Maharashtra State Board Of Technical Education, Mumbai

Learning and Assessment Scheme for Post H.S.C Diploma Courses

Programme Name	**: Diploma In Surface Coating Technology**		
Programme Code	**: SC**	**With Effect From Academic Year**	**: 2023-24**
Duration Of Programme	**: 6 Semester**	**Duration**	**: 16 WEEKS**
Semester	**: Fifth**	**Scheme**	**: K**

Sr No	Course Title	Abbrevation	Course Type	Course Code	Total IKS Hrs for Sem.	Learning Scheme					Credits	Assessment Scheme											
						Actual Contact Hrs./Week			Self Learning (Activity/ Assignment /Micro Project)	Notional Learning Hrs /Week		Paper Duration (hrs.)	Theory				Based on LL & TL				Based on Self Learning		Total Marks
																	Practical						
						CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
													Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
(All Compulsory)																							
1	MANAGEMENT	MAN	VEC	315301	1	3	-	-	1	4	2	1.5	30	70*#	100	40	-	-	-	-	25	10	125
2	INDUSTRIAL PAINT PRODUCTION	IPP	DSC	325326	-	4	-	4	2	10	5	3	30	70	100	40	25	10	50#	20	25	10	200
3	SURFACE PREPARATION AND PAINT APPLICATIONS METHODS	SPA	DSC	325327	2	4	-	4	2	10	5	3	30	70	100	40	25	10	50#	20	25	10	200
4	SPECIALIZED FINISHES	SPF	SEC	325010	-	2	-	4	2	8	4	-	-	-	-	-	50	20	50@	20	25	10	125
Elective-2 (Any - One)																							
5	ADVANCED INK TECHNOLOGY	AIN	DSE	325328	-	4	-	4	-	8	4	3	30	70	100	40	50	20	50#	20	-	-	200
	CHEMICAL TECHNOLOGY FOR PAINT INDUSTRIES	CTP	DSE	325329	-	4	-	4	-	8	4	3	30	70	100	40	50	20	50#	20	-	-	200
	COLORANT TECHNOLOGY	COT	DSC	325330	2	4	-	4	-	8	4	3	30	70	100	40	50	20	50#	20	-	-	200
Total					**5**	**17**		**16**	**7**		**20**		**120**	**280**	**400**		**150**		**200**		**100**		**850**

Abbreviations : CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, FA - Formative Assessment,SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends : @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :
1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

Course Category : Discipline Specific Course Core (DSC) , Discipline Specific Elective (DSE) , Value Education Course (VEC) , Intern./Apprenti./Project./Community (INP) , AbilityEnhancement Course (AEC) , Skill Enhancement Course (SEC) , GenericElective (GE)

Programme Name/s	**: Architecture Assistantship/ Automobile Engineering./ Artificial Intelligence/ Agricultural Engineering/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Architecture/ Cloud Computing and Big Data/ Civil Engineering/ Chemical Engineering/ Computer Technology/ Computer Engineering/ Civil & Rural Engineering/ Construction Technology/ Computer Science & Engineering/ Fashion & Clothing Technology/ Digital Electronics/ Data Sciences/ Electrical Engineering/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electrical Power System/ Electronics & Communication Engg./ Electronics Engineering/ Food Technology/ Computer Hardware & Maintenance/ Instrumentation & Control/ Industrial Electronics/ Information Technology/ Computer Science & Information Technology/ Instrumentation/ Interior Design & Decoration/ Interior Design/ Civil & Environmental Engineering/ Mechanical Engineering/ Mechatronics/ Medical Laboratory Technology/ Medical Electronics/ Production Engineering/ Printing Technology/ Polymer Technology/ Surface Coating Technology/ Computer Science/ Textile Technology/ Electronics & Computer Engg.**
Programme Code	**: AA/ AE/ AI/ AL/ AN/ AO/ AT/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CW/ DC/ DE/ DS/ EE/ EJ/ EK/ EP/ ET/ EX/ FC/ HA/ IC/ IE/ IF/ IH/ IS/ IX/ IZ/ LE/ ME/ MK/ ML/ MU/ PG/ PN/ PO/ SC/ SE/ TC/ TE**
Semester	**: Fifth / Sixth**
Course Title	**: MANAGEMENT**
Course Code	**: 315301**

I. RATIONALE

Effective management is the cornerstone of success for both organizations and individuals. It empowers diploma engineers/ professionals to accomplish their tasks with finesse and efficiency through strategic planning and thoughtful execution, projects can optimize finances, enhance safety measures, facilitate sound decision-making, foster team collaboration and cultivate a harmonious work environment. The diploma engineers require leadership and management skills with technical knowledge of the core field to carry out various tasks smoothly. This course aims to instill fundamental management techniques, empowering diploma engineers/ professionals to enhance their effectiveness in the workplace.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Apply the relevant managerial skills for achieving optimal results at workplace.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Use relevant management skills to handle work situation
- CO2 - Apply appropriate techniques of product, operations and project management
- CO3 - Use comprehensive tools of recent management practices
- CO4 - Plan suitable marketing strategy for a product / service
- CO5 - Utilize supply chain and human resource management techniques for effective management

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

MANAGEMENT **Course Code : 315301**

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
315301	MANAGEMENT	MAN	VEC	3	-	-	1	4	2	1.5	30	70*#	100	40	-	-	-	-	25	10	125

Total IKS Hrs for Sem. : 1 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Justify the importance of management thoughts in Indian knowledge system. TLO 1.2 Describe the importance of management in day to day life. TLO 1.3 Explain Henry Fayol’s principles of management. TLO 1.4 Describe the role of each level of management in its management hierarchy. TLO 1.5 Practice the self management skills for a given situation TLO 1.6 Apply the required managerial skills for a given situation	**Unit - I Introduction to Management** 1.1 Evolution of management thoughts from ancient/medieval to modern times in India (IKS) 1.2 Management: meaning, importance, characteristics, functions & challenges. 1.3 Introduction to scientific management- Taylor's & Fayol's principles of management 1.4 Levels & functions of management at supervisory level. 1.5 Self management skills: Self awareness, self discipline, self motivation, goal setting, time management, decision making, stress management, work life balance and multitasking 1.6 Overview of Managerial Skills: negotiation skills, team management, conflict resolution, feedback, leadership	Presentations Case Study Interactive session Quiz competition Mixed Picture Puzzle

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Identify the appropriate creativity technique for new product development TLO 2.2 Describe the new product development process for a product / service TLO 2.3 Comprehend the importance of various strategic steps Product Management TLO 2.4 Elaborate Agile product management TLO 2.5 Explain the significance of the Project Management TLO 2.6 Describe the various tools of project management	**Unit - II Product, Operations and Project Management** 2.1 Creativity and innovation management: creativity techniques - brainstorming, checklist, reverse brainstorming, morphological analysis, six thinking hats. 2.2 New product development, change management 2.3 Product Management -meaning, strategic steps for sustainable design of a product 2.4 Agile product management- concept, benefits, principles and manifesto 2.5 Project Management: importance, areas within project management,4Ps and phases 2.6 Tools of Project Management: PERT and CPM, GANTT & Chart Overview of Estimate and Budget	Presentations Case Study Video Demonstrations Presentations Role Play
3	TLO 3.1 Understand the importance of quality management tools TLO 3.2 Explain the importance of various techniques for optimization and waste minimization TLO 3.3 State the importance of ISO quality standards TLO 3.4 Describe ERP TLO 3.5 State the importance of ISO TLO 3.6 Recognize the importance of customer satisfaction as a competitive advantage	**Unit - III Management Practices** 3.1 Quality circle, kaizen, Six Sigma, TQM 3.2 5S, Kanban card system, TPM, Lean Manufacturing: Meaning, Steps and Importance 3.3 Quality Standards and ISO: Meaning, ISO 9001:2016, ISO 14000, OSHA 2020 3.4 The overview of ERP along with example 3.5 Service quality and customer/client satisfaction, servicescape	Presentation Case study Interactive session Quiz Video Demonstration Lecture Using Chalk-Board
4	TLO 4.1 Explain the importance of marketing techniques TLO 4.2 Explain the importance of needs, wants and desires in marketing TLO 4.3 Interpret the traditional and digital marketing techniques TLO 4.4 Plan different aspects of an event management	**Unit - IV Marketing Management** 4.1 Marketing management: meaning, significance, Seven P's of Marketing 4.2 Needs, wants and demands in marketing. Customer relationship management 4.3 Types of marketing: traditional and digital marketing 4.4 Event management: types, different aspects of event management, crisis management	Case Study Interactive session based video Role Play Flipped Classroom Presentations

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 State the importance of supply chain and logistics management TLO 5.2 Explain the components of supply chain and logistics Management TLO 5.3 Describe the role of information technology in supply chain & logistics management TLO 5.4 State the significance of Human Resource Management TLO 5.5 Analyze the various methods of recruitment, selection and training for an organization TLO 5.6 List the qualities of a successful supervisor	**Unit - V Supply Chain & Human Resource Management** 5.1 The overview of Supply Chain and logistics Management 5.2 Components of Supply Chain and logistics Management 5.3 Role of information technology in supply chain & logistics management 5.4 Overview of Human Resource Management- Meaning,significance,scope and principles 5.5 Recruitment, selection and training of human resources. Chalk Circle 5.6 Qualities of a successful supervisor /team leader and types of leadership	Presentations Video Demonstrations Case Study Collaborative learning Video Demonstrations Chalk-Board

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES : NOT APPLICABLE.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Assignment / Article

- Make a one page note based on a book of management you read.
- Write a short article on inventory management exploring online learning resources.
- Prepare a report on ISO standards applicable to your field. a. IATF 16949-2016 / SLA-TS 16949-2016, - Automotive Industry b. ISO 22000 — Food safety management c. ISO 50001 — Energy management d. ISO/IEC 27001 - Cyber Security e. ISO/DIS 4931-1 - Buildings and civil engineering works
- Prepare a 4 quadrant matrix of time management for managing the tasks.
- Prepare a report on any one software used for Supply Chain and Logistics Management.
- Prepare a GANTT Chart for project management related to your field.

Note Taking

- Watch a Tedx Talk Video on managerial skills and take notes in the form of keywords.

Case Study

- Prepare a case study and discuss the same on following topics a.Self Management Skills b.Six Thinking Hats c.Kaizen d.Quality Circle e.Safety Measures in different organizations related to your field
- Study the recruitment and selection process of any organization related to your field.
- Prepare a case study on management lessons based on life of Chhatrapati Shivaji Maharaj
- Conduct outbound training on managerial skills. Make a video and upload on social media.

Quizes

- Participate in online quizzes related to areas of management .

Assignment

- Workshops to be conducted for students on following topics a. creativity techniques b. time management c. stress management d. negotiation and conflict e. goal setting f. meditation new product development

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED : NOT APPLICABLE

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to Management	CO1	13	8	6	4	18
2	II	Product, Operations and Project Management	CO2	8	2	4	6	12
3	III	Management Practices	CO3	8	4	4	6	14
4	IV	Marketing Management	CO4	8	2	4	6	12
5	V	Supply Chain & Human Resource Management	CO5	8	4	4	6	14
Grand Total				**45**	**20**	**22**	**28**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- MCQ Based Class Test, Self Learning Activities / Assignment

Summative Assessment (Assessment of Learning)

- Summative Assessment (Assessment of Learning) MCQ based

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	1	1	1	-	-	2	3			
CO2	1	3	3	-	1	3	3			
CO3	1	3	1	-	1	1	3			
CO4	1	2	2	-	1	2	3			
CO5	1	1	2	-	1	2	3			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Chitale, Dubey	Organizational Behaviour Text and Cases	PHI LEARNING PVT. LTD., ISBN: 978-9389347067, 2019, 2nd Edition
2	A. K. Gupta	Engineering Management	S. Chand, ISBN: 81-219-2812-5, 2007, 2nd Edition
3	O. P. Khanna	Industrial Engineering &management	Dhanpat Rai Publication, ISBN: 978-8189928353, 2018
4	Harold Koontz and Heinz Weinrich	Essentials of Management	Tata McGraw Hill Education ISBN: 9789353168148, 2020, 12th edition
5	E. H. McGrath	Basic Managerial Skills for All	PHI ISBN: 978-8120343146, 2011, 9th Edition
6	Andrew DuBrin	Management Concepts and Cases	Cengage Learning, ISBN: 978-8131510537, 2009, 9th edition
7	K. Dennis Chambers	How Toyota Changed the World	Jaico Books ISBN: 978-81-8495-052-6, 2009
8	Jason D. O'Grandy	How Apple changed the Wolrd	Jaico Publishing House ISBN: 978-81-8495-052-0, 2009
9	Subhash Sharma	Indian Management	New Age International Private Limited ; ISBN-978-9389802412, 2020, 1st edition

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.debonogroup.com/services/core-programs/six-thinking-hats/	Six Thinking Hats
2	https://hbr.org/1981/09/managing-human-resources	HR Management
3	https://theproductmanager.com/topics/agile-product-management/	Agile Product Management
4	https://www.cdlogistics.ca/freight-news/the-5-components-of-supply-chain-management	Supply Chain Management
5	https://www.infosectrain.com/blog/understanding-the-concepts-of-gantt-chart-and-critical-path-methodology-cpm	PERT, CPM, GANTT Chart
6	https://www.simplilearn.com/best-management-tools-article	Management Tools

Sr.No	Link / Portal	Description
7	https://www.psychometrica.in/free-online-psychometric-tests.html	Psychometric Tests
8	https://www.investopedia.com/terms/e/erp.asp	ERP
9	https://asq.org/quality-resources/quality-management-system	QMS
10	https://testlify.com/test-library/creative-thinking/	Psychometric Tests
11	https://www.mindtools.com/	Management Skills
12	https://www.investopedia.com/terms/d/digital-marketing.asp	Digital Marketing

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

SPECIALIZED FINISHES **Course Code : 325010**

Programme Name/s : **Surface Coating Technology**
Programme Code : **SC**
Semester : **Fifth**
Course Title : **SPECIALIZED FINISHES**
Course Code : **325010**

I. RATIONALE

This course enables students to apply practices of Specialized Finishes in surface coating industry and allied industries. This course helps students to understand principles, techniques of light glowing, thermo-cool, candy finishes, multi-colour finishes, metallic coatings, texture finishes, wood effect finishes.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Apply different types of Specialized Finishes in surface coating and allied industries.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Explain types, process and application of specialized finishes.
- CO2 - Apply light glowing and multi-colour coatings on given substrate.
- CO3 - Describe types, process and application metallic coatings.
- CO4 - Perform stipple and texture finishes on given substrates.
- CO5 - Apply wood effect finishes on given substrate.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
325010	SPECIALIZED FINISHES	SPF	SEC	2	-	4	2	8	4	-	-	-	-	-	50	20	50@	20	25	10	125

Total IKS Hrs for Sem. : Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

SPECIALIZED FINISHES **Course Code : 325010**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 State importance of 3D floor coatings. TLO 1.2 Describe candy finish coating. TLO 1.3 Explain thermo-cool coatings.	**Unit - I Introduction to Specialized Finishes** 1.1 Concept of specialized finishes. 1.2 Characteristics of specialized finishes. 1.3 Concept of novelty finishes. 1.4 Concept of 3D floor application. 1.5 Concept and characteristics of candy finishes. 1.6 Concept and principles of thermo cool coatings.	Lecture Using Chalk-Board Demonstration Case Study Presentations
2	TLO 2.1 Explain light glowing coatings. TLO 2.2 Describe multi-colour coatings. TLO 2.3 List testing of multi-colour coatings. TLO 2.4 Write process for surface preparation.	**Unit - II Light glowing and multi-colour coatings** 2.1 Concept and characteristics of light glowing coatings. 2.2 Techniques and application of light glowing coatings. 2.3 Process of surface preparation. 2.4 Techniques and application of multi-colour coatings. 2.5 Characterization of light colour coatings and multi-colour coatings.	Presentations Case Study Lecture Using Chalk-Board Case Study
3	TLO 3.1 Explain metallic coatings. TLO 3.2 Write testing for Metallic coating. TLO 3.3 Describe elcetroless coatings. TLO 3.4 Explain testing of electro less coating.	**Unit - III Metallic finish coatings** 3.1 Concept and Types of metallic finish coatings. 3.2 Application of metallic finish coatings. 3.3 Concept of elcetroless coatings. 3.4 Application of elcetroless coatings. 3.5 Characterization of metallic finish and elcetroless coatings. 3.6 Application of hammer tone coatings	Lecture Using Chalk-Board Demonstration Case Study Presentations
4	TLO 4.1 Explain stipple coating. TLO 4.2 Write testing of stipple coatings. TLO 4.3 Describe texture finishes. TLO 4.4 Select tools used for texture finishes.	**Unit - IV Stipple and texture finishes** 4.1 Introduction to stipple finishes. 4.2 Surface preparation process for stipple and texture coatings. 4.3 Application of stipple coatings. 4.4 Application of texture coatings. 4.5 Characterization of stipple and texture coatings. 4.6 Tools for stipple and texture coatings.	Demonstration Presentations Case Study Lecture Using Chalk-Board
5	TLO 5.1 Understand texture finishes using roller. TLO 5.2 Explain testing of texture coatings. TLO 5.3 Apply wood texture finishes. TLO 5.4 Explain testing of wood texture finishes.	**Unit - V Wood effect finishes** 5.1 Concept of wood finishes. 5.2 Types of wood finish effects. 5.3 Surface preparation process for wood substrate. 5.4 Application methods for wood finishes. 5.5 Testing of wood finishes. 5.6 Concept of soft feel coatings and 5.7 Introduction to sublimation coating.	Video Demonstrations Presentations Case Study Lecture Using Chalk-Board

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Apply 3D floor coatings.	1	*Preparation and testing of 3D floor coatings.	4	CO1
LLO 2.1 Evaluate Candy finish coating.	2	Apply candy finish coating.	4	CO1
LLO 3.1 Apply thermo-cool coatings.	3	Preparation of Thermo-cool coatings.	4	CO1
LLO 4.1 Evaluate Thermo-cool coatings.	4	Testing of Thermo-cool coating.	4	CO1
LLO 5.1 Apply light glowing coatings.	5	Preparation of light glowing coatings.	4	CO2
LLO 6.1 Evaluate of light glowing stoving coatings.	6	Testing of light glowing stoving coatings.	4	CO2
LLO 7.1 Apply multi colour coatings.	7	*Preparation of multi colour coatings.	4	CO2
LLO 8.1 Evaluate of multi-colour coating	8	Testing of multi-colour coating	4	CO2
LLO 9.1 Apply metallic coatings.	9	*Preparation of metallic coatings.	4	CO3
LLO 10.1 Testing of metallic coatings.	10	*Testing of metallic coatings.	4	CO3
LLO 11.1 Apply electro less coating on panel.	11	Application of electro less coating on panel.	4	CO3
LLO 12.1 Evaluate electro less coating on panel.	12	Testing of electro less coating on panel.	4	CO3
LLO 13.1 Apply stipple coatings.	13	*Preparation of Stipple coatings.	4	CO4
LLO 14.1 Evaluate of stipple coatings	14	* Testing of Stipple coatings	4	CO4
LLO 15.1 Apply crackle finish.	15	Create crackle finishes using spatula and spray gun.	4	CO4
LLO 16.1 Evaluate of texture finishes.	16	Testing of texture finishes.	4	CO4
LLO 17.1 Apply texture finishes using roller.	17	Create texture finishes using roller.	4	CO5
LLO 18.1 Evaluate of texture finish using roller.	18	Testing of texture finish using roller.	4	CO5
LLO 19.1 Execute wood texture finishes.	19	*Create wood texture finishes.	4	CO5
LLO 20.1 Evaluate wood texture finishes.	20	*Testing of wood texture finishes.	4	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Assignment

- Prepare an album on different specialize finishes.
- Visit shop in market prepare technical report on various fineish available.
- Collect information of latest trending in floor coating applications.
- Collect information of latest trend in wood effect on different surface.

Micro project

- Prepare report on shade matching principal using Spectrophotometer
- Collect information of latest trending in floor coating applications

- Prepare report on physical vapor deposition (PVD).
- Prepare report on Chemical vapor deposition (CVD)
- Collect information of latest trend in wood coating.
- Prepare report on dip spin coatings application.
- Prepare report on 3d Printing
- Collect information on Self leveling coating.
- Collect information on hydrophobic coating.
- Prepare report on anti-carbonation coatings

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Measuring cylinder	1,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20
2	Stirrer	1,3,5,7,9,11,13,15,17,19
3	Brush	1,3,5,7,9,13,15,17
4	Ford cup Viscometer B4	1,3,5,7,9,13,15,17,19
5	Cement / asbestos sheet	1,5,9,15,17,19
6	Wood panel	1,5,9,15,17,19
7	Electo less coating bath	11
8	Roller	17
9	Threads , cotton waste , light weight cord / string	17
10	DFT meter	4,6,8,10,12,14,16,18,20
11	Gloss ‘O’ Meter	4,6,8,10,12,14,16,18,20
12	Pencil Harness tester	4,6,8,10,12,14,16,18,20
13	Cross cut adhesion tester	4,6,8,10,12,14,16,18,20
14	Resistance to solvents	4,6,8,10,12,14,16,18,20
15	Sand paper (80 / 120 / 300)	4,6,8,10,12,14,16,18,20
16	Cutter / Cutter guider	4,6,8,10,12,14,16,18,20
17	Spray gun	5,9
18	Oven	9,13
19	Weighing Balance	All
20	Spatula metal and plastic	All
21	Paper Glasses	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks

SPECIALIZED FINISHES **Course Code : 325010**

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to Specialized Finishes	CO1	6	0	0	0	0
2	II	Light glowing and multi-colour coatings	CO2	6	0	0	0	0
3	III	Metallic finish coatings	CO3	6	0	0	0	0
4	IV	Stipple and texture finishes	CO4	6	0	0	0	0
5	V	Wood effect finishes	CO5	6	0	0	0	0
Grand Total				**30**	**0**	**0**	**0**	**0**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Term Work, Micro Project

Summative Assessment (Assessment of Learning)

- Practical Exam / Oral

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	2	2	2	2	2	2			
CO2	3	2	2	2	1	2	2			
CO3	3	2	2	2	2	2	2			
CO4	3	2	2	2	2	2	2			
CO5	3	2	2	2	2	2	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	W. M. Morgan	Outlines of Paint Technology (3rd Edition)	CBS Publishers & Distributors Pvt. Ltd, 2000 ISBN: 9788123904306
2	V.C. Malshe and Meenal Sikchi	Basics of Paints Technology Part I	Antar Prakash Centre for Yoga, 2004 ISBN: 9788190329859
3	Dr. Swaraj Paul	Surface Coatings: Science & Technology (2nd Edition)	John Wiley and Sons Ltd.2014 ISBN:9788126552559
4	NIIR Board	Modern Technology of Paints, Varnishes & Lacquers (2nd Edition)	Asia Pacific Business Press Inc. 2007 ISBN: 8178330881

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=rzRh22MJH10	3D Floor Coatings
2	https://www.youtube.com/watch?v=fd7YPSo4E-0	Candy color painting method
3	https://www.youtube.com/watch?v=X8F18IY9PmY	Spatula texture design
4	https://www.youtube.com/watch?v=PyXf6KLI2mc	Glow in the dark ring object
5	https://www.youtube.com/watch?v=kqxc6Sm3pa4	Multi Color Acrylic pour painting
6	https://www.youtube.com/watch?v=yv7SogmppJQ	Metallic Epoxy Floor coating
7	https://www.youtube.com/watch?v=Rje0GPTxCEo	Spatula texture design
8	https://www.youtube.com/watch?v=uYbEflYcJRg	Fine Texture For Textured Walls
9	https://www.youtube.com/watch?v=2XX5QRMKG54	Texture wall painting techniques
10	https://www.youtube.com/watch?v=PCd1ASasokQ	3d Epoxy Floor
11	https://www.youtube.com/watch?v=NFlALQ9asqk	MIXING Glow in the Dark & Colored Pearls
12	https://www.youtube.com/watch?v=-SbBoMK-1bQ	Combine Two Colors , Multi Color
13	https://www.youtube.com/watch?v=z1RlWClwcPg	Metallic Powder Application
14	https://www.youtube.com/watch?v=MhbjQFhZ1bE	Electroless deposition: Corrosion Control
15	https://www.youtube.com/watch?v=gCLEJmn2n6M	Britmet Stipple Paint Application
16	https://www.youtube.com/watch?v=HBs8QG8agBo	Spatula Effect
17	https://www.youtube.com/watch?v=lm4J9O-uE6g	How To Use The Graining Tools Correctly

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

INDUSTRIAL PAINT PRODUCTION **Course Code : 325326**

Programme Name/s : **Surface Coating Technology**

Programme Code : **SC**

Semester : **Fifth**

Course Title : **INDUSTRIAL PAINT PRODUCTION**

Course Code : **325326**

I. RATIONALE

This course enables students to apply principles and practices of Industrial paint formulation and production in surface coating industry. This course helps students to understand selection of raw materials, formulation techniques, manufacturing processes of Industrial paint formulation and production.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Apply principles and practices of Industrial paint formulation and production in surface coating Industry.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Select corrosion resistant coatings.
- CO2 - Classify Industrial coatings.
- CO3 - Select Chemical resistant paints.
- CO4 - Use Specialty coatings.
- CO5 - Describe emerging trends in industrial finishes.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
325326	INDUSTRIAL PAINT PRODUCTION	IPP	DSC	4	-	4	2	10	5	3	30	70	100	40	25	10	50#	20	25	10	200

Total IKS Hrs for Sem. : 0 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain different corrosion mechanisms. TLO 1.2 Describe properties & applications of corrosion resistant coatings TLO 1.3 State principles of formulating corrosion resistance paint. TLO 1.4 Explain organic & Inorganic Zinc coating.	**Unit - I 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 . 1.4 Red oxide primer red oxide zinc chrome primer, yellow primer, etch primer, Zinc dust primer. 1.5 Introduction, properties & applications of Zinc silicate primer.	Presentations seminar Video Demonstrations Assignment
2	TLO 2.1 Write the requirements of industrial coatings. TLO 2.2 Describe formulations for industrial coating. TLO 2.3 Explain manufacturing processes of industrial coatings.. TLO 2.4 List area of applications of industrial coatings.	**Unit - II Industrial coatings** 2.1 Introduction to industrial coatings & its principle of development. 2.2 Formulation of industrial coatings, such as white goods, metal furniture, hospital equipment, laboratory furniture. 2.3 Formulation of automotive coatings with properties and applications. 2.4 Formulations of powder coatings. 2.5 Manufacturing process of powder coatings.	Presentations Seminar Assignment Video Demonstrations
3	TLO 3.1 Write compositions for epoxy and polyurethane paints. TLO 3.2 Explain properties of epoxy and polyurethane paints. TLO 3.3 Describe applications of epoxy and polyurethane paints. TLO 3.4 Explain water based coatings.	**Unit - III Chemical resistant paints** 3.1 Rational and significance of chemical resistant coatings. 3.2 Formulations of one pack & two 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 hardener & base polymer. 3.5 Introduction, properties & applications of Water-based coatings-epoxy and polyurethanes.	Presentations Lecture Using Chalk-Board Seminar Assignnment
4	TLO 4.1 Classify marine coatings. TLO 4.2 Explain properties of marine coatings. TLO 4.3 Write composition for heat resistant coatings. TLO 4.4 Describe applications of coil coatings .	**Unit - IV Specialty coatings** 4.1 Significance of marine coatings. 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, properties & applications of coil coating .	Presentations Seminar Demonstration Case Study

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 Describe Industrial Floor Coatings & Fire resistant coatings. TLO 5.2 Write applications of PVDF and PTFE coatings. TLO 5.3 Describe requirement of coatings for space vehicles. TLO 5.4 Explain Nano coatings and monocoat system (Direct to metal)	**Unit - V New trends in Industrial Finishes** 5.1 Introduction to floor coating and its type. 5.2 Applications of fire retardant coatings. 5.3 Properties and uses of coatings based on PVDF. 5.4 Properties and uses of coatings based on PTFE. 5.5 Coating for space vehicles. 5.6 Nano coatings like graphene based coating and monocoat system (DTM)	Video Demonstrations Case Study Presentations Seminar

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Prepare Red Oxide Zinc Chrome primer (ROZC) as per IS-2074.	1	*Preparation and testing of Prepare Red Oxide Zinc Chrome primer (ROZC) using Jar Mill.	4	CO1
LLO 2.1 Formulate Yellow Primer.	2	*Preparation & testing of yellow primer using laboratory pebble mill.	4	CO1
LLO 3.1 Prepare Etch Primer.	3	Preparation & testing of Etch primer using laboratory pebble mill.	4	CO1
LLO 4.1 Formulate Alkyd-amino stoving paint.	4	*Preparation & testing of Alkyd-amino stoving paint using pastel mortar.	4	CO2
LLO 5.1 Prepare Acrylic-amino stoving paint.	5	Preparation & testing of acrylic-amino stoving paint using pastel mortar.	4	CO2
LLO 6.1 Test particle size distribution (PSD) of powder paint.	6	*Testing of particle size distribution (PSD) of powder paint used for powder coating using sieve analysis.	4	CO2
LLO 7.1 Formulate 2 pack Epoxy (2 K epoxy) primer using polyamide hardener.	7	*Preparation & testing of 2 pack Epoxy primer (2 K epoxy) using pastel mortar/Ball Mill (Test-Hegman Gauge, Viscosity, Wt/lit, Xylene rub, pencil hardness, cross cut adhesion).	4	CO3
LLO 8.1 Prepare 2 pack Polyurethane enamel.	8	Prepare 2 pack Polyurethane (2 K PU) enamel of different finish using pastel mortar/sand mill (Test-Hegman Gauge, Viscosity, Wt/lit, Xylene rub, pencil hardness, cross cut adhesion).	4	CO3
LLO 9.1 Formulate chlorinated rubber enamel paint.	9	Prepare rubber enamel using pastel mortar/sand mill (Test-Hegman Gauge, Viscosity, Wt/lit, Xylene rub test, cross cut adhesion).	4	CO4
LLO 10.1 Prepare thermosetting acrylic (TSA) enamel.	10	*Preparation & testing of thermosetting acrylic (TSA) enamel using concept of weight per liter, Pigment binder ratio, PVC. (Test- Hegman Gauge, Viscosity, Wt/lit, Xylene rub, pencil hardness, cross cut adhesion).	4	CO4
LLO 11.1 Estimate Mixing ratio of Base resin & Hardner.	11	Testing the significance of mixing ratio of 2 pack epoxy OR 2 Pack PU system to test effective curing of system.	4	CO4
LLO 12.1 Evaluate Coil coating painted panels.	12	Testing of Coil coating painted panels for chemical resistance properties such as detergent rub test, solvent rub test, solvent patch test.	4	CO4

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 13.1 Prepare Aluminum heat resistant paint.	13	*Preparation & testing of aluminum heat resistant paint using heating mantel & stirrer (Test-Quenching and non quenching test).	4	CO4
LLO 14.1 Formulate fire retardant paint.	14	Preparation & testing of fire retardant paint using laboratory stirrer (Test for Fire retardancy of coated object).	4	CO5
LLO 15.1 Measure viscosity pick up for 2 pack epoxy paint against time.	15	*Draw graph of viscosity pick up against time for 2 pack epoxy resin/paint after mixing both components.	4	CO5
LLO 16.1 Measure viscosity pick up for 2 pack PU paint against time.	16	Draw graph of viscosity pick up against time for 2 pack PU resin/paint after mixing both components.	4	CO5
LLO 17.1 Test PTFE coating painted panels.	17	Testing of PTFE coating painted panels for chemical resistance properties such as detergent rub test, solvent rub test, solvent patch test.	4	CO5
LLO 18.1 Test PVDF coating painted panels.	18	Testing of PVDF coating painted panels for chemical resistance properties such as detergent rub test, solvent rub test, solvent patch test.	4	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- Prepare a report on advances in antistatic coatings.
- 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.
- 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 equipment 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 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.

Assignment

- 1. Prepare a chart of classification for Industrial, Protective and specialty coatings
- 2. Prepare report on water based Industrial coatings
- 3. Prepare report on new developments in protective coatings

Term work

- 1. Prepare journal for laboratory work

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Hegman Guage	1,2,3,4,5,7,8,9,10
2	Film applicator	1,2,3,4,5,7,8,9,10
3	Morest Chart	1,2,3,4,5,7,8,9,10
4	Ball Mill/Jar Mill	1,2,3,7
5	Brookfield Viscometer	11,15,16
6	DFT meter	12,13,14,17,18
7	Pencil Harness tester	3,6,17,18
8	Pastel Mortar	4,5,7,8,9,10
9	Sieves of different mesh sizes	6
10	Oven	6,10,13,14
11	Gloss ‘O’ Meter	6,7,8,9,10,12
12	Cross cut adhesion tester	7,8,9,10
13	Sand Mill	8,9,10
14	Stirrer	9,11,13,14,15,16
15	Weighing Balance	All
16	Spatula	All
17	Ford cup Viscometer	All
18	Specific gravity cup	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Corrosion resistant Coatings	CO1	12	2	4	8	14
2	II	Industrial coatings	CO2	12	2	4	8	14
3	III	Chemical resistant paints	CO3	12	2	4	8	14
4	IV	Specialty coatings	CO4	12	2	4	8	14
5	V	New trends in Industrial Finishes	CO5	12	2	4	8	14
Grand Total				**60**	**10**	**20**	**40**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Mid-term tests
- Assignment, Self-learning and Terms work
- Seminar/Presentation

Summative Assessment (Assessment of Learning)

- End of Term Examination
- Viva-voce
- Lab. performance

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	2	1	1	2	-	2			
CO2	3	2	1	1	1	-	2			
CO3	3	2	1	1	2	-	2			
CO4	3	2	1	1	2	-	2			
CO5	3	2	1	1	2	-	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	W. M. Morgan	Outlines of Paint Technology (3rd Edition)	CBS Publishers & Distributors Pvt. Ltd, 2000 ISBN: 9788123904306
2	Oil and Colour Chemists Association of Australia St (OCCA)	Surface Coatings, Vol I: Raw Materials and Their Usage	Chapman & Hall, 1993 ISBN: 9780412552106

Sr.No	Author	Title	Publisher with ISBN Number
3	H. F. Payne	Organic Coating Technology	John Wiley & Sons Inc (1961) ISBN: 9780471673538
4	V.C. Malshe and Meenal Sikchi	Basics of Paints Technology Part I	Antar Prakash Centre for Yoga, 2004 ISBN: 9788190329859
5	Dr. Swaraj Paul	Surface Coatings: Science & Technology (2nd Edition)	John Wiley and Sons Ltd.2014 ISBN:9788126552559
6	NIIR Board	Modern Technology of Paints, Varnishes & Lacquers (2nd Edition)	Asia Pacific Business Press Inc. 2007 ISBN: 8178330881

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=TKMgUCq3npg	Corrosion reactions & Chemistry
2	https://www.youtube.com/watch?v=Im23nVpB0bE	Corrosion and its Prevention | Metals and Non-Metals
3	https://www.youtube.com/watch?v=LM4VOW6xZ5Y	Extraction Of Iron From Its Oxides
4	https://www.youtube.com/watch?v=I3QLMl1AK9Y	Corrosion : Dry or Chemical Corrosion
5	https://www.youtube.com/watch?v=tXnMNFk_r4w	Electrochemical Corrosion
6	https://www.youtube.com/watch?v=Fb__KLI7D0s	The Extraction of Iron (GCSE Chemistry)-Part I
7	https://www.youtube.com/watch?v=b6Q6VWoUGE0	The Extraction of Iron (GCSE Chemistry)-Part II
8	https://www.youtube.com/watch?v=X6EVMSNOWXw	Spray Painting Anti Rust Painting Video - Zinc Paint Application
9	https://www.youtube.com/watch?v=XrY2eW2GroM	Fans Manufacturing Plant Video
10	https://www.youtube.com/watch?v=T5lsSr_Dp4o	GM Pretreatment Inspection and Paint Process
11	https://www.youtube.com/watch?v=ChVK8J1-has	Manufacturing Process of Epoxy Resins with Formulation
12	https://finishing.tips/catalyzed-polyurethane-finish/	Polyurethane diol solution
13	https://www.youtube.com/watch?v=eb8VAnLH1bg	5 Things You Need to Know About Water Based Polyurethane
14	https://www.westmarine.com/WestAdvisor/DIY-Bottom-Painting	How to Paint a Boat - DIY Guide to Bottom Painting
15	https://safety4sea.com/hull-coatings-technologies/	Hull coatings technologies
16	https://www.wacker.com/cms/en-us/products/applications/industrial-coatings/heat-resistance/heat-resistance-coatings.html	Heat Insulation-Renders and Plasters - Essential part of every wall system
17	https://www.youtube.com/watch?v=CS3Hx4Kl3bE	Bottom Job Paint Removal , Sanding and Painting Your Boat
18	https://www.youtube.com/watch?v=arUbCGHOSAc	The Coil Coating Process
19	https://www.concretenetwork.com/products-concrete-coatings/	How I Painted My Concrete Floor! DIY Budget Friendly Basement Floor Option
20	https://www.youtube.com/watch?v=RMXX2XCOy9M	How to do Epoxy Floors - STEP BY STEP GUIDE - S3E3
21	https://www.youtube.com/watch?v=oD2Cio0m3TM	Epoxy vs Polyurethane Flooring: Understand the differences

Sr.No	Link / Portal	Description
22	https://www.youtube.com/watch?v=pBBnYlln_TU	Fire Retardant / Flame Retardant Coatings
23	https://www.youtube.com/watch?v=alMKdUbE7vI	Intumescent Paints - Special Fire Resistant Coatings
24	htttps://www.outube.com/watch?v=8NC79e0oztM	Fire Testing Insulation Materials
25	https://www.youtube.com/watch?v=ofKWfeqzGBY	Automotive Refinishing
26	https://www.youtube.com/watch?v=q2CFwxuwFsM	Automotive Refinishing Procedure
27	https://www.youtube.com/watch?v=2YbR-mOSZro	BASF Automotive Refinish Coatings Key Account Management 2015
28	https://www.youtube.com/watch?v=BXFkTUlOJhM	What is PVDF paint
29	https://www.youtube.com/watch?v=X9GA9Ahuu9A	Difference Between PVDF Coating and Powder Coating - Which is Best
30	https://www.youtube.com/watch?v=4Boaw5TAnns	High Performance PTFE Coatings - Plastic Coatings Ltd
31	https://www.youtube.com/watch?v=Ed0O3yXobqk	Teflon™ Coatings 2020 Series - Introduction
32	https://www.youtube.com/watch?v=YL0sk4Ms208	Teflon Coating Line-Full Process
33	https://www.youtube.com/watch?v=z6ZZwqLkWHg	Zinc Flake Coating Technology
34	https://www.youtube.com/watch?v=vidwsuL9-7g	GEOPERT is a zinc flake coating system
35	https://insulationcoatings.com.au/super-therm-nasa-test-results/	Urban Heat Island (UHI) effect heat mitigation reduced with Super Therm® Insulation Coating
36	https://www.youtube.com/watch?v=u6IS24U85WU	NASA Space Shuttle TPS High-Temp Surface insulation (HRSI) & LI-900 Heat Tile
37	https://insulationcoatings.com.au/what-is-super-therm-ceramic-insulation-coating/	Super Therm High Performance Solar Heat Block Coating Test - Adelaide, South Australia
38	https://cen.acs.org/articles/93/i26/Airplane-Coatings-Help-Recoup-Fuel.html	Thermal Barrier Coatings | Yttria Stabilized Zirconia | Alumina | Nickel | Aircraft Engine | Turbine
39	https://ceramicpro.com/aviation-industry/	What is Ceramic Pro? How does it work?
40	https://www.aerodefensetech.com/component/content/article/adt/features/articles/34530	Coating Technology Enables Effective Missile Countermeasures
41	https://www.nanowerk.com/nanocoatings.php	Nano werk-Nano Coatings
42	https://www.sae.org/publications/technical-papers/content/2019-28-2541/	High durable PU Metallic Monocoat System for tractor Sheet Metal Application 2019-28-2541
43	https://www.thefreelibrary.com/UV+monocoat%3A+an+advanced+coating+technology+for+consumer+electronics.-a0331004044	UV monocoat: an advanced coating technology for consumer electronics
44	http://metconcoatings.com/whatsnew/MCC-4702.php	High performance monocoat (mcc 4702)

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

INDUSTRIAL PAINT PRODUCTION **Course Code : 325326**

MSBTE Approval Dt. 24/02/2025 **Semester - 5, K Scheme**

ADVANCED INK TECHNOLOGY **Course Code : 325328**

Programme Name/s : **Surface Coating Technology**
Programme Code : **SC**
Semester : **Fifth**
Course Title : **ADVANCED INK TECHNOLOGY**
Course Code : **325328**

I. RATIONALE

This course enable students to apply principles and practices of advanced ink technology in surface coating industry. This course helps students to understand fundamentals of printing technology, paste gel ink printing technology, liquid ink printing technology, new trends in printing technology, and eco-friendly inks technology use in surface coating and allied industries.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Apply principles and practices of advanced ink technology in surface coating and allied industries.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Comprehend fundamentals of printing technology.
- CO2 - Describe paste gel ink printing technology.
- CO3 - Describe liquid ink printing technology.
- CO4 - List new trends in printing technology.
- CO5 - Explain eco-friendly inks technology.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
325328	ADVANCED INK TECHNOLOGY	AIN	DSE	4	-	4	-	8	4	3	30	70	100	40	50	20	50#	20	-	-	200

Total IKS Hrs for Sem. : Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Describe ancient printing and ink technology (IKS). TLO 1.2 Explain of evolution of printing technology. TLO 1.3 Classify types and methods printing technology. TLO 1.4 State new trends in printing technology like 3D printing.	**Unit - I Fundamentals of Printing Technology** 1.1 Ancient printing and ink technology (IKS). 1.2 Evolution of printing technology. 1.3 Types and classification of printing technology and methods. 1.4 New trends in printing technology. 1.5 Basics of 3D printing technology .	Presentations Video Demonstrations Lecture Using Chalk-Board
2	TLO 2.1 Describe basics of Letter press / tradel Printing technology. TLO 2.2 Explain basics of lithography / offset printing technology. TLO 2.3 State fundamentals of plate making for offset printing. TLO 2.4 Explain process of screen, letterpress and lithography printing technology.	**Unit - II Paste/Oil based Printing Technology** 2.1 Introduction to letterpress printing technology. 2.2 Introduction to lithography / offset printing technology. 2.3 Fundamentals of plate making for offset printing. 2.4 Introduction to screen printing technology. 2.5 Screen preparations methods for screen printing technology. 2.6 Ink requirements for letterpress, screen, and lithography printing.	Presentations Video Demonstrations Lecture Using Chalk-Board
3	TLO 3.1 Draw gravure cylinder making process. TLO 3.2 Explain gravure printing technology. TLO 3.3 Apply appropriate ink for gravure printing technology. TLO 3.4 Describe flexography printing technology.	**Unit - III Liquid Ink Printing Technology** 3.1 Introduction to gravure printing technology. 3.2 Gravure cylinder making process. 3.3 Basics of flexography printing technology. 3.4 Fundamentals of plate making for flexography printing technology. 3.5 Requirement of ink for gravure and flexography printing technology.	Presentations Video Demonstrations Lecture Using Chalk-Board
4	TLO 4.1 Describe digital printing technology TLO 4.2 Explain laser jet and ink jet printing technology TLO 4.3 Demonstrate 3D printing technology TLO 4.4 Describe various functional inks	**Unit - IV New Trends in Printing Technology** 4.1 Introduction to digital printing technology. 4.2 Laser jet and ink jet printing technology. 4.3 3D printing technology. 4.4 Functional inks (Conductive). 4.5 Smart printing inks (Thermochromic). 4.6 Security / Anti-Counterfeit Inks. 4.7 Introduction to glass printing / glass painting.	Presentations Video Demonstrations Lecture Using Chalk-Board

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 Explain water-based Inks - Properties and uses of water-based inks. TLO 5.2 Describe properties and applications of laserjet and inkjet inks. TLO 5.3 List advantages and applications of UV-curable inks. TLO 5.4 Differentiate Bio-Based, Biodegradable, Low-VOC and VOC-Free Inks.	**Unit - V Eco-Friendly Inks Technology** 5.1 Water-based Inks - properties and uses of water-based inks. 5.2 Laser jet powder ink - properties and applications of laserJet Inks. 5.3 Inkjet inks - properties and applications of inkjet inks. 5.4 UV-curable Inks - advantages and applications of UV-curable inks. 5.5 Bio-Based and Biodegradable Inks - Development and benefits of bio-based inks. 5.6 Low-VOC and VOC-Free Inks - Importance of low-VOC and VOC-free inks in reducing environmental impact.	Presentations Demonstration Lecture Using Chalk-Board

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Compare and contrast different printed samples (e.g., letterpress, offset, screen).	1	*Comparision and checking contrast difference in printed samples (e.g., letterpress, offset, screen).	4	CO1
LLO 2.1 Prepare ball pen base ink for writing pen.	2	Preparation of ball pen base ink for writing pen.	4	CO1
LLO 3.1 Use 3D printing machine for plastic and polymer surfaces.	3	*Perform 3D printing on plastic and polymer surfaces.	4	CO1
LLO 4.1 Prepare Liquid /Water base Ink compositions using natural materials.	4	Preparation of Liquid /Water base Ink compositions using natural materials.	4	CO1
LLO 5.1 Prepare solvent base Ink for Glitter effect sketch pen.	5	Preparation of solvent base Ink for Glitter effect sketch pen.	4	CO1
LLO 6.1 Use 3D printing for metal products.	6	Perform 3D printing on metal products.	4	CO1
LLO 7.1 Use offset printing machine.	7	Perform offset printing on offset printing machine.	4	CO2
LLO 8.1 Prepare a screen for printing and create a simple print with single color.	8	*Preparation of a screen for printing and create a simple print with single color.	4	CO2
LLO 9.1 Prepare a screen for printing and create a two color print with registration mark.	9	Preparation of a screen for printing and create a two color print with registration mark.	4	CO2
LLO 10.1 Test visual quality parameters of digital printing using laser and Inkjet printing on same paper.	10	*Testing of visual quality parameters of digital printing using laser and Inkjet printing on same paper.	4	CO2
LLO 11.1 Determine the effect of digital printing using laser and Inkjet printing on different papers.	11	Determination of effect of digital printing using laser and Inkjet printing on different papers.	4	CO2
LLO 12.1 Use flexographic plate and print a design.	12	*Perform prinitng using a flexographic plate.	4	CO3
LLO 13.1 Test visual quality parameters of printing gravure and flexography.	13	Testing of visual quality parameters of printing gravure and flexography.	4	CO3

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 14.1 Test visual quality parameters of printing using gravure and flexography printing on substrate.	14	*Testing of visual quality parameters of printing using gravure and flexography printing on substrate.	4	CO3
LLO 15.1 Use gravure cylinder for printing process.	15	Perform printing using gravure cylinder process.	4	CO3
LLO 16.1 Print a design using a digital printer and analyze the results.	16	Printing of a design using a digital printer and analyze the results.	4	CO4
LLO 17.1 Print the same design using both laser jet and inkjet printers and compare.	17	*Printing same design using both laser jet and inkjet printers and compare.	4	CO4
LLO 18.1 Prepare solvent base fluorescent Highlighter Ink for highlighter marker pen.	18	Preparation of solvent base fluorescent Highlighter Ink for highlighter marker pen.	4	CO5
LLO 19.1 Use thermochromic or conductive inks for printing process.	19	*Perform printing using thermochromic or conductive inks.	4	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Assignment

- Write a report on the history and evolution of letterpress printing. Include key milestones and technological advancements.
- Compare and contrast lithography and offset printing. Highlight their advantages and disadvantages.
- Write about the different types of plates used in offset printing. List their materials and applications.
- Explain the basic principles of screen printing. Include a step-by-step guide on how to set up a screen printing unit
- Write a detailed report on the various methods of screen preparation. Compare their effectiveness and suitability for different printing substrates.
- Study the different types of inks used in letterpress, screen, and lithography printing. List their properties and applications.
- Write an article on the latest trends in printing technology, such as eco-friendly printing, 3D printing, and digital printing advancements. Write how these trends are shaping the future of the printing industry.
- Explain how 3D printers work, the different types of 3D printing technologies, and their applications in various industries.
- Write a detailed report on the principles and applications of gravure printing technology. Include its history, key components, and advantages.
- Write about the different methods of cylinder making for gravure printing. List the materials used and the steps involved in the process.
- Study the types of inks used in gravure printing. Write a report on their properties, formulations, and applications.
- Study types of inks used in flexography printing. Write a report on their properties, formulations, and applications.
- Write about the different methods of plate making for flexography printing. Discuss the materials used and the steps involved in the process.
- Compare and contrast laser jet and ink jet printing technologies in terms of cost, quality, speed, and applications.
- Write an article on the properties and applications of conductive inks in modern electronics.
- Explore the science behind thermochromic inks and their potential applications in various fields.
- Analyze the importance of security inks in preventing counterfeiting and their impact on industries like currency printing and product packaging.

Term Work

- Prepare journal for laboratory work

Micro project

- Create a small letterpress print using basic tools. Document the process with photos and a brief description.
- Print a simple flyer or poster using offset printing techniques. Explain the steps involved in the process.
- Design and print a simple T-shirt or poster using screen printing. Document each step with photos and descriptions.
- Test the performance of different inks on various substrates. Document the results and provide a comparative analysis.
- Create a comparative chart that highlights the key features, advantages, and disadvantages of each printing method. Include examples of products that are best suited for each method.
- Develop a presentation that showcases the new trends in printing technology.
- Design and print a simple 3D object using a 3D printer. Document the entire process, from creating the digital model to the final printed object, and include photos and descriptions.
- Create a small gravure print using a simple engraved cylinder. Document the process with photos and a brief description.
- Test the performance of different gravure inks on various substrates. Document the results and provide a comparative analysis.
- Design and print a simple label or packaging using flexography techniques. Document the process with photos and descriptions.
- Test the performance of different flexography inks on various substrates. Document the results and provide a comparative analysis
- Design a security feature using anti-counterfeit inks for a hypothetical product. Explain how it works and its effectiveness
- Create a PowerPoint presentation explaining the basic principles of digital printing technology, including its applications in various industries.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Ink jet printer	10,11,16,17
2	Laser jet printer	10,11,16,17
3	Flexography printing setup	12,14
4	Gravure printing setup	15
5	Brookfield Viscometer	2,18,19
6	Sand Mill	2,4,5
7	Hegman Guage	2,4,5
8	Ball Mill/Jar Mill	2,4,5,18,19
9	Stirrer	2,4,5,18,19

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
10	Specific gravity cup	2,4,5,18,19
11	3D printing machine	3,6
12	Ford cup Viscometer	4,5,18,19
13	Offset printing machine	7
14	Screen printing setup	8,9
15	Weighing Balance	All
16	Spatula	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Fundamentals of Printing Technology	CO1	12	2	4	8	14
2	II	Paste/Oil based Printing Technology	CO2	12	2	4	8	14
3	III	Liquid Ink Printing Technology	CO3	12	2	4	8	14
4	IV	New Trends in Printing Technology	CO4	12	2	4	8	14
5	V	Eco-Friendly Inks Technology	CO5	12	2	4	8	14
Grand Total				**60**	**10**	**20**	**40**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Mid term tests
- Assignment, Self-learning and Terms work
- Seminar/Presentation

Summative Assessment (Assessment of Learning)

- Lab performance
- Viva-voce
- End of Term Examination

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	-	-	2	2	-	2			
CO2	3	2	2	2	2	-	2			
CO3	3	2	2	2	2	-	2			

CO4	3	1	2	-	1	-	2			
CO5	3	2	2	-	3	-	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Bob Thompson	Printing Materials Science and Technology	Pira lnternational Printing Guide ISBN1858029813,978185802981
2	L.C.Young	Materials in Printing Processes	Focal Library of Printing Technology ISBN:0240507568,9780240507569
3	R.H. Leach, Ray Pierce	The Printing Ink Manual	Springer ISBN:9789401170994,9789401170994
4	Nelson Richards Eldred	Chemistry for the Graphic Arts	GATF,USA ISBN:9780883622490
5	National Institute Of Industrial Research	The complete technology book on Printing Inks	Asia Pacific Business Press Inc. ISBN:8178330482
6	Surjeet Gupta	A guide to Printing Inks	Print India Journal, Delhi
7	Norman Underwood	The Chemistry and Technology of Printing Inks	University of Michigan Library
8	Alfred Seymour	Modern Printing Inks	Forgotten Books. ISBN: 0266596924 / 9780266596929
9	Ernest W. Flick	Printing Ink Formulations	Noyes Pubns. ISBN: ? 0815510144 / 9780815510147
10	Mander-Kidd Ltd	How Printing Ink is Made	Mander-Kidd Ltd Publications
11	The Print and Production Manual	Sean Smyth	Pira International Ltd, Randalls Road, Leatherhead, Surrey KT22 7RU, UK, 9th edition, ISBN: 185802238X ISBN:978-1858022383
12	NIIR Board	Screen Printing Technology Hand Book	Asia Pacific business press Inc. ISBN: 8178330539
13	Kipphan Helmut	Handbook of print media	Heidelberger Druckmaschinen AG, Heidelberg, April 2000ISBN-13: 978-3540335702
14	Ian Faux	Modern Lithography	Macdonad & Evans Plynont ISBN 10;0712113622
15	NIIR BOARD OF CONSULTANTS AND ENGINEERS	PAINTS, PIGMENTS, VARNISHES AND ENAMELS TECHNOLOGY HANDBOOK	ISBN-10 8178330377, ISBN-13 978-8178330372
16	Flexographic Technical Association	Flexography Principles and Practice	Flexographic Technical Association, NY ISBN - 978-0989437417
17	Crouch, J. Page	Flexography Primer	Graphic Art Technical Foundation, Pittsburgh, USA, Gatf Press (1998) ISBN 10: 0883622041 ISBN 13: 9780883622049

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=Fypi6dAJB8E	Ink Manufacturing
2	https://www.youtube.com/watch?v=ILg7TYt2ysc	Ink Factory
3	https://www.youtube.com/watch?v=zpcqOjopmk4	Raw Materials Mixup
4	https://www.youtube.com/watch?v=aA87xbiCNpA	Ink Adhesion
5	https://www.youtube.com/watch?v=VvHILU6BhRw	UV Ink Adhesion

Sr.No	Link / Portal	Description
6	https://www.youtube.com/watch?v=gTUTrv73erw	Ink Proofing Kit
7	https://www.youtube.com/watch?v=rTBtELJAItc&list=WL&index=8	Ink Viscosity Measurement
8	https://www.youtube.com/watch?v=F1tklxUiTPU&list=WL&index=	Pigment Dispersion
9	https://www.youtube.com/watch?v=HaMBk3uDZUs	Screen Printing: Choosing the proper mesh count
10	https://www.youtube.com/watch?v=wcO_EkxAeGI	Understanding Off-Contact Screen Printing
11	https://www.youtube.com/watch?v=WPgXGRuETv0	Flatbed screen printing machine
12	https://www.youtube.com/watch?v=5LMU-zB8Sro	Offset printing process introduction
13	https://www.youtube.com/watch?v=c4S51how-y4	Gravure printing process
14	https://www.youtube.com/watch?v=IDGJkAKFnGI	Plate making for offset
15	https://www.youtube.com/watch?v=9pocAG01M5s	Flexographic printing process

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

CHEMICAL TECHNOLOGY FOR PAINT INDUSTRIES **Course Code : 325329**

Programme Name/s : **Surface Coating Technology**
Programme Code : **SC**
Semester : **Fifth**
Course Title : **CHEMICAL TECHNOLOGY FOR PAINT INDUSTRIES**
Course Code : **325329**

I. RATIONALE

This course enables students to apply the basic concepts and principles of various equipment and unit operations. It also helps students to use various devices, and unit operations such as fluid flow, heat transfer, and filtration, drying, crushing and size separation in paint industries. Students will get hands-on experience to enhance skills of various systems and auxiliary equipment used in the paint industry.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Use of various devices and auxiliary equipment in the paint industry.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Use flow measuring devices.
- CO2 - Select relevant fluid handling devices for the paint industry.
- CO3 - Apply heat transfer principles in the paint industry.
- CO4 - Explain processes filter and dryer for the paint industry.
- CO5 - Select crusher and screens in the paint industry.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
325329	CHEMICAL TECHNOLOGY FOR PAINT INDUSTRIES	CTP	DSE	4	-	4	-	8	4	3	30	70	100	40	50	20	50#	20	-	-	200

Total IKS Hrs for Sem. : 0 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain Laminar and Turbulent flow with diagram. TLO 1.2 State Reynolds number. TLO 1.3 Draw schematic diagram for flow measurement devices. TLO 1.4 Explain construction and working of Orifice flow meter.	**Unit - I Fluid flow** 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. 1.5 Concept of Digital Flow Meter.	Lecture Input-cum-discussion Demonstration Assignment
2	TLO 2.1 Classify pumps and valves. TLO 2.2 Explain construction of pumps and valves. TLO 2.3 Describe working of pumps and valves. TLO 2.4 Sketch different valves used in paint industries.	**Unit - II Pumps and valves** 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.	Lecture Input-cum-discussion Presentation (PPTs) Demonstration
3	TLO 3.1 Classify distillation processes. TLO 3.2 Explain modes of heat transfer. TLO 3.3 Explain construction and working of different heat exchanger. TLO 3.4 Describe applications of distillations.	**Unit - III Heat transfer** 3.1 Principles of heat transfer modes. 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.	Input/ cum discussion Presentations Demonstration Presentations

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Classify various types of filters and dryers TLO 4.2 Explain construction and working of filters. TLO 4.3 Explain construction and working of rotary drum dryer. TLO 4.4 Write applications of filters and dryers.	**Unit - IV 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.	Lecture Using Chalk-Board Video Demonstrations Presentations
5	TLO 5.1 Classify size reduction equipment's. TLO 5.2 Explain mechanism and process of size reduction. TLO 5.3 Explain construction and working of crushers. TLO 5.4 Explain working of different types of sieving screens.	**Unit - V Size reduction** 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.	Video Demonstrations Presentations Lecture Using Chalk-Board

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Conduct survey of flow meters in paint industry.	1	Survey of flow meters in laboratory.	4	CO1
LLO 2.1 Analyze flow of fluid (Laminar or Turbulent) using visual observation.	2	Identify flow of fluid (Laminar or Turbulent) using visual observation.	4	CO1
LLO 3.1 Find rate of sedimentation in different density fluids.	3	*Compare rate of sedimentation in different density fluids.	4	CO1
LLO 4.1 Use of centrifugal pump for fluid flow.	4	*Check working mechanism of centrifugal pump.	4	CO2
LLO 5.1 Identify various components/parts of reciprocating pump.	5	Identify various components/parts of reciprocating pump.	4	CO2
LLO 6.1 Select a valve based on application criteria.	6	*Classify various valves based on given criteria.	4	CO2
LLO 7.1 Measure heat transfer rate of various metals rods.	7	Measure heat transfer rate of various metals rods.	4	CO3
LLO 8.1 Find convection mode of heat transfer.	8	*Evaluate convection mode of heat transfer.	4	CO3
LLO 9.1 Distill the solvent mixture.	9	Perform simple distillation for solvent separation.	4	CO3
LLO 10.1 Determine effect of temperature on viscosity using oils/resin/paint.	10	Determination of effect of temperature on viscosity using oils/resin/paint.	4	CO3
LLO 11.1 Calculate percentage volatile matter by using 'tray dryer'.	11	* Calculate percentage volatile matter by using 'tray dryer'.	4	CO4
LLO 12.1 Conduct filtration for separation of solid liquid mixture.	12	*Perform filtration for separation of solid liquid mixture.	4	CO4
LLO 13.1 Conduct vacuum filtration for separation of solid liquid mixture.	13	Conduct vacuum filtration for separation of solid liquid mixture.	4	CO4
LLO 14.1 Separate solid-liquid mixture in to components by centrifuge method.	14	Use centrifuge method for separation of solid-liquid mixture.	4	CO4

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 15.1 Calculate percentage of oversize and undersize particles by using sieve analysis method.	15	*Determine percentage of oversize and undersize particles by using sieve analysis method.	4	CO5
LLO 16.1 Reduce and separate the particle size by mechanical mechanism.	16	Apply Impact mechanism for reducing the particle size of material and check particle size.	4	CO5
LLO 17.1 Use ball mill for dry powder synthesis.	17	Use ball mill for dry powder synthesis.	4	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- 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 advanced/digital flow measuring devices.
- b. Prepare a report on calibration techniques of flow measuring devices.
- c. Prepare an album on various valves used in the paint industry.
- d. Collect information on various pumps.
- e. Collect information on various heat exchangers used in the paint industry.
- f. Prepare a report on various distillation methods.
- g. Collect information on the 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 like Dryers, filters, Heat exchangers, screens, size reduction equipment etc.
- k. Collect information on advanced size reduction equipment.
- l. Collect information on advanced size separation techniques.

Assignment

- Prepare an album for flow measuring devices.
- Search various heat exchanger manufacturer in India and prepare a report
- Write advanced techniques in filtration and drying.
- Visit pump manufacturing industry and draw flow diagram for manufacturing plant.

Term work

- Prepare a journal consisting: a. List of laboratory experiences given. b. For each practical perform write (Scope, chemicals, instruments, process, observations, diagram, calculations and result etc.) c. Arrange (b) chronologically (date wise) d. Prepare report for submission

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Venture meter	1
2	Rotameter	1
3	Orifice meter	1
4	Red wood viscometer	10
5	Oven-250 degree	11
6	Simple filtration setup	12
7	Vacuum pump	13
8	Centrifuge machine	14
9	Grizzlies screen	15
10	Sieves	15
11	Hammer	16
12	Ball mill	16,17
13	Transparent 0.5-inch piper 2 feet.	2
14	Beaker-500 ml	2,3,10
15	Measuring cylinder-1000 ml	3
16	Centrifugal pump setup	4
17	Reciprocating pumps setup	4
18	Gate valve	6
19	Globe valve	6
20	Needle valve	6
21	Non return valve	6
22	Al, Fe, Copper, Brass Rod	7
23	Heating mantle	8,9
24	Distillation flask	9
25	Weight balance	All
26	Spatula	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Fluid flow	CO1	12	2	4	8	14

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
2	II	Pumps and valves	CO2	12	2	4	8	14
3	III	Heat transfer	CO3	12	2	4	8	14
4	IV	Filtration and Drying	CO4	12	2	4	8	14
5	V	Size reduction	CO5	12	2	4	8	14
Grand Total				**60**	**10**	**20**	**40**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Seminar/Presentation
- Mid-term tests
- Assignment, Self-learning and Terms work

Summative Assessment (Assessment of Learning)

- End of Term Examination
- Viva-voce
- Lab. Performance

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	2	2	1	2	2	2	2			
CO2	2	2	1	2	1	2	2			
CO3	2	2	1	2	1	2	2			
CO4	2	2	1	2	2	2	2			
CO5	2	2	1	2	2	2	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

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

Sr.No	Author	Title	Publisher with ISBN Number
5	Alan J. Chapman	Heat Transfer	PEARSON INDIA ISBN : 9332575061
6	Erich Krell	Handbook of Laboratory Distillation	Elsevier Science ISBN : 0444556400
7	C.L.Prasher	Crushing and Grinding Process Handbook	Wiley ISBN : 047110535X
8	Brian Nesbitt	Handbook of Pumps and Pumping	Elsevier Science -0080549217
9	Brian Nesbitt	Handbook of Valves and Actuators	Elsevier Science-0080549284
10	Trevor Sparks, George Chase	Filters and Filtration Handbook	Butterworth-Heinemann Ltd-978-0080993966

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=wlPXZrP9vR8	Introduction to flow of fluid
2	https://www.youtube.com/watch?v=gByrUkZUnKo	Flow measurement
3	https://www.youtube.com/watch?v=oINBqDpvSIc	Venturimeter & derive equation of discharge
4	https://www.youtube.com/watch?v=1wNmtle6qkE	Reynolds Number - Laminar and Turbulent Flow
5	https://www.youtube.com/watch?v=JrjTRKBtYgw	Types of Fluid Flow | Fluid Mechanics & Machineries
6	vhttps://www.youtube.com/watch?v=wsm5zzsBI4s	Pumps Types
7	vhttps://www.youtube.com/watch?v=XxAhrF7KZuE	Types of valves used in pumping
8	https://www.youtube.com/watch?v=HxpzoDJeYwI	Centrifugal pump construction and working
9	https://www.youtube.com/watch?v=_5AZwrTkQNA	Introduction to heat
10	https://www.youtube.com/watch?v=OdwrxKRSjEU	Modes of heat transfer
11	https://www.youtube.com/watch?v=OyQ3SaU4KKU	Shell and tube heat exchanger
12	https://www.youtube.com/watch?v=QXy_Cn6KIPs	Distillation process
13	https://www.youtube.com/watch?v=par3tAK7VLg	Fraction distillation
14	https://www.youtube.com/watch?v=Fh9Bkzr2-5A	Vacuum distillation
15	https://www.youtube.com/watch?v=wRB_6qbYmiQ	Drying
16	https://www.youtube.com/watch?v=1XeTr5NLNTc	Filtration
17	https://www.youtube.com/watch?v=KD7gxIclilQ	Filtration equipment
18	https://www.youtube.com/watch?v=uOv5PFy4s2c	Tray dryer, Rotary dryer
19	https://www.youtube.com/watch?v=1Zcp2cbbvvE	Mixing
20	https://www.youtube.com/watch?v=gG3QvzCqw6M	Size reduction mill
21	https://www.youtube.com/watch?v=vrvXDpmpVHY	Size reduction

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

COLORANT TECHNOLOGY **Course Code : 325330**

Programme Name/s : **Surface Coating Technology**
Programme Code : **SC**
Semester : **Fifth**
Course Title : **COLORANT TECHNOLOGY**
Course Code : **325330**

I. RATIONALE

This course enables students to apply principles and practices of different colorants and processes in surface coating industry. This course helps students to understand manufacturing, testing and uses of colorants in surface coating industry. Also, the students will be able to do characterization of colorants, shades and shade matching for application of colorants in surface coating industry.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Apply principles and practices of different colorant and process in surface coating industry.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Explain the importance of colorants.
- CO2 - Formulate universal colorants.
- CO3 - Test colorants as per requirements.
- CO4 - Explain applications of colorants.
- CO5 - Describe process for shade matching.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
325330	COLORANT TECHNOLOGY	COT	DSC	4	-	4	-	8	4	3	30	70	100	40	50	20	50#	20	-	-	200

Total IKS Hrs for Sem. : 2 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Describe concept of colorants. TLO 1.2 Write history for colorants in India. TLO 1.3 Classify types of colorants. TLO 1.4 Explain concept of universal colorants.	**Unit - I Introduction to colorants** 1.1 Concept of colorants. 1.2 History for colorants in India (IKS). 1.3 Types of colorants. 1.4 Significance of colorants. 1.5 Concept of universal colorants.	Lecture Using Chalk-Board Presentations Case Study
2	TLO 2.1 Select raw materials for colorants. TLO 2.2 Write formulation for colorants. TLO 2.3 Draw machines used for colorants manufacturing. TLO 2.4 Draw process flowchart for colorants.	**Unit - II Manufacturing of colorants** 2.1 Raw materials for colorants. 2.2 Formulating principle for colorants. 2.3 Machines for colorants manufacturing. 2.4 Process flowchart for colorants.	Presentations Demonstration Lecture Using Chalk-Board Case Study
3	TLO 3.1 Explain significance of colorant testing. TLO 3.2 Write test procedure for percentage nonvolatile matter. TLO 3.3 Classify various testing for colorants.	**Unit - III Testing of colorants** 3.1 Significance of Testing. 3.2 Extent of dispersion. 3.3 Color strength. 3.4 Compatibility with different bases. 3.5 Percentage solids / NVM. 3.6 Stability in different bases. 3.7 Long term durability.	Video Demonstrations Case Study Presentations Lecture Using Chalk-Board
4	TLO 4.1 Write application areas for colorants. TLO 4.2 Explain the concept of food grade colorant. TLO 4.3 Describe application process for textile printing.	**Unit - IV Application of colorants** 4.1 Application for colorants in interior and exterior paint applications. 4.2 Application of colorants for solvent base coating. 4.3 Application of colorants for plastic processing-Master batch. 4.4 Application of colorants for textile printing. 4.5 Food grade colorants (FDA approval).	Presentations Video Demonstrations Lecture Using Chalk-Board Case Study
5	TLO 5.1 Explain concept of colour and colour matching. TLO 5.2 Describe working of automatic shade matching machine. TLO 5.3 Write concept of colour matching cabinet.	**Unit - V Characterization of color, shade and shade matching** 5.1 Concept of color and color matching. 5.2 Concept of shade and shade matching machine. 5.3 Concept and type of shade cards. 5.4 Automatic shade matching machine at paint outlets. 5.5 Colour matching cabinet.	Presentations Lecture Using Chalk-Board Video Demonstrations

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Apply compatibility of colorant with different bases.	1	Testing of compatibility of colorant with different bases.	4	CO1

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 2.1 Determine compatibility of universal colorant.	2	*Test the compatibility of universal colorant.	4	CO1
LLO 3.1 Apply water base colorant.	3	*Formulate water base colorant.	4	CO2
LLO 4.1 Evaluate properties of water base colorant.	4	*Measure properties of water base colorant.	4	CO2
LLO 5.1 Apply universal colorant.	5	Formulate universal colorant.	4	CO2
LLO 6.1 Evaluate properties of universal colorant.	6	Determine properties of universal colorant.	4	CO2
LLO 7.1 Test extent of dispersion.	7	*Measure extent of dispersion of colorants.	4	CO3
LLO 8.1 Evaluate strength of colorants.	8	*Measure strength of colorants.	4	CO3
LLO 9.1 Determine percentage Nonvolatile matter.	9	Calculate percentage Nonvolatile matter.	4	CO3
LLO 10.1 Evaluate stability of colorants.	10	*Test stability of colorants.	4	CO4
LLO 11.1 Apply shade for water base exterior application.	11	Prepare shade for water base exterior application.	4	CO4
LLO 12.1 Apply a shade for solvent based coatings.	12	*Prepare a shade for solvent based coatings.	4	CO4
LLO 13.1 Apply a shade as per master.	13	Prepare a shade as per master.	4	CO5
LLO 14.1 Use analysis of survey of various shade card.	14	Conduct survey of various shade card.	4	CO5
LLO 15.1 Apply working principle of colour matching machine.	15	*Use of colour matching machine for shade matching of given colorant sample.	4	CO5
LLO 16.1 Use of colorant for textile printing.	16	Testing of colorant for textile printing.	4	CO5
LLO 17.1 Apply colorant for leather printing.	17	Testing of colorant for leather printing.	4	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Term work

- Prepare a journal consisting: a. List of laboratory experiences given. b. For each practical perform write (Scope,chemicals, instruments, process, observations, diagram, calculations and result etc.) c. Arrange (b) chronologically(date wise) d. Prepare report for submission

Micro project

- Micro project- I: colorants a. Search colorants manufacturing methods / practices /procedure in the industry/ field. b.Write details procedure of method with flow diagram and control plan. c. Describe various equipment's, raw materials,d. Prepare report (10-15 pages) with enclosures of photograph and references.
- Micro project- II: Colorants application a- Search colorant application methods / practices /procedure in the industry/ field. b.Write details procedure of method with flow diagram and control plan. c. Describe various equipment's, raw materials,d. Prepare report (10-15 pages) with enclosures of photograph and references.

Assignment

- a Prepare an album on different shade cards
- b. Search various colorant manufacturer in India and prepare a report.
- c. Visit colorant dispersing unit shop / lab / industry and prepare technical report

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Brushes	1,3,5,11,12,13,15,17
2	Mechanical stirrer	1,3,5,11,12,13,15,17
3	Spray booth assembly	1,3,5,11,12,13,15,17
4	Gloss-O-meter	1,3,5,11,12,13,15,17
5	Block Applicator	1,3,5,11,12,13,15,17
6	Measuring cylinder	10
7	Color dispersing machine	14,15
8	Screen	16
9	Squeeze	16,17
10	Bar Applicator	17
11	Sand Mill	3,5,11,12,13
12	Ball Mill	3,5,11,12,13
13	Dyno Mill	3,5,11,12,13
14	Oven	9,16,17
15	Spatula	All
16	Beaker (250 ml, 500ml)	All
17	MS panels	All
18	Sand Paper (80, 120, 320)	All
19	Weighing Balance	All
20	Thermometer 100 – 360 degree	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to colorants	CO1	12	2	4	8	14
2	II	Manufacturing of colorants	CO2	12	2	4	8	14
3	III	Testing of colorants	CO3	12	2	4	8	14
4	IV	Application of colorants	CO4	12	2	4	8	14

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
5	V	Characterization of color, shade and shade matching	CO5	12	2	4	8	14
Grand Total				**60**	**10**	**20**	**40**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Seminar/Presentation
- Mid-term tests
- Assignment, Self-learning and Terms work

Summative Assessment (Assessment of Learning)

- End of Term Examination
- Viva-voce
- Lab. performance

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	1	-	-	-	-	2			
CO2	3	2	2	2	2	2	2			
CO3	3	2	2	2	2	2	2			
CO4	3	-	-	-	2	-	2			
CO5	3	-	-	-	2	-	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	W. M. Morgan	Outlines of Paint Technology (3rd Edition)	CBS Publishers & Distributors Pvt. Ltd, 2000 ISBN: 9788123904306
2	Publisher : De Gruyter (27 April 2023)	Handbook of Colorants Chemistry: Dyes and Pigments Fundamentals	ISBN-10 : 3110776995 ISBN-13 : 978-3110776997
3	V.C. Malshe and Meenal Sikchi	Basics of Paints Technology (Part II) (1st Edition)	Antar Prakash Centre for Yoga, India, 2004 ISBN: 9788190329842
4	Felix Konstandt	Organic Coatings: Properties and Evaluation	Chemical Publishing Co, New York ISBN: 0820603066

Sr.No	Author	Title	Publisher with ISBN Number
5	Guy E. Weismantel	Paint Handbook	McGraw-Hill publication ISBN: 0070690618
6	Gardner Henry and George Sward	Paint Testing Manual Physical and Chemical Examination (13th Edition)	American Society for Testing and Materials, 1972
7	Dwight G. Weldon	Failure Analysis of Paints and Coatings	A John Wiley & Sons, Ltd., Publication ISBN: 978047069753-5
8	Thomas Bechtold, ,Avinash P. Manian	Handbook of Natural Colorants, 2nd Edition	(Wiley Series in Renewable Resource) Hardcover – Import, 6 April 2023 Wiley-Blackwell; 2nd edition (6 April 2023) ISBN-10 : 1119811716 ISBN-13 : 978-1119811718

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://lanxess.com/en/media/press-releases/2022/06/sustainable-colorants-for-the-plastics-industry	Sustainable colorants for the plastics industry
2	https://www.youtube.com/watch?v=79bckRYMmUQ	Elementary Concept of Color and Colorants (Chromophore, Chromogen, Auxochrome)
3	https://www.youtube.com/watch?v=s1x19d32LqU	Asian Organic Colorants
4	https://www.youtube.com/watch?v=YeI6Wqn4I78	Color Theory Basics
5	https://www.youtube.com/watch?v=6l8NI97hT-4	History for colorants in India
6	https://www.youtube.com/watch?v=YgcikCbEf0g	Machines for colorants
7	https://www.youtube.com/watch?v=zz9sPnqPrLA	Color strength.
8	https://www.youtube.com/watch?v=HsnOqqb3jtQ	Color strength.
9	https://www.youtube.com/watch?v=JmmysW-R8us	Application for colorants
10	https://www.youtube.com/watch?v=6DpyqbL5eo4	Application for colorants for plastic
11	https://www.youtube.com/watch?v=OIwhQtnnIOk	Universal acrylic colorant
12	https://www.youtube.com/watch?v=L1CK9bE3H_s	Colour theory
13	https://www.youtube.com/watch?v=iF1chlZKQDw	Colour mixing
14	https://www.youtube.com/watch?v=Is_xE129rEQ	Colour dispensing machine
15	https://onlinecourses.swayam2.ac.in/nos24_sc13/preview	Painting technology

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students