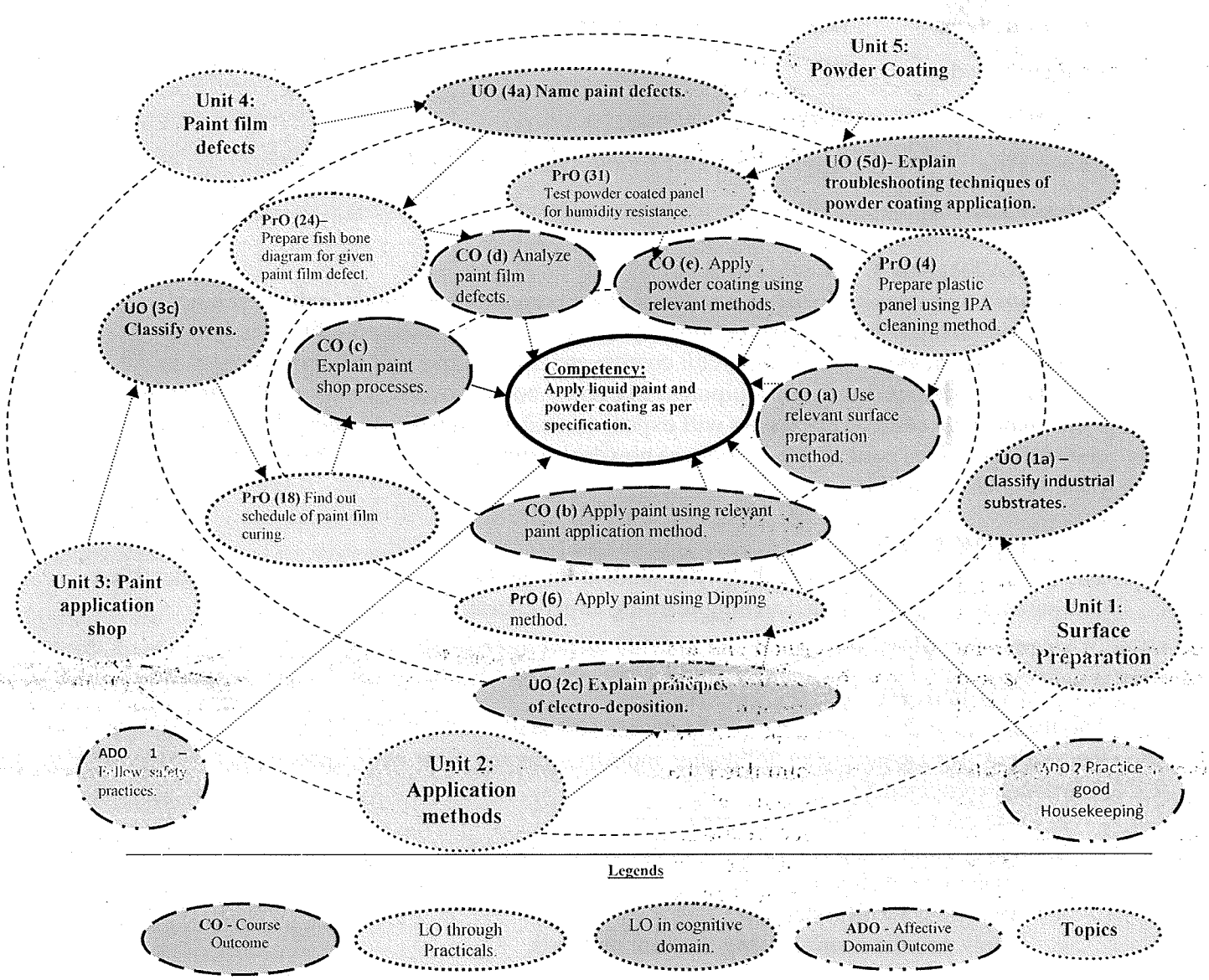


Figure 1 - Course Map

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 mild steel panel using 7 tank method-Zn phosphate (Part-I: Bath preparation)	I	2*
2	Prepare mild steel panel using 7 tank method-Zn phosphate (Part-II: Pre-treatment and Evaluation)	I	2*
3	Prepare aluminum panel using chemical cleaning method.	I	2
4	Prepare plastic panel using IPA cleaning method.	I	2*
5	Prepare Copper surface using chemical cleaning method.	I	2
6	Apply paint using Dipping method. (Part-I: Experimental set up)	II	2*
7	Apply paint using Dipping method. (Part-II: Coating and its evaluation)	II	2*

8	Apply paint using Flow method. (Part-I: Experimental set up)	II	2
9	Apply paint using Flow method. (Part-II: Coating and its evaluation)	II	2
10	Apply paint by spray method using conventional spray gun. (Part-I: Panel painting)	II	2*
11	Apply paint by spray method using conventional spray gun. (Part-II: Coating and its evaluation)	II	2
12	Apply paint by film applicator. Part-I: Film applications	II	2
13	Apply paint by film applicator. Part-II: WFT to DFT evaluation	II	2
14	Compare paint finish by changing spray parameters such as: Flow rate, Spray pressure, viscosity. (Part I: Panel Painting)	III	2*
15	Compare paint finish by changing spray parameters such as: Flow rate, Spray pressure, viscosity. (Part-II: Coating Evaluation-Finish, DFT, gloss, adhesion)	III	2*
16	Demonstrate radiation curing method (IR and UV) of coating.	III	2
17	Find out schedule of paint film curing. (Part-I: Panel Painting)	III	2*
18	Find out schedule of paint film curing. (Part-II: Coating Evaluation)	III	2*
19	Demonstrate working of TTR for "Time V/s Temperature" profiling of curing oven. .	III	2
20	Identify paint defects on painted panels	IV	2
21	Determine Sagging index of paint using sag indexer.	IV	2
22	Transform paint defective surface (Run down / Dust) into defect free surface. (Part I: (Rework and its SOP)	IV	2*
23	Transform paint defective surface (Run down / Dust) into defect free surface. (Part II: (Repainting and its SOP)	IV	2*
24	Prepare fish bone diagram for given paint film defect.	IV	2*
25	Produce given paint defects-Rundown/Dust (Part I: Defect generation)	IV	2
26	Produce given paint defects-Rundown/Dust (Part II: Coating evaluation)	IV	2
27	Apply powder coating using electrostatic spray gun (Part-I: Powder coating and curing)	V	2*
28	Apply powder coating using electrostatic spray gun (Part-II: Cross cut adhesion, Impact resistance, pencil hardness and MEK rub test)	V	2*
29	Apply powder coating using Fluidized bed application (Part-I: Experimental set up)	V	2
30	Apply powder coating using Fluidized bed application. (Part-II: Mechanical properties Evaluation)	V	2
31	Test powder coated panel for humidity resistance.	V	2*
32	Test powder coated panel for salt spray resistance.	V	2
	Total		**48**

Note

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

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

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

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

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

The ADOs are not specific to any one PrO but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period. 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	MS panels	All PrOs
4	Sand Paper (80, 120, 320)	All PrOs
5	Cotton waste	All PrOs
6	Weighing Balance	All PrOs

S. No.	Equipment Name with Broad Specifications	PrO. No.
7	Thermometer	All PrOs
8	Stop Watch	All PrOs
9	Plastic Baths	1,2,6,7
10	pH paper/pH meter	1,2
11	Aluminum panel	3
12	Plastic panel	4
13	Copper panel	5
14	Spray booth assembly	10,11,14,17,20,23,25
15	Oven	6,7,8,9,10,11,13,15,18,23,25
16	Ford Cup B-4	6,8,10,12,14,17,20
17	Adhesion Tape	6,7,8,9,10,11,13,15,18,28,30
18	Scratch Hardness Tester	6,7,8,9,10,11,13,15,18,28,30
19	Pencil hardness tester	6,7,8,9,10,11,13,15,18,28,30
20	Gloss-O-meter	10,11,15,18
21	DFT meter	6,7,8,9,10,11,1,15,18,23,26,28,30
22	Block Applicator	12,13
23	Tooth gauge/ Inmont gauge	13
24	Magnifying lens	20
25	[illegible] meter	21
26	Electrostatic powder coating spray gun	27
27	Impact tester	28
28	Fluidized bed for powder coating	29
29	Humidity Chamber	30
30	Salt Spray Chamber	31

8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics should be taught and assessed 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 Surface Preparation	1a. Classify industrial substrates. 1b. Explain surface preparation methods for industrial substrates. 1c. Explain 7 tank pretreatment (PT) process for mild steel. 1d. State importance of nano technology-based PT.	1.1 Classification of industrial substrates. 1.2 Mechanical methods for surface preparation of industrial substrates, e.g., solvent cleaning, Hand tool cleaning, power tool cleaning, flame cleaning, abrasive blasting. 1.3 Chemical methods of industrial surfaces, e.g., degreasing, de-rusting, conversion coating. 1.4 Surface preparation methods for industrial substrates like Galvanized iron, Aluminum, plastics. 1.5 Introduction to nano based PT technology.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit-II Application methods	2a. List paint application methods. 2b. Explain construction and working various paint spray application techniques. 2c. Explain principles of electro-deposition.	2.1 Introduction to industrial paint application methods like dip coating, flow coating. 2.2 Construction and working of conventional spray gun, HVLP, airless gun, air assisted airless gun, electrostatic spray guns, disc, bell and robotics. 2.3 Principles of electro-deposition.
Unit– III Paint application shop	3a. Draw automotive paint shop layout. 3b. Explain spray booth with its operating parameters. 3c. Classify ovens. 3d. Write paintshop practice for environment sustenance.	3.1 Paint application shop layout. 3.2 Types of spray booths. 3.3 Importance of booth parameters. 3.4 Types of ovens and its profiling (TTR and baking window) 3.5 Concept of radiation curing such as IR and UV. 3.6 Sludge handling, VOC management & water management in paint shop.
Unit-IV Paint film defects	4a. Name paint defects. 4b. Identify different root causes of paint film defects. 4c. Explain defect identification techniques. 4d. Explain rework process for paint touch up.	4.1 Types of various paint defects. 4.2 Causes of paint defects such as – Pin holing, Cissing/Craters, Solvent popping, Sagging, Blisters, Orange Peel, Yeliowing, Flaking, Chalking, Cracking, spitting, dry spray, mottling, peel off, blushing. 4.3 Defect identification techniques like fish bone diagram FTA and Corrective actions. 4.4 Rework/touch up of paint defect.
Unit– V Powder Coating	5a. Compare powder coating with liquid coating. 5b. Sketch layout of powder coating application system. 5c. Draw powder coating recovery system. 5d. Explain troubleshooting techniques of powder coating applications.	5.1 Introduction to powder coating. 5.2 Application of powder coating by electrostatic spray and fluidized bed application. 5.3 Introduction to powder coating booths and recovery systems. 5.4 Powder coating troubleshooting techniques and rework.

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	Surface Preparation	10	2	4	8	14
II	Application methods	10	2	4	8	14
III	Paint application shop	10	2	4	8	14
IV	Paint film defects	10	2	4	8	14
V	Powder Coating	08	2	4	8	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 evidence for their (student's) portfolio which will be useful for their placement interviews:

a. Visit paint application industry/paint testing Laboratory/computerized color dispensing machine.
b. Collect the surface preparation standards.
c. Prepare a report on new trends on spray techniques.
d. Collect the data of robotic paint application.
e. Make a report on layout of paint application shops.
f. Collect the data of latest trends in paintshop operation.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.
f. Correlate paint properties and application methods for industrial coatings.
g. Use Flash/Animations to explain various surface preparation methods, application methods, paint defect identification with its rework, powder coating applications etc.
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 and application equipment.
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 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 powder coating standard like ISO, IS,, ASTM, NACE, SSPC.
b. Prepare a report on Electro deposition bath parameters.
c. Prepare report on paint shop sludge disposal processes.
d. Prepare an album on different type of substrate used in automotive industries like SS, GI, AL, PP, PP+EPDM, SMC, Nylon, ABS etc.
e. Collect the information of Conveyers used in paint shop.
f. Collect the Surface preparation standards like NACE, SSPC Sa….etc.
g. Prepare a report on air circulation system of paint shop.
h. Prepare a report on paint kitchen and its parameters.
i. Prepare a report on Effluent treatment process for coating industry.
j. Collect various defect analysis tools like why-why analysis, Ishikawa diagram, brain storming etc.
k. Control plan (Failure mode and effect analysis) FMEA.
l. Industry 4.0 and Internet of things (IOT)
m. Basic principles of kaizen/ POKA YOKE,

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	Automotive Paints and Coatings	Hans-Joachim Streitberger and Karl-Friedrich Dossel	WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, 2008 ISBN: 9783527309719
3	Basics of Paints Technology (Part II) (1st Edition)	V.C. Malshe and Meenal Sikchi	Antar Prakash Centre for Yoga, India, 2004 ISBN: 9788190329842
4	Organic Coatings: Properties and Evaluation	Felix Konstandt	Chemical Publishing Co, New York ISBN: 0820603066
5	Paint Handbook	Guy E. Weismantel	McGraw-Hill publication ISBN: 0070690618
6	Paint Testing Manual Physical and Chemical Examination (13th Edition)	Gardner Henry and George Sward	American Society for Testing and Materials, 1972
7	Failure Analysis of Paints and Coatings	Dwight G. Weldon	A John Wiley & Sons, Ltd., Publication ISBN: 978047069753-5

14. SOFTWARE/LEARNING WEBSITES

a. https://youtu.be/1Fu7Ex46yRo : 7 tank processes
b. https://youtu.be/n2zNRzemBoI : Dip Coating
c. https://youtu.be/hnYMKPuQhWA :Dip Coating
d. https://youtu.be/cpqqWVOF5zQ :Flow Coating
e. https://youtu.be/u1JvyVo9IFE :Flow coating
f. https://youtu.be/vOmB0yzJ0m8 :Designing of spray gun
g. https://youtu.be/JXcxMzaCem0 :Use of spray gun
h. https://youtu.be/-0BX0_8TQ78 : Use of spray gun
i. https://youtu.be/c24HhItNU4E : Block applicator
j. https://youtu.be/6xTW9JPm3YI : Block applicator
k. https://youtu.be/2d3uf1FnW_Q : Types of guns
l. https://youtu.be/1_3fkZi5xxk : HVLP and Conventional guns
m. https://youtu.be/QWmZDiMjRM4 : Air assisted Vs Air less assisted spray gun
n. https://youtu.be/f40oVSWBGr4 : Air less assisted spray gun
o. https://youtu.be/DX9u-yGLw9I : Robotic applications
p. https://youtu.be/bdQ37t_tIMg : Robotic painting
q. https://youtu.be/G0D9tM7exAM : Paintshop
r. https://youtu.be/U2tM-3btYLc : Paint shop layout
s. https://youtu.be/gz8BgWEG_V4 : Paint booths
t. https://youtu.be/aRoKrbwws-Q : Electrodeposition
u. https://youtu.be/ITOL3ADEZw : Electroplating Vs Electrodeposition
v. https://youtu.be/O0ScFQ1rbe4 : BMW paintshop
w. https://youtu.be/qBevmC_LxJE : Ovens
x. https://youtu.be/b16IcUSh69g : Ovens
y. https://youtu.be/XcuTdd3NWK0 : UV and IR
z. https://youtu.be/zgNK-zf2g24 : UV and IR
aa. https://youtu.be/sScwCusitzA : EMT of Oven
bb. https://youtu.be/rYUeoVCNW7M : EMT and TTR of oven
cc. https://youtu.be/NL5gZydeCWo : Defect rework
dd. https://youtu.be/kyepHOW1Cu0 :Defect rework
ee. https://youtu.be/6mxbrepm18w : Sag Index meter
ff. https://youtu.be/B0ayYSMjogE : Sag index meter
gg. https://youtu.be/Fwfgx0dOYvE :Concept of Fish bone diagram
hh. https://youtu.be/NnE35kKPQvo :Electrostatic powder spray application
ii. https://youtu.be/h3zbxTAFKtY : Electrostatic powder coating spray gun
jj. https://youtu.be/a2BWZFyGhb0 :Fluidized bed powder coating
kk. https://youtu.be/8PxVBc1kpPo : Salt Spray test
ll. https://youtu.be/lFAjbYeKMqM : Powder coating tests

25	Sag index meter

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

Program Code : **SC**

Semester : **Fifth**

Couse Title : **Chemical Technology for Paint Industries**

Couse Code : **24526**

1. RATIONALE:

This course is useful to understand the application of various devices used for various unit operations such as fluid flow, Heat transfer, filtration, drying, crushing and size separation in paint industries. Students will get hands-on experience of auxiliary equipment used in paint industry; it will also enhance the exposure of various systems used in paint industry.

2. COMPETENCY

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

Operate various devices used in paint industries.

3. Course Outcomes:

a. Use flow measuring devices.
b. Select relevant fluid handling devices for coating industry.
c. Apply heat transfer principles in coating industry.
d. Select filter and dryer for coating industry.
e. Use crusher and screens.

4. TEACHING AND EXAMINATION SCHEME

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

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

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

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

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

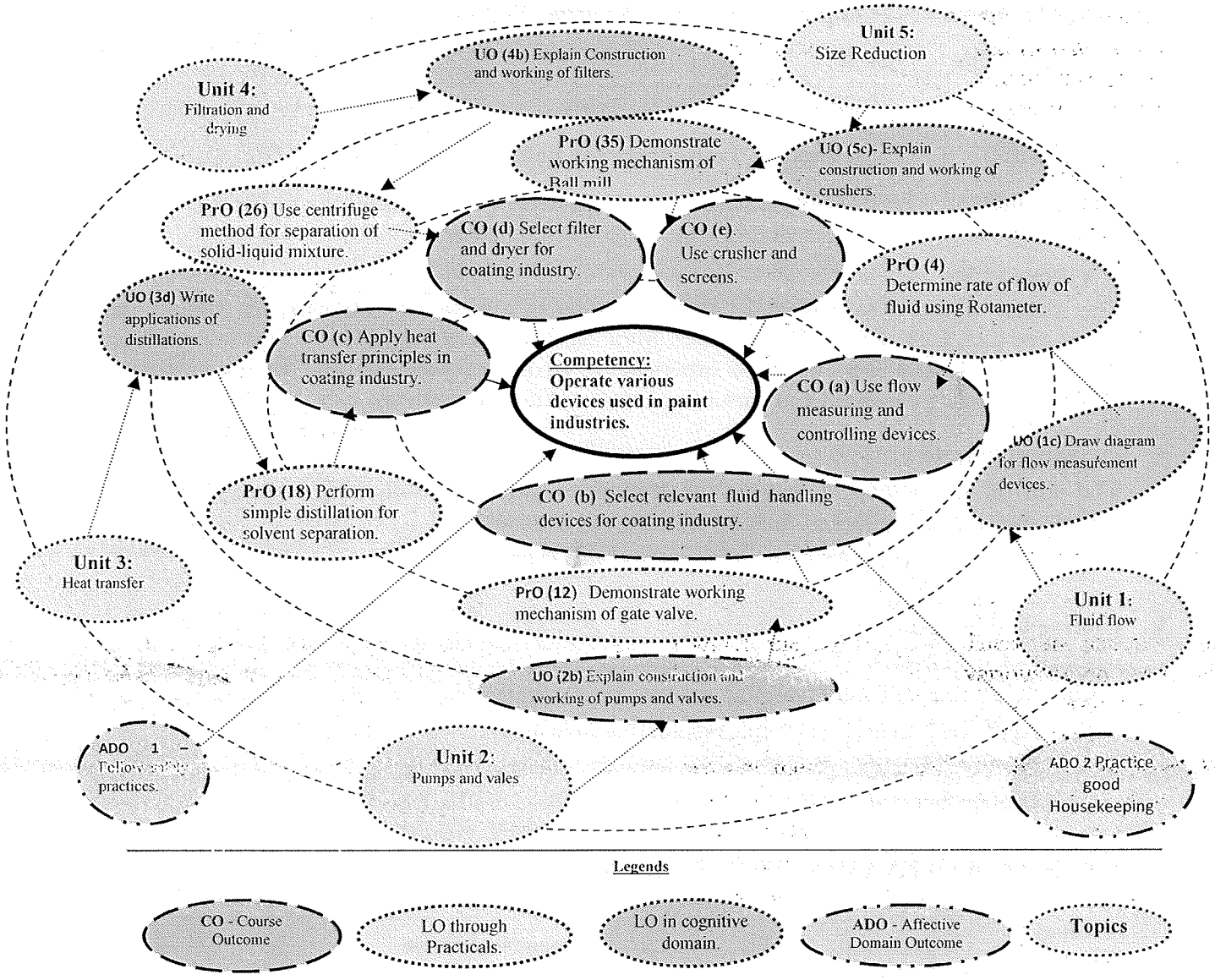


Figure 1 - Course Map

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:

Sr. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
1	Survey of flow meters in laboratory.	I	2*
2	Determine rate of flow of fluid using Venturi meter.	I	2*
3	Identify flow of fluid (Laminar or Turbulent) using visual observation.	I	2*
4	Determine rate of flow of fluid using Rotameter.	I	2*
5	Determine rate of flow of fluid using orifice meter.	I	2
6	Compare rate of sedimentation in different density fluids.	I	2

7	Demonstrate working mechanism of venturi meter.	I	2
8	Compare rate of sedimentation in different viscosity fluids.	I	2
9	Identify various components/parts of centrifugal pump.	II	2
10	Identify various components/parts of reciprocating pump.	II	2*
11	Identify various valves in the laboratory.	II	2*
12	Demonstrate working mechanism of gate valve.	II	2*
13	Demonstrate working mechanism of globe valve.	II	2
14	Demonstrate working mechanism of Needle valve.	II	2
15	Demonstrate working mechanism of Non-return valve.	II	2
16	Demonstrate conduction mode of heat transfer using different metal rods.	III	2*
17	Demonstrate convection mode of heat transfer.	III	2
18	Perform simple distillation for solvent separation.	III	2*
19	Determine effect of temperature on viscosity using oils/resin/paint.	III	2*
20	Demonstrate equilibrium point of temperature by using beaker and test tube.	III	2
21	Determine percentage volatile matter by using 'tray dryer'.	IV	2*
22	Perform simple filtration for separation of solid liquid mixture.	IV	2
23	Perform vacuum filtration for separation of solid liquid mixture.	IV	2
24	Determine moisture content using dryer.	IV	2*
25	Determine drying time using tray dryer.	IV	2
26	Use centrifuge method for separation of solid-liquid mixture.	IV	2*
27	Use Buchner funnel solid-liquid mixture.	IV	2
28	Prepare lab scale bag filter.	IV	2
29	Use Whatman filter paper for separation of mixture.	IV	2
30	Determine oversize and undersize particles by using grizzlies.	V	2
31	Determine percentage of oversize and undersize particles by using sieve analysis method	V	2*
32	Use Impact mechanism for reducing the particle size of material and check particle size.	V	2*
33	Use Rubbing mechanism for particle size reduction and check particle size.	V	2
34	Demonstrate working mechanism of Hammer mill.	V	2
35	Demonstrate working mechanism of Ball mill.	V	2*
36	Demonstrate working mechanism of Air classifying mill	V	2
	Total (no. of hrs. to be engaged)		48

Note

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

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

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

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

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

The ADOs are not specific to any one PrO but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period. 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	Venture meter	1,2,7
2	Transparent 0.5-inch piper 2 feet.	3
3	Beaker-500 ml	1,2,3,4,5,6,17,20
4	Rotameter	4
5	Orifice meter	5
6	Measuring cylinder-1000 ml	6,8
7	Centrifugal pump parts	9
8	Reciprocating pumps	10
9	Gate valve	11,12

S. No.	Equipment Name with Broad Specifications	PrO. No.
10	Globe valve	11,13
11	Needle valve	11,14
12	Non return valve	11,15
13	Al, Fe, Copper, Brass Rod	16
14	Heating mantle	17,18
15	Distillation flask	18
16	Red wood viscometer	19
17	Oven-250 degree	21,24,25
18	Weight balance	All practical
19	Spatula	All practical
20	Vacuum pump	23
21	Centrifuge machine	26
22	Grizzlies screen	30
23	Sieves	31
24	Hammer	32
25	Ball mill	35

8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics should be taught and assessed 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 Fluid flow	1a. Explain Laminar and Turbulent flow with diagram. 1b. State Reynolds number. 1c. Draw diagram for flow measurement devices. 1d. Explain construction and working of Orifice flow meter.	1.1 Introduction to fluid flow. 1.2 Concept of Reynold's number. 1.3 Classification of fluid flow: Laminar and Turbulent flow Compressible and In-compressible flow. 1.4 Construction and working of Orifice meter, venturi meter and Rotameter.
Unit-II Pumps and valves	2a. Define pump and valve. 2b. Explain construction and working of pumps and valves. 2c. Sketch diagram of valve.	2.1 Introduction to pumps and Valves 2.2 Applications of pumps and valves in paint industries. 2.3 Construction and working of centrifugal and reciprocating pump (ratio pump). 2.4 Construction and working of gate valve, globe valve, ball valve, butterfly valve, non-return valve and needle valve.
Unit– III Heat	3a. Define distillation and modes of heat transfer.	3.1 Introduction to modes of heat transfer.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
transfer	3b. Explain construction and working of different heat exchanger. 3c. Sketch diagram of heat exchanger. 3d. Write applications of distillations.	3.2 Construction and working of U-tube, shell and tube, condenser type heat exchanger. 3.3 Applications of heat exchangers. 3.4 Introduction to various types of distillation processes. 3.5 Applications of distillation in industries.
Unit –IV Filtration and Drying	4a. Define filtration. 4b. Explain Construction and working of filters. 4c. Explain Construction and working of rotary drum dryer. 4d. Write applications of filtration and Drying.	4.1 Introduction to filtration and drying operation. 4.2 Construction and working of filter press, continuous rotary and vacuum filter. 4.3 Construction and working of tray dryer, rotary drum dryer and spray dryer. 4.4 Application of filtration and drying.
Unit-V Size reduction	5a. Write significance of size reduction. 5b. Explain mechanism of size reduction. 5c. Explain construction and working of crushers. 5d. Explain working of different types of sieving screens.	5.1 Classification of size reduction equipment's. (like coarse crushers, intermediate crushers and fine crushers) 5.2 Construction and working of crushers; ball mill and tube mill. 5.3 Construction and working of air classifying mill (ACM) and cyclone separator. 5.4 Construction and working of sieve analysis apparatus, trommels and grizzlies.

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	Fluid flow	10	2	4	8	14
II	Pumps and valves	10	2	4	8	14
III	Heat transfer	10	2	4	8	14
IV	Filtration and Drying	10	2	4	8	14
V	Size reduction	08	2	4	8	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 evidence for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare a report on visit paint application industry/paint testing Laboratory.
b. Prepare an album on flow measuring devises.
c. Prepare an album on Pumps.
d. Make a report on Heat transfer equipment.
e. Prepare a report on working principles of size reduction equipment's.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

a. Massive open online courses (***MOOCs***) may be used to teach various topics/subtopics.
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. Use Flash/Animations to explain various Pumps, Filtration methods, Heat exchangers and Size reduction.
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 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 report on advanced / digital flow measuring devises.
b. Prepare a report on calibration techniques of flow measuring devises.
c. Prepare an album on various valves used in paint industry.
d. Collect information on various pumps.
e. Collect the information on various heat exchangers used in paint industry.
f. Prepare a report on various distillation methods.
g. Collect information on latest trends in filtration techniques.
h. Prepare a report on new techniques in drying.
i. Make a market survey on Heat exchanger/Dryer/ Filter etc. manufacturer.
j. Prepare a report on characterization of various equipment's like Dryer, filter, Heat exchangers, screens, size reduction equipment's etc.
k. Collect information of advanced size reduction equipment's.
l. Collect information of advanced size separation techniques.

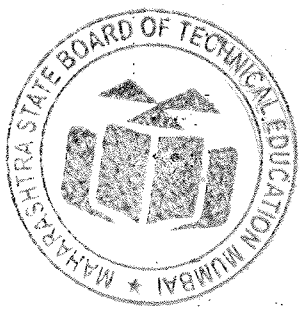
13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Chemical Engineering Vol-I (6th Edition)	J M Coulson & J F Richardson	Replica press Pvt. Ltd, 2000 ISBN: 0750644443
2	Chemical Engineering Vol-II (4th Edition)	J M Coulson & J F Richardson	Asian Books Private Limited. ISBN: 081-86299-11-4
3	Introduction to Chemical Engineering (5th Edition)	Kenneth A. Solen & John N. Harb	John Wiley & Sons, Inc. ISBN: 978-0-470-88572-7
4	Unit operations of Chemical Engineering (5th Edition)	McCabe and Smith	McGraw-Hill publication, 1993 ISBN: 0-07-112738-0

14. SOFTWARE/LEARNING WEBSITE

a. https://www.youtube.com/watch?v=wlPXZrP9vR8
b. https://www.youtube.com/watch?v=gByrUkZUnKo
c. https://www.youtube.com/watch?v=oINBqDpvSIc
d. https://www.youtube.com/watch?v=1wNmtle6qkE
e. https://www.youtube.com/watch?v=JrjTRKBtYgw
f. https://www.youtube.com/watch?v=wsm5zzsBI4s
g. https://www.youtube.com/watch?v=XxAhrF7KZuE
h. https://www.youtube.com/watch?v=DmJCDOTIDRY
i. https://www.youtube.com/watch?v=HxpzoDJeYwI
j. https://www.youtube.com/watch?v=OkGDkN8HeDc
k. https://www.youtube.com/watch?v=_5AZwrTkQNA
l. https://www.youtube.com/watch?v=OdwrxKRSjEU
m. https://www.youtube.com/watch?v=OyQ3SaU4KKU
n. https://www.youtube.com/watch?v=4ZV8MgZ0Yiw
o. https://www.youtube.com/watch?v=5GIdxtG8dVI

p. https://www.youtube.com/watch?v=QXy_Cn6KIPs
https://www.youtube.com/watch?v=par3tAK7VLg
q. https://www.youtube.com/watch?v=Fh9Bkzr2-5A
r. https://www.youtube.com/watch?v=wRB_6qbYmiQ
s. https://www.youtube.com/watch?v=1XeTr5NLNTc
t. https://www.youtube.com/watch?v=KD7gxIclilQ
u. https://www.youtube.com/watch?v=uOv5PFy4s2c
v. https://www.youtube.com/watch?v=1Zcp2cbbvvE
w. https://www.youtube.com/watch?v=4MVzWYb_8_8
x. https://www.youtube.com/watch?v=dqsFfYIAzeg
y. https://www.youtube.com/watch?v=T30cbHg8spc
z. https://www.youtube.com/watch?v=An-pgVbismU
aa. https://www.youtube.com/watch?v=gG3QvzCqw6M
bb. https://www.youtube.com/watch?v=vrvXDpmpVHY


MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION MUMBAI

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

Program Code : **SC**

Semester : **Fifth**

Couse Title : **Novelty Finishes and Aesthetics**

Couse Code : **24050**

1. RATIONALE

Surface coating industry witnessing lot of emerging trends in manufacturing, applications and allied industries. It is necessary for surface coating technologist to get acquainted with these emerging trends to apply his expertise in applications and relevant field to apply the concepts of novelty finishes.

2. COMPETENCY

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

Relate basic principles of surface coatings with emerging trends available in coating Industry.

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:

a. Use novel techniques in surface coating application.
b. Test properties of novel coatings.
c. Select the tools for developing novelty finishes.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
				Theory							Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
--	--	2	2	--	--	--	--	--	--	--	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 center of this map.

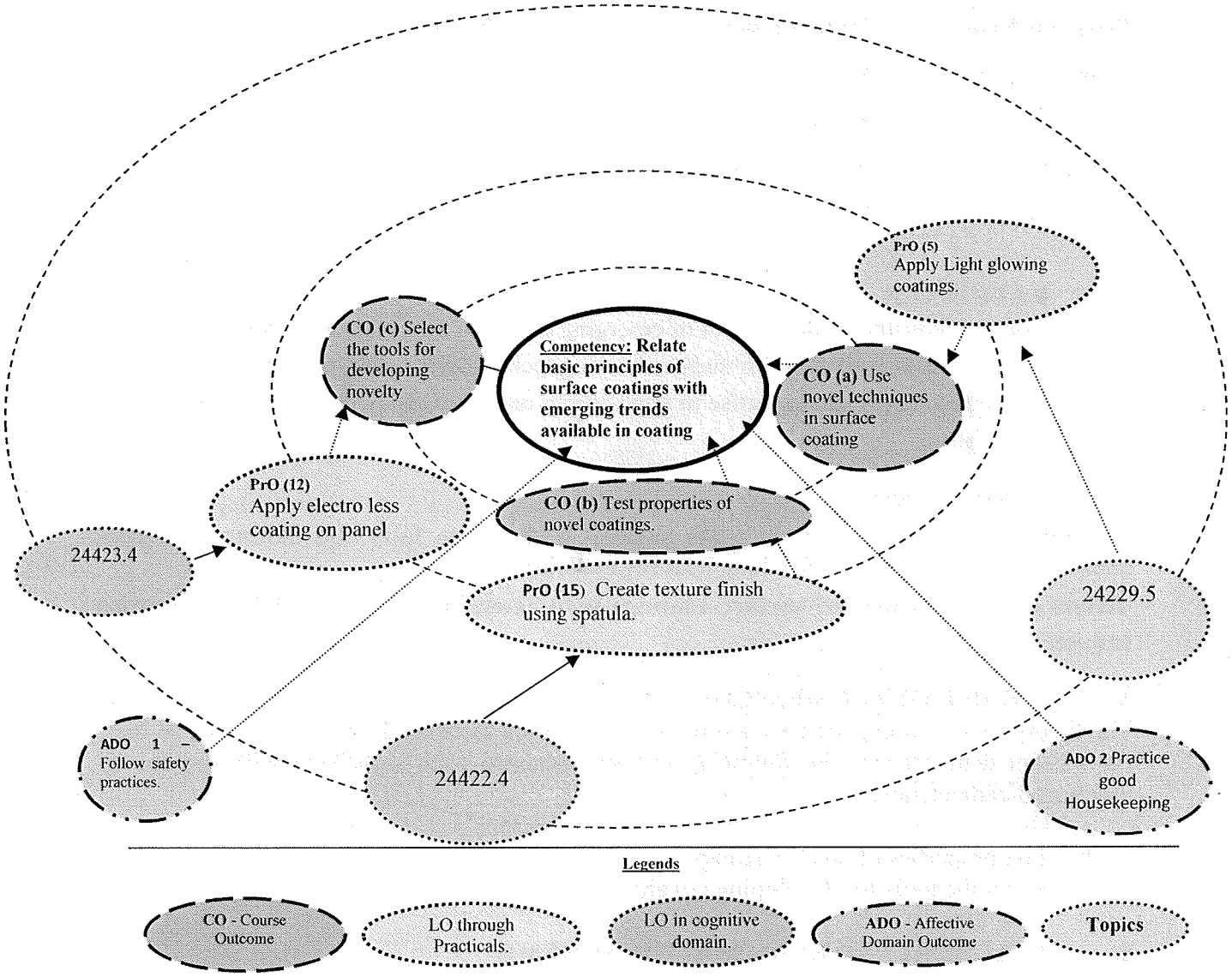


Figure 1 - Course Map

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	Demonstrate 3D floor coatings.	24423.1	2*
2	Demonstrate Candy finish coating		2*
3	Apply Thermo cool coatings. (Part-I: Experimental Set up)	24421.1	2
4	Apply Thermo cool coatings. (Part-II: Application and testing)	24421.1	2
5	Apply Light glowing coatings. (Part-I: Experimental Set up)	24229.5	2
6	Apply Light glowing coating (Part-II: Application and testing)	24229.5	2
7	Apply Multi color finish. (Part-I: Experimental Set up)	24422.2	2
8	Apply Multi color finish. (Part-II: Application and testing)	24422.2	2
9	Apply Metallic coating. (Part-I: Surface preparation)	24421.3, 24229.5	2
10	Apply Metallic coating. (Part-II: Application)	24421.3, 24229.5	2
11	Apply electro less coating on panel (Part-I: Surface preparation)	24423.4	2
12	Apply electro less coating on panel (Part-II: Plating)	24423.4	2
13	Apply Stipple finish (Part-I: Experimental Set up)	24422.2	2*
14	Apply Stipple finish (Part-II: Application and testing)	24422.2	2*
15	Create texture finish using spatula. (Part-I: Experimental Set up)	24422.2	2*
16	Create texture finish using spatula. (Part-II: Application and testing)	24422.2	2*
17	Create Texture finish using roller. (Part-I: Experimental Set up)	24422.2	2*
18	Create Texture finish using roller. (Part-II: Application and testing)	24422.2	2*
19	Create effect of wood coating using water base paints. Part-I: Experimental setup	24421.3, 24422.2	2
20	Create effect of wood coating using water base paints. (Part-II: Application and testing)	24421.3, 24422.2	2

Note:

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

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

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

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

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

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

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Spatula	15,16
2	Beaker (250 ml, 500ml)	3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20
3	Sand Paper (80, 120, 320)	3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20
4	Wooden panels	19,20
5	MS panels	5,6,7,8,9,10,11,12,13,14,15,16,17,18
6	Brush	5,6,7,8,9,10,13,14,19,20
7	Oven	3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20
8	Roller	17,18
9	Weighing Balance	3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20
10	Measuring cylinder (100ml)	3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20
11	Gloss-O-meter	3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20
12	DFT meter	3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20

S. No.	Equipment Name with Broad Specifications	PrO. No.
13	Adhesion Tape	3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20
14	Cutter/Cutter guider	3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20

8. UNDERPINNING THEORY COMPONENTS

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

Not Applicable

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Not Applicable

10. SUGGESTED STUDENT ACTIVITIES

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

a. Visit construction site for painting processes.
b. Collect information of various texture finishes in market.
c. Visit Electroplating industry.
d. Prepare album on new trends in architectural finishes.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.
f. Correlate paint properties and application methods for Novelty 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 report on Shade matching principles with spectrophotometer.
b. Collect the information of latest trends in floor coating.
c. Prepare a report on Physical vapor deposition (PVD)
d. Prepare a report on Chemical vapor deposition (CVD)
e. Collect the information on latest trends in wood coating.
f. Prepare a report on dip spin coating application techniques.
g. Prepare a report on 3 D printing
h. Prepare a report on self-leveling finishes.
i. Prepare a report on hydrophobic coating.
j. Prepare a report on anti-carbonation coating.

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) (1st Edition)	V.C. Malshe and Meenal Sikchi	Antar Prakash Centre for Yoga, India, 2004 ISBN: 9788190329842
3	Paint India Magzines		

14. SOFTWARE/LEARNING WEBSITES

1. https://www.youtube.com/watch?v=rzRh22MJH10
2. https://www.youtube.com/watch?v=fd7YPSo4E-0
3. https://www.youtube.com/watch?v=X8F18IY9PmY
4. https://www.youtube.com/watch?v=PyXf6KLI2mc
5. https://www.youtube.com/watch?v=kqxc6Sm3pa4
6. https://www.youtube.com/watch?v=yv7SogmppJQ
7. https://www.youtube.com/watch?v=D08DaQZzuLg
8. https://www.youtube.com/watch?v=Rje0GPTxCEo
9. https://www.youtube.com/watch?v=uYbEflYcJRg
10. https://www.youtube.com/watch?v=2XX5QRMKG54

Program Name : **Diploma in Information Technology/ Automobile Engineering / Digital Electronics / Medical Electronics / Plastic Engineering / Production Engineering / Fashion & Clothing Engineering / Electrical Engineering Group/ Instrumentation/ Instrumentation & Control / Food Technology/ Printing Technology / Surface Coating Technology / Dipoma in Medical Laboratory Technology**

Program Code : **IF/AE/DE/MU/IS/IC/PS/PG/PT/DC/EE/EP/EU/FC/PN/SC/ML**

Semester : **Fifth**

Course Title : **Entrepreneurship Development**

Course Code : **22032**

1. RATIONALE

Globalisation, liberalization and privatization along with revolution in information technology have opened up new opportunities transforming lives of masses. In this context, there is immense opportunity of establishing manufacturing, service, trading, marketing and consultancy enterprises by diploma engineer. Our fast growing economy provides ample scope for diploma engineers to succeed as an entrepreneur. Entrepreneurship requires distinct skill sets which are attempted to be developed through this course. To begin with, this course aims to develop the competency and the related outcomes in order to start small enterprises.

2. COMPETENCY

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

- **Develop project proposals to launch small scale enterprises.**

3. COURSE OUTCOMES (COs)

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

a. Identify your entrepreneurial traits.
b. Identify the business opportunities that suits you.
c. Use the support systems to zero down to your business idea.
d. Develop comprehensive business plans.
e. Prepare plans to manage the enterprise effectively.

4. TEACHING AND EXAMINATION SCHEME

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

(\$):*Online Examination; (~):PA has two components under practical marks i.e. the assessment of practicals (seen in section 6) has a weightage of 60% (i.e.15 marks) and micro-project assessment (seen in section 12) and the remaining has a weightage 40% (i.e.10 marks) will be 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* **\$:** Online examination.

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

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

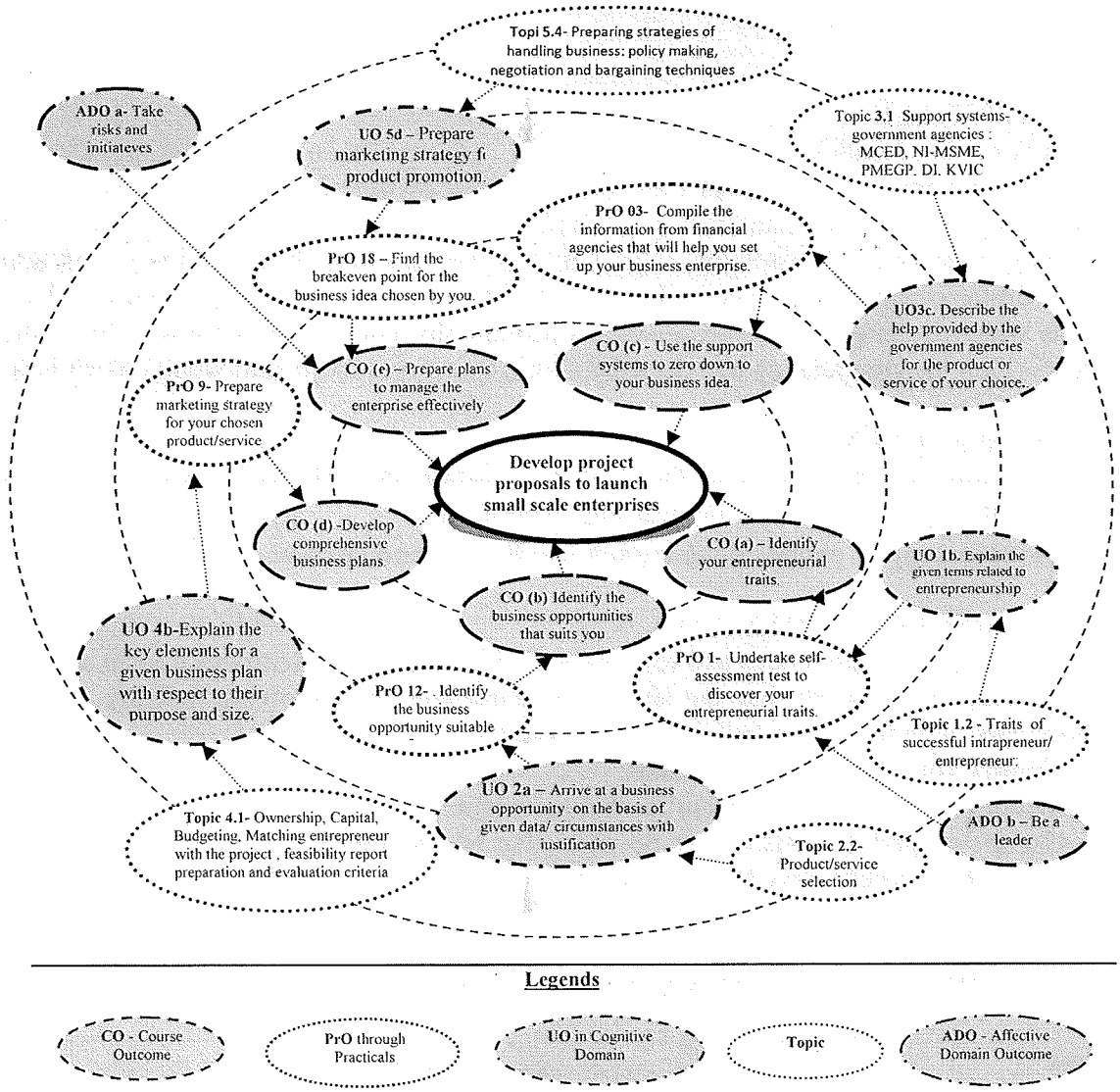


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

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

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Submit a profile summary(about500words) of a successful entrepreneur indicating milestone achievements.	I	02*
2	Undertake SWOT analysis to arrive at your business idea of a product/service.	I	02
3	Generate business ideas(product/service) for intrapreneurial and entrepreneurial opportunities through brainstorming.	II	02*
4	Undertake self-assessment test to discover your entrepreneurial traits.	II	02
5	Identify the business opportunity suitable for you.	II	02
6	Arrange an exhibition cum sale of products prepared out of waste.	II	02
7	Survey industries of your stream, grade them according to the level of scale of production, investment, turnover, pollution to prepare a report on it.	II	02
8	Visit a bank/financial institution to enquire about various funding schemes for small scale enterprise.	III	02
9	Collect loan application forms of nationalise banks/other financial institutions.	III	02
10	Compile the information from financial agencies that will help you set up your business enterprise.	III	02*
11	Compile the information from the government agencies that will help you set up your business enterprise.	III	02
12	Prepare Technological feasibility report of a chosen product/service.	III	02
13	Prepare financial feasibility report of a chosen product/service.	III	02
14	Craft a vision statement and enabling mission statements for your chosen enterprise.	III	02
15	Prepare a set of short term,medium and long term goals for starting a chosen small scale enterprise	III	02
16	Prepare marketing strategy for your chosen product/service.	IV	02*
17	Compile information about various insurance schemes covering different risk factors.	IV	02
18	Organize a funfair of your class and write a report of profit/loss	V	02
19	Find the breakeven point for the business idea chosen by you.	V	02
20	Arrange a discussion session with your institute's pass out students who are successful entrepreneurs.	V	02
21	Prepare a business plan for your chosen small scale enterprise	V	02*
	Total		**42**

Note:

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

Sample Products that can be manufactured under SME

1. Badges cloth embroidered and metals
2. Bags of all types i.e. made of leather, cotton, canvas and jute etc. including kit bags, mail bags, sleeping bags and water-proof bag
3. Bandage cloth
4. Basket cane (Procurement can also be made from State Forest Corpn. and State Handicrafts Corporation)
5. Bath tubs of plastic
6. Battery Charger
7. Belt leather and straps
8. Bolts and Nuts
9. Boot Polish
10. Brooms
11. Domestic Brushes of different types
12. Buckets of all types of plastic
13. Button of all types
14. Chappals and sandals
15. Cleaning Powder
16. Cloth Covers for domestic use
17. Cloth Sponge
18. Coir mattress cushions and matting
19. Cotton Pouches
20. Curtains mosquito
21. Domestic Electric appliances as per BIS Specifications: Toaster Electric, Elect. Iron, Hot Plates, Elect. Mixer, Grinders Room heaters and convectors and ovens
22. Dust Bins of plastic
23. Dusters Cotton all types except the items required in Khadi
24. Electronic door bell
25. Emergency Light (Rechargeable type)
26. Hand drawn carts of all types
27. Hand gloves of all types
28. Hand numbering machine
29. Hand Pump
30. Hand Tools of all types
31. Handles wooden and bamboo (Procurement can also be made from State Forest Corpn. and State Handicrafts Corporation)
32. Haver Sacks
33. Honey
34. Invalid wheeled chairs.
35. Iron (dhobi)
36. Lamp holders
37. Letter Boxes
38. Nail Cutters
39. Oil Stoves (Wick stoves only)
40. Paper conversion products, paper bags, envelops, Ice-cream cup, paper cup and saucers and paper Plates
41. Pickles, Chutney and Pappads
42. Pouches for various purposes

43. Safe meat and milk
44. Safety matches
45. Safety Pins (and other similar products like paper pins, staples pins etc.)
46. Shoe laces
47. Sign Boards painted
48. Soap Liquid
49. Spectacle frames
50. Steel Chair
51. Umbrellas
52. Utensils all types

Sample Services that can be offered under SME

1. Marketing Consultancy
2. Industrial Consultancy
3. Equipment Rental & Leasing
4. Typing Centres
5. Photocopying Centres (Zeroxing)
6. Industrial photography
7. Industrial R & D Labs.
8. Industrial Testing Labs.
9. Desk Top publishing
10. Advertising Agencies
11. Internet Browsing/Setting up of Cyber Cafes
12. Auto Repair, services and garages
13. Documentary Films on themes like Family Planning, Social forestry, energy conservation and commercial advertising
14. Laboratories engaged in testing of raw materials, finished products
15. 'Servicing Industry' Undertakings engaged in maintenance, repair, testing or electronic/electrical equipment/ instruments i.e. measuring/control instruments servicing of all types of vehicles and machinery of any description including televisions, tape recorders, VCRs, Radios, Transformers, Motors, Watches.
16. Laundry and Dry Cleaning
17. X-Ray Clinic
18. Tailoring
19. Servicing of agriculture farm equipment e.g. Tractor, Pump, Rig, Boring Machines.
20. Weigh Bridge
21. Photographic Lab
22. Blue printing and enlargement of drawing/designs facilities
23. ISD/STD Booths
24. Teleprinter/Fax Services
25. Sub-contracting Exchanges (SCXs) established by Industry Associations.
26. Coloured or Black and White Studios equipped with processing laboratory.
27. Ropeways in hilly areas.
28. Installation and operation of Cable TV Network:
29. Operating EPABX under franchises
30. Beauty Parlours
31. Creches.

S. No.	Performance Indicators	Weightage in %
1	Leadership skills	20

S. No.	Performance Indicators	Weightage in %
2	Team work	20
3	Lateral/creative thinking	10
4	Observations and recording	10
5	Self learning	20
6	Answer the sample questions	10
7	Submission of report in time	10
	Total	**100**

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

a. Follow safe practices
b. Practice good housekeeping
c. Practice energy conservation
d. Demonstrate working as a leader/a team member
e. 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 experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Seminar Hall equipped with conference table,chairs and multimedia facilities	All
2	Modern desktop Computer with internet connection.	All

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 (In cognitive domain)	Topics and Sub-topics
Unit – I Entrepreneurship Development - Concept and Scope	1a. Describe the procedure to evaluate your entrepreneurial traits as a career option for the given product to be manufactured or services to be rendered.	1.1 Entrepreneurship as a career 1.2 Traits of successful intrapreneur/ entrepreneur: consistency, creativity, initiative, independent decision making, assertiveness, persuasion, persistence, information seeking,

Unit	Unit Outcomes (In cognitive domain)	Topics and Sub-topics
	1b. Explain the given terms related to Entrepreneurship 1c. Describe the salient features of the resources required for starting the specified enterprise. 1d. Identify the characteristics for a given type of enterprise.	handling business communication, commitment to work contract, calculated risk taking. 1.3 Entrepreneurship : scope in local and global market. 1.4 Intrapreneur and entrepreneur 1.5 Types of enterprises and their features : manufacturing, service and trading. 1.6 Steps in setting up of a business.
Unit – II Entrepreneurial Opportunities and selection process	2a. Arrive at a business opportunity on the basis of given data/circumstances with justification. 2b. Describe the scheme(s) offered by the government for starting the specified enterprise. 2c. Suggest a suitable place for setting up the specified enterprise on the basis of given data/circumstances with justification. 2d. Suggest the steps for the selection process of an enterprise for the specified product or service with justification. 2e. Describe the market study procedure of the specified enterprise.	2.1 Product/Service selection: Process, core competence, product/service life cycle, new product/ service development process, mortality curve, creativity and innovation in product/ service modification / development. 2.2 Process selection: Technology life cycle, forms and cost of transformation, factors affecting process selection, location for an industry, material handling. 2.3 Market study procedures: questionnaire design, sampling, market survey, data analysis 2.4 Getting information from concerned stakeholders such as Maharashtra Centre for Entrepreneurship Development[MCED], National Institute for Micro, Small and Medium Enterprises [NI-MSME], Prime Minister Employment Generation Program [PMEGP], Directorate of Industries[DI], Khadi Village Instries Commission[KVIC]
Unit – III Support Systems	3a. Describe the support system required for the specified enterprise. 3b. Describe the help provided by the government agencies for the specified product/service. 3c. Describe the help provided by the non-governmental agencies for the specified product/service. 3d. Compute the breakeven	3.1 Categorisation of MSME, ancillary industries 3.2 Support systems- government agencies: MCED, NI-MSME, PMEGP,DI, KVIC 3.3 Support agencies for entrepreneurship guidance, training, registration, technical consultation, technology transfer and quality control, marketing and finance. 3.4 Breakeven point, return on investment and return on sales.

Unit	Unit Outcomes (In cognitive domain)	Topics and Sub-topics
	point for the specified business enterprise, stating the assumptions made.	
UNIT IV Business Plan Preparation	4a. Justify the importance of the business plan for the given product/service. 4b. Explain the key elements for the given business plan with respect to their purpose/size 4c. Prepare the budget for the given venture. 4d. Prepare the details of the given component of the given startup business plan.	4.1 Sources of Product for Business : Feasibility study 4.2 Ownership, Capital, Budgeting, Matching entrepreneur with the project , feasibility report preparation and evaluation criteria 4.3 Business plan preparation
Unit –V Managing Enterprise	5a. Justify the USP of the given product/ service from marketing point of view. 5b. Formulate a business policy for the given product/service. 5c. Choose the relevant negotiation techniques for the given product/ service with justification. 5d. Identify the risks that you may encounter for the given type of business/enterprise with justification. 5e. Describe the role of the incubation centre for the given product/service.	5.1 Unique Selling Proposition [U.S.P.]: Identification, developing a marketing plan. 5.2 Preparing strategies of handling business: policy making, negotiation and bargaining techniques. 5.3 Risk Management: Planning for calculated risk taking, initiation with low cost projects, integrated futuristic planning, angel investors, venture capitalist. 5.4 Incubation centres: Role and procedure.

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

9. SSUGGESTED STUDENT ACTIVITIES

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

a. Develop two products from household waste (attach photographs).
b. Download product development and innovative films from internet.
c. Prepare a collage for 'Traits of successful entrepreneurs'.
d. Invite entrepreneurs, industry officials, bankers for interaction.
e. Identify your hobbies and interests and convert them into business idea.
f. Convert you project work into business.

g. Choose a product and design a unique selling preposition, brand name, logo, advertisement (print, radio, television), jingle, packing, packaging, label for it.
h. Develop your own website. Share your strengths and weakness on it. Declare your time bound goals and monitor them on the website.
i. Choose any advertisement and analyse its good and bad points.
j. Decide any product and analyse its good and bad features.
k. Select any product and prepare its cost sheet.
l. Choose any product and study its supply chain.
m. Arrange brainstorming sessions for improvement of any product.
n. Study schemes for entrepreneurship promotion of any bank.
o. Visit industrial exhibitions, trade fairs and observe nitty-gritty of business.
p. Open a savings account and build your own capital.
q. Organise industrial visit and suggest modifications for process improvement.
r. Interview at least four entrepreneurs or businessman and identify Charms of entrepreneurship and Traits of successful entrepreneurs.
s. Analyse case studies of any two successful entrepreneurs.
t. Perform a survey and identify local resources available for setting up of an enterprise.
u. Engage in marketing of products.
v. Carry out a demand supply gap analysis for a particular product.
w. Organise a prototype development competition.
x. Try for sponsorship, arge fairs, events in the institute and try for sponsorships.
y. Select any performance criteria and continuously compete with yourself.
z. On any performance criteria continuously compete with others.
aa. Foresee your dream and make a long term plan for its accomplishment.
bb. Dream for something unique and make a write-up.
cc. Read articles, books on creativity.
dd. Using morphological analysis technique, reduce cost or increase quality of a product.
ee. Conduct a market survey for a project. Collect data on machinery specifications, price, output/hr, power consumption, manpower requirement, wages, raw material requirement, specification, price, competitor's product price, features, dealer commissions, marketing mix.
ff. Prepare a business plan and organize a business plan competition.
gg. Select a social cause, set objectives, plan and work for its accomplishment.
hh. Videograph as many as possible from the above and upload on your website, YouTube, facebook.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

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

f. Guide student(s) in undertaking micro-projects.
g. Instructors should emphasise more on deductive learning. Students should learn to recognise, create, shape opportunities, and lead teams for providing economic-social value to society.
h. Business simulations should be used to enhance behavioural traits of successful intrapreneurs and entrepreneurs amongst students. Emphasis should be on creating entrepreneurial society rather than only setting up of enterprise.
i. They must be encouraged to surf on net and collect as much information as possible.
j. Each student should complete minimum twenty activities from the suggested list. Minimum possible guidance should be given for the suggested activities.
k. Students should be promoted to use creative ideas, pool their own resources, finish their presentation, communication and team skills.
l. Alumni should be frequently invited for experience sharing, guiding and rewarding students.
m. Display must be arranged for models, collages, business plans and other contributions so that they motivate others.

11. SUGGESTED MICRO-PROJECTS

One Business Plan as a micro-project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he should submit it by the end of the semester to develop the industry oriented COs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation in the middle of the semester and one at the end of the semester before submission of the project proposal incorporating the concepts taught during semester. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course.

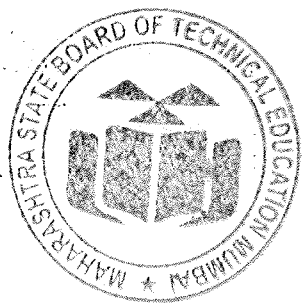
12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Books	Author	Publication
1	The Entrepreneurial Instinct : How Everyone Has the Innate Ability to Start a Successful Small Business	Mehta, Monica	McGraw-Hill Education, New Delhi, 2012, ISBN 978-0-07-179742-9
2	Entrepreneurship	Hisrich, R. D.	McGraw-Hill Education, New Delhi, 2013 ISBN-13: 978-1259001635
3	Part I Readings in Entrepreneurship Education	Sareen, S.B.	Entrepreneurship Development Institute of India (EDI), GOI, Ahmedabad, 2016; ISBN: 978-0078029196 ..
4	Reading Material of Entrepreneurship Awareness Camp	Gujral, Raman	Entrepreneurship Development Institute of India (EDI), GOI, 2016 Ahmedabad,
5	Product Design and Manufacturing	Chitale, A K	PHI Learning, New Delhi, 2014; ISBN: 9788120348738
6	Entrepreneurship Development Small Business Entrepreneurship	Charantimath, Poornima	Pearson Education India, New Delhi; ISBN: 9788131762264
7	Entrepreneurship Development: Special edition for MSBTE	CPSC, Manila	Tata McGraw Hill, New Delhi,
8	Entrepreneurship and Small	Khanka, S.S.	S.Chand and Sons, New Delhi,

S. No.	Title of Books	Author	Publication
	Business Management		ISBN: 978-93-5161-094-6
9	Entrepreneurship Development	S, Anil Kumar	New Age International, New Delhi, ISBN: 9788122414349

13. SUGGESTED SOFTWARE/LEARNING WEBSITES

1	MCED Books links	http://www.mced.nic.in/UdyojakSpecial.aspx?linktype=Udyojak
2	MCED Product and Plan Details	http://www.mced.nic.in/allproduct.aspx
3	The National Institute for Entrepreneurship and Small Business Development Publications	http://niesbud.nic.in/Publication.html
4	Courses : The National Institute for Entrepreneurship and Small Business Development	http://niesbud.nic.in/docs/1standardized.pdf
5	Entrepreneur.com	https://www.entrepreneur.com/lists
6	GOVT. SPONSORED SCHEMES	https://www.nabard.org/content1.aspx?id=23andcatid=23andmid=530
7	NABARD - Information Centre	https://www.nabard.org/Tenders.aspx?cid=501andid=24
8	NABARD – What we Do	http://www.nabard.org/content1.aspx?id=8andcatid=8andmid=488
9	Market Review	http://www.businesstoday.in/markets
10	Start Up India	http://www.startupindia.gov.in/pdffile.php?title=Startup%20India%20Action%20Planandtype=Actionandq=Action%20Plan.pdfandcontent_type=Actionandsubmenupoint=action
11	About - Entrepreneurship Development Institute of India (EDII)	http://www.ediindia.org/institute.html
12	EDII - Centres	http://www.ediindia.org/centres.html
13	EDII - Publications	http://www.ediindia.org/publication.html
14	Business Plans: A Step-by-Step Guide	https://www.entrepreneur.com/article/247574
15	The National Science and Technology Entrepreneurship Development Board (NSTEDB)	http://www.nstedb.com/index.htm
16	NSTEDB - Training	http://www.nstedb.com/training/training.htm
17	Tata Exposures	http://www.tatasocial-in.com/project-exposure
18	Ministry Of Micro, Small And Medium EnterpriseS	http://www.dcmsme.gov.in/schemes/TEQUPDetail.htm
19	List of Business Ideas for Small Scale Industry	https://smallb.sidbi.in/%20/thinking-starting-business/big-list-business-ideas-small-business
20	Thinking of Entrepreneurship	https://smallb.sidbi.in/entrepreneurship-stage/thinking-entrepreneurship
21	List of services for Small Scale Industry	http://www.archive.india.gov.in/business/Industry_services/illustrative.php
22	NSIC Schemes and Services	http://www.nsic.co.in/SCHSERV.ASP


MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION MUMBAI