DEPARTMENT OF TECHNICAL EDUCATION (DIPLOMA SECTOR)
UTTAR PRADESH

CURRICULUM FOR DIPLOMA PROGRAMME
IN
PAINT TECHNOLOGY
(5th to 6th Semester)

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Semester System

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(EFFECTIVE FROM YEAR 2026-27)

Prepared By:

INSTITUTE OF RESEARCH, DEVELOPMENT & TRAINING, U.P., KANPUR

UPDATED AND APPROVED BY BOARD OF TECHNICAL EDUCATION U.P. LUCKNOW IN C.D.C MEETING HELD ON 16.07.2026

CONTENTS

FIFTH SEMESTER

UPDATED AND APPROVED BY BOARD OF TECHNICAL EDUCATION U.P. LUCKNOW IN C.D.C MEETING HELD ON 16.07.2026

1. SALIENT FEATURES

1)	Name of the Programme	:	Diploma Programme in Paint Technology
2)	Duration of the Programme	:	Three years (Six Semesters)
3)	Entry Qualification	:	Matriculation or equivalent NEP-2020/NSQF Level-4 as Prescribed by State Board of Technical Education, U.P.
4)	Pattern of the Programme	:	Semester Pattern
5)	NSQF Level	:	Level - 5
6)	Ratio between Theory and Practical	:	40: 60 (Approx.)

7) **Industrial Training**

Four and six weeks of industrial training is made mandatory after the II and IV semesters during summer vacation.Total marks allotted to industrial training will be respectively 50 & 100.

In the last (6^{th} Semester) we have made the one semester Industrial training/Internship as optional along with usual classroom training.

8) **Ecology and Environment**

As per Govt. of India directives a subject on Environmental Science has been incorporated in the curriculum.

9) **Entrepreneurship and Start-ups**

A full subject Entrepreneurship & Start-ups has been incorporated in the curriculum.

10) **Student Centred Activities**

A provision of 2-4 hrs per week has been made for organizing Student Centered Activities for overall personality development of students. Such activities will comprise of co–curricular activities such as expert lectures, self-study, games, hobby classes like photography, painting, singing etc. seminars, declamation contests, educational field visits, NCC, NSS, library and other cultural activities.

11) **Project work**

A project work has been included in the curriculum to enable the student get familiarize with the practices and procedures being followed in the industries and provide an opportunity to work on some live projects in the industry.

2- PROGRAM OUTCOMES (POs)

PO1: Basics and Discipline specific Knowledge
Assimilate knowledge of basic mathematics, science, engineering fundamentals.

PO2: Problem's Analysis and solution
Identify, analyse and solve problems using standard methods and established techniques.

PO3: Design and Development
Design solutions for technical problems.
Assist in designing components, systems, or processes to meet specific requirements.

PO4: Engineering Tools, Experimentation, and Testing
Use modern engineering tools and appropriate techniques to conduct experiments as per BIS standard.

PO5: Socio/ Economic /Environmental impact assessment/remedy.

Apply relevant technologies while considering societal needs, environmental impact keeping in view sustainable and ethical responsibilities.

PO6: Project Management and Communication
Apply engineering management principles, work effectively as an individual or in a team, and communicate clearly on activities.

PO7: Lifelong Learning
Recognize the importance of continuous learning and actively pursue self-improvement to keep pace with technological developments.

STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN PAINT TECHNOLOGY

FIFTH SEMESTER

SR. NO.	SUBJECTS	COURSE TYPE & CATEGORY	STUDY SCHEME PERIODS/WEEK			CREDIT	MARKS IN EVALUATION SCHEME								TOTAL MARKS OF INTERNAL & EXTERNAL
							INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
			L	T	P		TH	PR	TOT	TH	HRS	PR	HRS	TOT	
5.1	PROCESS CONTROL AND INSTRUMENTATION	PROGRAM CORE (THEORY)	2	-	-	2	40	-	40	60	3	-	-	60	100
5.2	PROCESS CONTROL AND INSTRUMENTATION (Lab)	PROGRAM CORE (Practical))	-	-	4	2	-	60	60	-	-	40	3	40	100
5.3	Coating Properties, Evaluation, Quality Control	Program Core (Theory)	3	-	-	3+0=3	40	-	**40**	60	3	-	-	**60**	**100**
5.4	Coating Properties, Evaluation, Quality Control	Program Core (Practical)	-	-	4	0+2=2	-	60	**60**	-	-	40	3	**40**	**100**
5.5	Program Elective-3	Program Core (Theory)	3	-	-	3+0=3	40	-	**40**	60	3	-	-	**60**	**100**
5.6	Program Elective-4	Program Core (Practicum)	2	-	4	2+2=3	40	-	**40**	60	3	-	-	**60**	**100**
5.7	(Q) Open Elective-2 OR	Open Elective	2	-	-	02	-	-	**50***	-	-	-	-	**-**	**NA**
	*Advance Skill Development	Certification Course					-	-	**-**	-	-	-	-	**-**	**NA**
5.8	**Summer Internship-II (4-6 Weeks)	Summer Training	-	-	-	02	-	60	**60**	-	-	40	3	**40**	**100**
5.9	(Q) Indian Constitution	Audit Course	2	-	-	-	50*	-	**50***	-	-	-	-	**-**	**NA**
# Student Centered Activities			-	-	10	-	-	50	**50**	-	-	-	-	**-**	**50**
Total			**14**	**-**	**22**	**20**	**160**	**230**	**390**	**240**	**-**	**120**	**-**	**360**	**750**

NOTE:-**(Q)** It is compulsory to appear and to pass the examination, but marks will not be included for percentage and division of obtained marks.

* Advance skill development mention at **5.7** in the table provide the scope of selecting the course as per choice from the elective list provided in the syllabus conducted by various agency of repute of duration not less than 20 Hrs (Offline/Online).

** Students will present a seminar on their summer internship along with certificate, project and report.

Student Centered Activities will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. Photography etc., Seminars, Declamation Contests, voluntary contribution in physical activities, Educational Field Visits, NCC, NSS, Cultural Activities and Self-Study. The periods allotted to SCA can also be utilized to complete the syllabus for other subjects.

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STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN PAINT TECHNOLOGY

SIXTH SEMESTER

NORMAL PATHWAY

SR. NO.	SUBJECTS	COURSE TYPE & CATEGORY	STUDY SCHEME PERIODS/WEEK			CREDIT	MARKS IN EVALUATION SCHEME								TOTAL MARKS OF INTERNAL & EXTERNAL
							INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
			L	T	P		TH	PR	TOT	TH	HRS	PR	HRS	TOT	
6.1	Architecture and Industrial Coating	Program Core (Practicum)	3	-	2	3+1=4	40	-	**40**	60	3	-	-	**60**	**100**
6.2	Entrepreneurship And Start-Up	Program Core (Theory)	2	-	-	2+0=2	40	-	40	60	3	-	-	60	**100**
6.3	In-House Project	Project	4	-	16	12	-	240	240	-	-	160	-	160	**400**
6.4	(Q) Open elective-3 OR	Open elective (Theory)	2	-	-	2	-	-	50*	-	-	-	-	-	**NA**
	*Advance Skill Certification	(Certification course)					-	-	-	-	-	-	-	-	**NA**
#Student Centered Activities			-	-	6	-	-	50	50	-	-	-	-	-	**50**
TOTAL			**11**	**-**	**24**	**20**	**80**	**290**	**370**	**120**	**-**	**160**	**-**	**280**	**650**

(Q) It is compulsory Q appear and to pass the examination but marks will not be included of percentage and division of obtain marks.

*Advance skill development mentioned at 6.4 in the table provides the scope of selecting the course as per choice form the elective list provided in the syllabus conducted by various agencies of repute of duration not less than 20 hrs.

Student Centered Activities will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. Photography etc., Seminars, Declamation Contests, voluntary contribution in physical activities, Educational Field Visits, NCC, NSS, Cultural Activities and Self-Study. The periods allotted to SCA can also be utilized to complete the syllabus for other subjects.

Above scheme can be customized as per the specific requirements of the respective course

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OR

6th SEMESTER

INDUSTRIAL PATHWAY

Sr. No.	SUBJECTS	Category & Course Type	STUDY SCHEME Periods/Week			Credits(C) (L+T)+P=C	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External	Assessment
							INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT						
			L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot		
6.1	Entrepreneurship and Start-ups (ONLINE Mode)	Humanities & Social Science (Theory)	-	-	-	2	-	-	-	100	03	-	-	100	100	Theory
6.2	Industrial Hands On Practice	Industrial Training	-	-	-	12	150*			200**					350	
6.3	Industrial Project	Industrial Training	-	-	-	4	50*			50**					100	
6.4	# Seminar	In House	-	-	-	2	-	100	100	-	-	-	-	-	100	
Total			-	-	-	**20**	-							-	**650**	

NOTE:

1. The Industrial training tenure should not be less than 14 Weeks.
2. Industry must be registered with MSME / Directorate of industries/Limited Organization/ State/Central Government establishments.
3. Monthly progress reports of Intern/ Trainee should be attested and forwarded by industrial supervisor (allotted to Intern/Trainee) during industrial Internship/Training.
4. The Industrial unit/organisation must evaluate students using the format provided by polytechnic in the form of marks.
5. The Industrial Hands on Practice, Industrial Project and seminar must be evaluated on the basis of the AICTE Internship Policy: Guidelines and procedures (Chapter -9 Procedures / format for organizing internship)
6. **"Entrepreneurship and Start-up"** course is also mandatory in Industrial internship/training mode. It will be conducted online mode by his/her polytechnic institute. After completing the online course, students must appear for exam conducted by the Board of Technical Education, Lucknow.

7. ***Evaluation by faculty mentor**
   The institute will depute one faculty member for mentoring at least 20-30 students undertaking apprenticeship training. Such mentors will monitor, guide and provide counselling to the students as and when required. Faculty mentor of the institute(s) may make a surprise visit to the internship/apprenticeship site to check the student's presence physically. (The Proforma of the evaluation is attached as the Annexure -1)

8. ** **Evaluation by industry** : The industry shall assess the candidates based on the following parameters attendance, discipline and punctuality, familiarity of tools and material, engineering skills, application of knowledge and problem-solving skills, comprehension and observation, professional ethics, safety and environmental consciousness, communication skills, supervisory skills and general conduct during the period (The Proforma of the evaluation is attached as the Annexure -2)

9. **# Evaluation through seminar presentation/Viva-Voce at the institute :** The student will give a seminar based on his training report, before an expert committee constituted by the concerned department as per norms of the institute. The evaluation will be based on the following criteria .

PROGRAM ELECTIVE-3

SR. NO.	SUBJECT NAME
POE 3.1	Printing Ink & Packaging Technology
POE 3.2	Modern Separation Technique

PROGRAM ELECTIVE-4

SR. NO.	SUBJECT NAME
POE 4.1	Pollution Control and Industrial Safety
POE 4.2	Safety In Chemical Process Industry

OPEN ELECTIVE-2

SR. NO.	Q THEORY COURSES NAME
OE 2.1	ENERGY CONSERVATION AND AUDITS
OE 2.2	INDUSTRIAL AUTOMATION AND MES
OE 2.3	**CERTIFICATION COURSE**
1	Courses conducted by center of excellence (established by 3rd party as –TATA TECHNOLOGIES etc.)
2	Courses conducted by INFOSYS PRINGBOARD
3	Courses conducted by TCS ION
4	Courses conducted by other relevant Government ,International/national organization or platforms of repute
5	Courses conducted by AICTE-ELIS and Centrally funded technical institutes
6	Courses conducted by C-DAC
7	Courses conducted by NEILIT

LIST OF COURSES CONDUCTED BY TATA TECHNOLOGIES (OPEN ELECTIVE)

1. Fundamentals of Innovation and Design Thinking
2. Product Design and Development
3. Product Verification and Analysis
4. Advanced Automobile
5. Electric Vehicle
6. Internet of Things
7. Advanced Manufacturing
8. Advanced Welding & Painting using Simulator
9. Industrial Robotics
10. Inspection and Quality Control
11. Advanced Plumbing
12. AI and ML

OPEN ELECTIVE-3

SR. NO.	Q THEORY COURSES NAME
OE 3.1	ECONOMIC POLICIES IN INDIA
OE 3.2	PROJECT MANAGERMENT
OE 3.3	**CERTIFICATION COURSE**
1	Courses conducted by center of excellence (established by 3rd party as –TATA TECHNOLOGIES etc.)
2	Courses conducted by INFOSYS PRINGBOARD
3	Courses conducted by TCS ION
4	Courses conducted by other relevant Government ,International/national organization or platforms of repute
5	Courses conducted by AICTE-ELIS and Centrally funded technical institutes
6	Courses conducted by C-DAC
7	Courses conducted by NEILIT

DETAILED CONTENTS OF VARIOUS SUBJECTS

THEORY	5.1 PROCESS CONTROL AND INSTRUMENTATION	L	T	P
		2	-	-

COURSE OBJECTIVES

- To provide knowledge of industrial instrumentation for measurement of process variables.
- To develop understanding of automatic control systems used in chemical industries.
- To study dynamic behavior of first and second order processes.
- To familiarize students with controllers, control valves, PLC and DCS systems.
- To enable students to analyze and implement closed loop control systems.

COURSE OUTCOMES (CO)

After successful completion of this course, the students will be able to:

CO1: Measure temperature, pressure, level, and flow using appropriate industrial instrumentation.
CO2: Explain the components and significance of automatic control systems and process dynamics.
CO3: Analyze the dynamic behavior of first-order and second-order process systems.
CO4: Apply different modes of control action and develop block diagrams for closed-loop control systems.
CO5: Explain the basic concepts and applications of PLC and DCS in process control systems.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

Course Outcomes (COs)	PO1 Basics & Discipline Knowledge	PO2 Problem Analysis	PO3 Design & Development	PO4 Tools, Experimentation & Testing	PO5 Socio-Economic/ Environmental	PO6 Project Mgmt & Communication	PO7 Lifelong Learning	PSO1	PSO2
CO1	3	1	1	3	1	–	3	*	*
CO2	3	2	1	2	1	1	2	*	*
CO3	2	3	–	2	–	1	1	*	*
CO4	2	2	2	3	1	1	1	*	*
CO5	2	1	–	2	1	1	1	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)
* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

COURSE CONTENTS

Unit-1: Instrumentation (06 Periods)

1. Temperature : Types of Temperature measuring instruments, Bimetallic Thermometer , Thermocouples, RTD , Temperature Transmitter.
2. Pressure: Types of Pressure measuring instruments, Bourdon Tube gauge, U Tube Manometer, Diaphragm pressure sensor, Pressure Transmitter.
3. Level measurement: Types of Level measuring instruments, Float type Level measuring instrument, Ultrasonic Level measuring instrument, Differential Pressure Type Level measuring instrument, level transmitter.
4. Flow rate: Types of Flow rate measuring instruments, Mass flow meter

Experiments:

1. Measurement of Temperature by Thermocouple module.
2. Measurement of Temperature by of RTD module.
3. Level measurement by using Differential Pressure (DP) Transmitter.
4. Measurement of Pressure by Bourdon Pressure Transducer.

Unit-2: Introduction: Process Dynamics (06 Periods)

Automatic control system and its significance; Manual v/s Automatic control, Physical and block diagrams of stirred tank heater system.

Elements of control System: Controller, Measuring instrument, Final control elements, Transmitter, Transducers.

Process Characteristics: Process variables, Laplace transformation, Forcing functions: step, ramp, impulse and sinusoidal function.

Unit-3: Elements of Process Dynamics (08 Periods)

1. Ist order system - Examples of 1st order system: Naked bulb thermometer and its derivation; Stirred tank heater; Mixing process; Liquid levels (derivation excluded).
2. IInd order system- Examples of 2nd order system: Non-Interacting and Interacting system (concept only). Transfer function of 2nd order system (derivation excluded); Terms used in Underdamped system: Decay ratio, Overshoot, Response time and Rise time.

Experiments:

1. Study of characteristics of control valve (Linear, Equal% and Quick opening).
2. Study the linearity of P/I and I/P converter (Transducers).
3. Study of P, PI, PD and PID controller using Pressure controller Trainer kit by monitoring the process in SCADA mode or Analog mode
4. To study the response of two tank in non-interacting liquid level system.
5. To study the response of two tank in interacting liquid level system.

Unit-4: Controller Characteristic or Modes of Control Action

(06 Periods)

Standard block diagram symbol, overall transfer function for a single loop system, Negative and positive feedback system, servo and regulatory problem, Final control elements: control valve mechanism, Elements of controller, Type of controllers: proportional control, Two positions/ON-OFF control, integral control, proportional-integral control, proportional derivative control, proportional-integral-derivative control their comparison.

Experiments:

1. To study on-off controller for temperature control.
2. To calibrate pressure gauge with the help of dead weight pressure gauge

Unit-5: Introduction to Programmable Logic Controller (PLC) and Distributed Control System (DCS)

(02 Periods)

INSTRUCTIONAL STRATEGY

The subject gives the knowledge of various process, instruments and controls to measure process parameters. So the theoretical knowledge of this subject should be properly imparted to the students with the help of practical examples. Each topic should be supplemented with examples.

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MEANS OF ASSESSMENT

- Class Test
- Home Assignment
- Sessional Test
- Practical work

RECOMMENDED BOOKS

1. Industrial Instrumentation by Donald P. Eckman, Wiley Eastern Publications.
2. Process System Analysis and Control by Coughanowr and Steven LeBlanc, McGraw Hill publications.
3. Industrial Instrumentation by SK Singh, Tata McGraw Hill Publications.
4. Principles of Industrial Instrumentation by D. Patranabis; Tata McGraw Hill Company
5. Chemical Process Control: An Introduction to Theory BY George Stephanopoulos

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted(%)
1	6	25
2	6	25
3	8	25
4	6	20
5	2	5
Total	28	100

PRACTICAL	5.2 PROCESS CONTROL AND INSTRUMENTATION (Lab)	L	T	P
		-	-	4

COURSE OBJECTIVE

The objective of this course is to develop practical skills in the measurement, calibration and control of process variables using industrial instruments and control systems. The course also enables students to study process dynamics and controller performance used in process industries.

COURSE OUTCOMES (COs)

CO1: Measure temperature and calibrate process instruments using standard industrial methods.

CO2: Measure and interpret pressure and level parameters using industrial measuring instruments.

CO3: Analyze the performance characteristics of control valves and signal converters used in process control systems.

CO4: Evaluate the dynamic behavior of interacting and non-interacting process systems.

CO5: Operate and compare different controller modes for effective process control.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

Course Outcomes (COs)	PO1 Basics & Discipline Knowledge	PO2 Problem Analysis	PO3 Design & Development	PO4 Tools, Experimentation & Testing	PO5 Socio-Economic/ Environmental	PO6 Project Mgmt & Communication	PO7 Lifelong Learning	PSO1	PSO2
CO1	3	2	-	2	2	-	-	*	*
CO2	3	3	-	2	2	-	-	*	*
CO3	3	3	2	2	3	-	-	*	*
CO4	3	3	2	3	2	-	-	*	*
CO5	3	3	3	2	3	-	-	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

UNIT–1: Temperature Measurement and Calibration

1. Measurement of Temperature by Thermocouple Module.
2. Measurement of Temperature by RTD Module.
3. Calibration of Pressure Gauge with the Help of Dead Weight Pressure Gauge.

UNIT–2: Pressure and Level Measurement

4. Level Measurement by using Differential Pressure (DP) Transmitter.
5. Measurement of Pressure by Bourdon Pressure Transducer.

UNIT–3: Control Valves and Signal Converters

6. Study of Characteristics of Control Valve (Linear, Equal Percentage and Quick Opening).
7. Study the Linearity of P/I and I/P Converter.

UNIT–4: Process Dynamics

8. To Study the Response of Two Tank Non-Interacting Liquid Level System.
9. To Study the Response of Two Tank Interacting Liquid Level System.

UNIT–5: Process Controllers

10. To Study On-Off Controller for Temperature Control.
11. To Study P, PI, PD and PID Controller using Pressure Controller Trainer Kit by Monitoring the Process in SCADA Mode or Analog Mode.

INSTRUCTIONAL STRATEGY

The subject gives the knowledge of various process, instruments and controls to measure process parameters. So the theoretical knowledge of this subject should be properly imparted to the students with the help of practical examples. Each topic should be supplemented with examples.

MEANS OF ASSESSMENT

- Practical work

RECOMMENDED BOOKS

1. Industrial Instrumentation by Donald P. Eckman, Wiley Eastern Publications.
2. Process System Analysis and Control by Coughanowr and Steven LeBlanc, McGraw Hill publications.
3. Industrial Instrumentation by SK Singh, Tata McGraw Hill Publications.
4. Principles of Industrial Instrumentation by D. Patranabis; Tata McGraw Hill Company
   Chemical Process Control: An Introduction to Theory BY George Stephanopoulos

THEORY	5.3 COATING PROPERTIES EVALUATION AND QUALITY CONTROL	L	T	P
		3	-	-

COURSE OBJECTIVES

This subject equips the students with basic paint testing. In the subject students learns the fundamental concepts on which paint properties to be evaluated and practically done in quality control lab.

COURSE OUTCOMES

After completion of this course, the students will be able to:

CO1: Understanding on different physical, chemical and mechanical properties of paint films

CO2: Understanding the measurement and performance of Liquid Paint Film and understand basic concepts of quality control, quality circles, and ISO standards.

CO3: Understanding the measurement and performance of dried Paint Film

CO4: Learning the performance of dry paint films using short-term test

CO5: Understand and evaluate the long-term durability and ageing behavior of coatings

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	–	1	–	–	1	*	*
CO2	3	2	2	2	2	–	1	*	*
CO3	2	2	2	2	1	1	2	*	*
CO4	2	2	2	2	2	1	2	*	*
CO5	2	3	2	2	2	2	3	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

COURSE CONTENTS

UNIT 1-COATING PROPERTIES: (10 Periods)

Classification of paints and understanding on general physical, chemical and mechanical properties of oil paints, enamels, varnishes and lacquers. Factors affecting adhesion, wetting power, optical properties , color , L,a,b, and ΔE values, gloss, hiding etc,

UNIT 2-ANALYSIS OF PAINTS & VARNISHES: (8 Periods)

Analysis of paints and varnishes: Volatile and non-volatile matter, pigment content , binder or solid vehicle content, water content, ash content, pigment, binder and solvent analysis, concept of quality circles, Introduction to ISO.

UNIT 3-TESTING OF LIQUID PAINT/FILM: (8 Periods)

- Objectives of paint testing
- Quality control procedures
- standard specifications and test methods,

- Classifications of paint test and evaluation tests
- **Test on liquid paints**: density, dispersion, viscosity and consistency, wet opacity and dry hiding, spreading capacity and spreading rate, wet & dry film thickness, drying time etc.

UNIT 4-TESTING OF DRY PAINT FILMS (SHORT TERM TEST): (8 Periods)

Test of dried coatings: Color and color fastness, light fastness, gloss, flexibility, adhesion, impact test, scratch hardness, pencil hardness, cupping test, mar resistance, abrasion, resistance, resistance to chemical ,Vaseline resistance, petrol/diesel resistance , solvent resistance, resistance to heat and fire.

UNIT 5-DURABILITY TESTS (LONG TERM TEST/AGEING TEST)): (8 Periods)

- Ageing properties of coatings
- Natural and outdoor durability test (artificial weathering test in a weatherometer),
- Humidity resistance
- Protection against corrosion (PAC)
- Cyclic corrosion test(CCT)
- salt spray test(SST)
- Defects observed in paint film on exposure

INSTRUCTIONAL STRATEGY

The subject gives the knowledge of various process, instruments and controls to measure process parameters. So the theoretical knowledge of this subject should be properly imparted to the students with the help of practical examples. Each topic should be supplemented with examples.

MEANS OF ASSESSMENT

- Class Test
- Home Assignment
- Sessional Test

RECOMMENDED BOOKS

- Organic Coating Technology Vol-1 By- Henry Fleming Payne Publisher John Willey & sons
- Surface Coatings : Raw materials & their usage Vol-2 By-OCCA-Australia Publisher Chapman & Hall
- Outlines of Paint Technology By -W.M.Morgan Publisher Edward Arnold
- Paint and Coating Testing Manual By- Joshep V. Koleske Publisher ASTM International

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SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	10	30
2	08	20
3	08	20
4	08	15
5	08	15
Total	**42**	**100**

PRACTICAL	5.4 COATING PROPERTIES EVALUATION AND QUALITY CONTROL (Lab)	L	T	P
		-	-	4

COURSE OBJECTIVES

This subject equips the students with basic paint testing. In the subject students learns the fundamental concepts on which paint properties to be evaluated and practically done in quality control lab.

COURSE OUTCOMES

After completion of this course, the students will be able to:
CO1: Understand and measure optical properties of coatings such as L, a, b and ΔE values.
CO2: Perform standard tests on liquid paints and films to evaluate rheological and application properties.
CO3: Evaluate mechanical, physical, and chemical properties of dry paint films.
CO4: Analyze paints and varnishes for composition parameters like VOC, NVM and ash content.
CO5: Assess long-term durability and corrosion resistance of coatings using accelerated tests.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	–	2	–	–	1	*	*
CO2	2	2	2	3	1	1	2	*	*
CO3	2	3	2	3	2	1	2	*	*
CO4	3	2	–	2	3	–	1	*	*
CO5	2	3	2	3	3	2	3	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)
* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

COURSE CONTENTS

UNIT 1-COATING PROPERTIES:

Experiment:

1. To measure L, a, b value of paint and calculate delta E value comparing master panel.

UNIT 2-TESTING OF LIQUID FILMS:

Experiment:

1. To measure viscosity of paint using ford cup
2. To measure WFT and DFT of paint and establish relation using Nonvolatile content
3. To measure hiding using morust chart
4. To measure dispersion of paint using hegman gauge
5. To measure drying time of paint/Varnish using Drying recorder
6. To measure spreading rate of the paint/varnish/lacquer

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UNIT 3-TESTING OF DRY PAINT FILMS:
Experiment:

1. To check the gloss of paint/varnish/lacquer
2. To measure scratch and pencil hardness of paint/varnish/lacquer
3. To measure flexibility of paint/varnish/lacquer using conical mandrel test
4. To measure hardness of paint/varnish/lacquer using impact tester
5. To measure chemical resistance of paint/varnish/lacquer against petrol,diesel,acid,alkali,lubricating oil, hot water
6. To check the adhesion of paint/varnish/lacquer using cross cut/hatch test

UNIT 4-ANALYSIS OF PAINTS & VARNISHES:
Experiment:

1. To measure volatile organic content (VOC) and nonvolatile matter (NVM) of paint/varnish/lacquer.
2. To measure ash content of paint

UNIT 5-DURABILITY TESTS:

1. To measure durability of paint using Salt spray test(SST)
2. To measure durability of paint using humidity test

INSTRUCTIONAL STRATEGY

The subject gives the knowledge of various process, instruments and controls to measure process parameters. So the theoretical knowledge of this subject should be properly imparted to the students with the help of practical examples. Each topic should be supplemented with examples.

MEANS OF ASSESSMENT

- Practical note book
- Hands on practical knowledge
- Viva

RECOMMENDED BOOKS

- Organic Coating Technology Vol-1 By- Henry Fleming Payne Publisher John Willey & sons
- Surface Coatings : Raw materials & their usage Vol-2 By-OCCA-Australia Publisher Champan & Hall
- Outlines of Paint Technology By -W.M.Morgans Publisher Edward Arnold
- Paint and Coating Testing Manual By- Joshep V. Koleske Publisher ASTM International

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PROGRAM ELECTIVE -3

		L	T	P
THEORY	**5.5 PRINTING INK & PACKAGING TECHNOLOGY** **POE 3.1**	**3**	**-**	**-**

COURSE OBJECTIVES

The objective of this course is to enable the students:

To understand various types of printing processes, substrates and inks used

To evaluate various raw materials used in printing inks

To formulate inks for various applications

To solve various ink related problems

To understand various Packaging Techniques and its end uses

COURSE OUTCOMES

After completion of this course, the students will be able to:

CO1: Understand major printing systems, principles of printing, ink–substrate interactions, and ink drying mechanisms.

CO2: Identify, test, and evaluate raw materials used in printing ink manufacturing.

CO3: Learn principles of ink formulation for various printing processes and solve ink-related problems.

CO4: Understand different types of inks, their manufacturing processes, quality control, safety, and environmental aspects.

CO5: Understand packaging concepts, materials, forms, hazards, and recycling for various industrial applications.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	–	2	–	–	1	*	*
CO2	3	2	–	2	1	–	1	*	*
CO3	2	2	3	2	1	1	2	*	*
CO4	3	2	2	2	2	2	2	*	*
CO5	3	2	2	–	3	2	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

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COURSE CONTENTS

UNIT 1-MAJOR PRINTING SYSTEM: (5 Periods)

Principle of printing: Nature of printing inks, substrate selection, scope,

Classification of printing process:

- **Printing processes-impact type**: offset lithographic process, web offset process, flexographic process, gravure process, letterpress process, screen printing process, intaglio printing process.
- **Printing processes non-impact type**: inkjet printing, toner printing systems etc.

Mechanism of ink drying.

UNIT 2-TESTING & EVALUATION OF RAW MATERIAL: (5 Periods)

Raw material used in printing ink, testing and evaluation of raw materials for their use in ink manufacturing.

UNIT 3-PRINCIPLES OF INK FORMULATION: (11 Periods)

- Letterpress, Lithographic (offset) and Web offset inks: General characteristics, types of presses, schematic diagram of the process, ink formulation, ink related problems and their possible solution.
- Gravure, Flexographic inks: General characteristics, formulating principles, schematic diagram of the process, ink formulation and varnishes for specific end-use applications.
- Screen inks for paper, plastics, textile, leather, wood, glass etc. Daylight fluorescent inks,

UNIT 4-TYPES OF INK & MANUFACTURING PROCESS: (10 Periods)

Inks for newspapers, publication work, posters, labels and packaging materials, Heat set and quick set inks for multi-color printing , Metal decoding inks , Over print varnishes and lacquers, Magnetic inks, Ceramic inks, Inks for printed circuit boards, Water based inks, Inks for the electronics industry, Ultra-violet and electron-beam curing inks

Manufacturing process of inks, mixing and milling equipments, ink quality control testing, handling, storage and factory layout, Health, safety and the environment.

UNIT 5-PACKAGING: (11 Periods)

Elements of packaging, concepts, function, scope, packaging values, Professional approach to development of package for food products, general consumables, cosmetics, pharmaceuticals, engineering materials and other utilities.

A. **Packaging forms:**

Packaging material and forms: Wood containers, glasses wares, metal containers, paper & paper boards, folded cartons and setup boxes.

B. **Types of packaging:**

i) General type

Primary packaging, Secondary packaging, Tertiary packaging

ii) Based on substrate

Paper and paper board, folded cartons and setup boxes, corrugated board, Interior packaging, Tetra pack, Wood containers, Glassware, Metal container (Cans and drums etc.), Plastics Packaging: Extruded Films, flexible packaging, thermoforming.

C. **Hazards:**

Biotic and abiotic hazards associated with packaging.

D. **Recycling of packaging material**

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INSTRUCTIONAL STRATEGY

Industrial visit to any Printing & Packing industry can be organized. Audio-visual should be used in teaching.

MEANS OF ASSESSMENT

- Assignment and quiz/class tests
- Mid semester and end semester written tests
- Practical work

RECOMMENDED BOOKS

1. Printing Ink Manual By R.H.Leach & R.J.Pierce
2. Handbook of Package Engineering By Joseph F.Hanlon
3. Edible Coatings & Soluble Packaging By Roger Daniels
4. Ink Technology for Students & Printers; by E.A. Apps
5. Water based inks by Lad
6. Protective Wrapping, by C.R.Oswin

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	5	15
2	5	15
3	11	25
4	10	20
5	11	25
Total	**42**	**100**

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OR
Program Elective -3

THEORY	5.5 MODERN SEPARATION TECHNIQUES (POE 3.2)	L	T	P
		3	-	-

COURSE OBJECTIVES:
To identify about the kind of separation processes in general and novel separations are integral part of any process chemical industries.

COURSE OUTCOMES:
On completion of the course the students will be able to:
CO1: Understand principles, theory, equipment design, and applications of thermal diffusion and zone melting.
CO2: Understand chromatographic techniques, molecular sieves, and their industrial applications.
CO3: Understand cryogenic separation, supercritical fluid extraction, and azeotropic separation processes.
CO4: Understand membrane separation processes, membrane modules, and their industrial applications.
CO5: Understand foam and bubble separation techniques, adsorption principles, and column operations.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	2	2	–	–	1	*	*
CO2	3	2	2	2	1	–	1	*	*
CO3	3	2	2	1	1	–	1	*	*
CO4	3	3	3	2	2	1	2	*	*
CO5	3	2	2	1	2	–	1	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)
***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

COURSE CONTENT

UNIT-I: (09Periods)
Thermal Diffusion: Basic Rate Law, Theory of Thermal Diffusion Phenomena for gas and liquid mixtures, Equipments design and Applications. Zone Melting

UNIT-II: (09 Periods)
Chromatographic techniques, Equipment and Commercial processes, Molecular Sieves.

UNIT-III: (09 Periods)
Cryogenic, Supercritical fluid extraction and Azeotropic separation.

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UNIT-IV: (09 Periods)

Principle of membrane separations process; Classification: Reverse osmosis, Ultra-filtration, Micro-filtration, Nano-filtration and Dialysis; Membrane modules and application; Electro-dialysis; Per-vaporation and gas separation using membranes; Electrophorosis; Liquid membranes.

UNIT-V: (06 Periods)

Foam and bubble separation: Principle; Classification; Separation techniques; Column operations. Surface Adsorption, Nature of foams.

REFERENCE BOOKS:

1. Schoen H. M., New Chemical Engineering Separation Techniques, 2nd Edition, Inter Science Publications,New York.
2. Seader, J.D, and Henley E.J.,Separation 'Process Principles,' John Wiley & Sons, Inc..
3. Perry R.H. and. Green D.W.,Perry's Chemical Engineers Hand book, 6th Edition. McGraw Hill, NY
4. King C.J. 'Separation Processes', 4th Edition, Tata McGraw Hill, New Delhi,.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Periods)	Marks Allotted (%)
1.	09	22
2.	09	22
3.	09	22
4.	09	22
5.	06	12
Total	42	100

Program Elective - 4

PRACTICUM	5.6 POLLUTION CONTROL AND INDUSTRIAL SAFETY (POE - 4.1)	L	T	P
		2	-	4

COURSE OBJECTIVES

A Chemical Engineering technician must have the knowledge of different types of pollution caused due to industrialization so that he may help in balancing the eco-system and control the pollution by means of control devices. The technician must know various types of accidents which occur in chemical plants and how to safeguard them to avoid injury to men and material.

COURSE OUTCOMES

After completion of this course, the students will be able to:

CO1: Understand the fundamentals of environmental pollution, air pollutants, air pollution control equipment, and ambient air quality standards.

CO2: Understand water pollution parameters, standards, and industrial wastewater treatment methods.

CO3: Understand environmental protection acts, hazardous chemical management, and safety Regulations.

CO4: Understand radioactive pollution, solid waste management techniques, and sustainable Environmental practices.

CO5: Understand industrial safety practices, chemical handling, hazard prevention, and accident case studies.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	2	2	3	–	1	*	*
CO2	3	3	2	2	3	–	1	*	*
CO3	3	2	1	1	3	–	2	*	*
CO4	3	2	2	1	3	–	1	*	*
CO5	3	2	2	1	2	1	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

COURSE CONTENTS

Unit-1: Introduction & Air Pollution and Control Mechanism (6 Periods)

Environment and Pollution, Classification of pollution e.g. Land, Water, Air, Noise Environment Impact assessment Studies, Character and origin of industrial wastes.

1. Definition of air pollution, Types of Air pollutants and their sources like SPM, SO_X, NO_X, NH_3, F, Cl, CFC, CO_2 etc.
2. Air Pollution control equipment in industries
3. Settling chamber
4. Cyclone
5. Electrostatic precipitator
6. Bag Filter
7. Ambient air quality measurement & their standards

PRACTICALS

1. Removal of suspended impurities from air using fabric filter.
2. Demonstration of Cyclone Separator for removal of suspended particles from air.

Unit-2: Water Pollution (6 Periods)

1. Water pollution, standards for drinking water, domestic waste water and industrial waste water. Methods of measurement of various parameter like BOD, SS, pH, COD, TDS etc.
2. Methods of treatment of industrial waste water like chemical treatment, physio-chemical treatment, bio-chemical treatment

PRACTICALS

1. Determination of pH value
2. Determination of turbidity
3. Determination of total solids, suspended solids, and total dissolved solids
4. Determination of dissolved oxygen (DO)/BOD/COD.
5. Determination of sulphate in water
6. Determination of chloride in water
7. Removal of suspended solids from water by coagulation

Unit-3: Environment Protection & Pollution Acts (6 Periods)

1. Environmental protection from hazardous chemicals waste:
2. Terminology relating to chemical hazards and air pollution, classification of chemical hazards and hazardous chemicals, codes of safety for operational hazards in laboratories, industries etc. (Reference should be made of I.S. Codes)
3. A water pollution prevention control Act 1974, Air Pollution Act 1981, Environment protection Act 1986, Hazardous chemical manufacturing, storage and impact rules 1989 and
4. hazardous waste and management and handling rules 1989, Regulation and control Rules 2000.

Unit-4: Radio Active Pollution & Solid Waste Management (4 Periods)

Sources and effect on human, animal, plant and material; measurement; means to control and preventive measures

1. Municipal solid waste, biomedical waste, Plastic waste and its management, solid waste disposal methods such as open dumping, sanitary landfilling composting, incineration.
2. Importance of development of green area

PRACTICALS

1. Prepare chart for treatments of different solid waste

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Unit-5: Safety in Chemical Industry (6 Periods)

1. Receiving and storing chemicals- transporting and moving chemicals- Safety in chemical reactions, pipelines with color coding in chemical factories.
2. Precautions in the case of processes in operations involving explosive or inflammable dusts, gases, vapours etc. Maintenance of chemical plants-corrosion health hazards in common chemical processes, Fire hazards and their prevention.
3. Codes of practice and specification for safety equipment (Reference should be made from I.S. Codes), case study of major chemical process industries disasters/accidents.

INSTRUCTIONAL STRATEGY

1. Case Study of any disaster should be undertaken. Study should be data based. Field visit to the industries should be planned.
2. Student should encourageto undertake project work related to environmental problems.

MEANS OF ASSESSMENT

- Class Test
- Home Assignment
- Attendance
- Sessional Test

RECOMMENDED BOOKS

1. Safety in Process Plant Design by Wells
2. Safety and Accident Prevention in Chemical Operation by H. H, Tanacatte and W. S. Wood
3. Engineering Chemistry by P.C. Ja

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Periods)	Marks Allotted (%)
1.	6	20
2.	6	20
3.	6	20
4.	4	18
5.	6	22
Total	28	100

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OR

Program Elective -4

PRACTICUM	**5.6 Safety In Chemical Process Industry** **POE 4.2**	**L**	**T**	**P**
		2	**-**	**4**

COURSE OBJECTIVES

Students learn about implementation of safety procedures, risk analysis and assessment, hazard Identification.

COURSE OUTCOMES

After completion of this course, the students will be able to:

CO1 Apply hazard identification and risk assessment methodologies.

CO2 Identify workplace hazards and apply safe housekeeping, fire safety and emergency guidelines.

CO3 Apply safe handling, storage, exposure control and confined space safety practices for hazardous chemicals.

CO4 Analyze industry-specific hazards and apply personnel safety and environmental pollution prevention measures.

CO5 Develop safety management practices, conduct safety audits and understand legal aspects of safety.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	3	2	3	2	–	1	*	*
CO2	3	2	2	1	3	–	1	*	*
CO3	3	3	2	2	3	–	1	*	*
CO4	3	2	2	1	3	–	1	*	*
CO5	3	2	2	1	2	2	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

*PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

COURSE CONTENTS

UNIT-I: Hazard identification methodologies, risk assessment methods-PHA, HAZOP, MCA, ETA, FTA, consequence analysis (6 periods)

Practicals:

2. Conducting a hazard identification exercise using PHA, HAZOP, MCA, ETA, FTA methodologies
3. Simulating risk assessment scenarios in a mock worldwide.

UNIT-II: Hazards in work places - nature and type of work places, types of hazards, hazards due to improper house-keeping, hazards due to fire in multi-floor industries and buildings, guidelines and safe methods in the above situations. (6 periods)

Practicals:

4. Demonstrating proper housekeeping techniques to mitigate hazards

UNIT-III: Workers' exposures to hazardous chemicals, TLVs of chemicals, physical and chemical properties of chemicals leading to accidents like fire explosions, ingestion and inhalation, pollution in work places due to dangerous dusts, fumes and vapours, guidelines and safe methods in chemicals handling, storage and entry into confined spaces. (6 periods)

Practicals:

1. Performing safe handling, storage and disposal of hazardous chemicals
2. Conducting a confined space entry simulation with safety protocols.

UNIT-IV: Hazards peculiar to industries like fertilizer, heavy chemicals, petroleum, pulp and paper, tanneries, dyes, paints, pesticides, glass and ceramics, dairy and sugar industries, guidelines for safe-guarding personnel and safeguarding against water, land and air pollution in the above industries.
(6 periods)

Practicals:

1. Assessing and mitigating hazards in mock fertilizer, petroleum, or dairy industry setups.

UNIT-V: Safety education and training- safety management, fundamentals of safety tenets, measuring safety performance, motivating safety performance, legal aspects of industrial safety, safety audit.
(4 periods)

Practicals:

1. Designing and presenting a safety training module or audit report

REFERENCE BOOKS:

1. Dr B.K. Bhaskara Rao, Er. R.K. Jain, and Vineet Kumar, "Safety in Chemical Plants/Industry and Its Management" Khanna Publishers.

2. S.C. Sharma, "Industrial Safety and Maintenance Management", Khanna Book Publishing Co. Private Limited, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (periods)	Marks Allotted (%)
1	6	21
2	6	21
3	6	21
4	6	21
5	4	16
Total	**28**	**100**

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Open Elective -2

Open Elective	5.7 ENERGY CONSERVATION AND AUDITS (OE-2.1)	L T P
		2 - -

COURSE OBJECTIVES

The pressure of technological development in all sectors on the Renewable energy source has led to the growing cost of energy around the world. Efficient and judicious use of the available energy sores would lead to the easing of such pressure and drastic decrease in the operating costs of the organizations and industries. Thus, it is necessary to save and conserve energy to the maximum possible extent. Also, essential theoretical knowledge and practical skills about the energy conservation is to be provided through different approaches, project management and economic aspects. The process of energy audit will help to identify the various possible avenues in which savings of energy can be effectively adopted. This course makes the Diploma Holder well acquainted in the techniques of energy conservation in the fields of engineering. It also introduces him to the energy audit procedures.

COURSE OUTCOMES (CO):

After completion of this course, the students will be able to:

CO1 Understand types of energy resources, national and regional energy scenarios, energy conservation principles and provisions of the Energy Conservation Act.

CO2 Analyze electrical supply systems, transformers, motors and utility equipment to identify energy efficiency and conservation opportunities.

CO3 Apply energy-efficient practices in lighting, DG systems and thermal utilities including boilers, furnaces and cooling towers.

CO4 Understand Energy Conservation Building Code (ECBC), building energy efficiency measures, waste heat recovery and co-generation systems.

CO5 Understand and perform basic energy audits and recommend general energy-saving measures for domestic, commercial and industrial applications.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	–	–	2	–	2	*	*
CO2	3	3	2	2	2	–	1	*	*
CO3	3	3	2	2	2	–	1	*	*
CO4	3	2	2	1	2	–	1	*	*
CO5	3	3	2	2	2	2	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

*PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

COURSE CONTENTS

Unit 1-Basics of Energy

Classification of energy- primary and secondary energy, commercial and non-commercial energy, non-renewable and renewable energy with special reference to solar energy, Capacity factor of solar and wind power generators. Global fuel reserve Energy scenario in India and state of U.P. Sector-wise energy consumption (domestic, industrial, agricultural and other sectors), Impact of energy usage on climate Energy Conservation and EC Act 2001.

Introduction to energy management

Energy conservation, energy efficiency and its need, Salient features of Energy Conservation Act 2001 & The Energy Conservation (Amendment) Act, 2010 and its importance. Prominent organizations at centre and state level responsible for its implementation, Standards and Labeling: Concept of star rating and its importance, Types of product available for star rating.

Unit 2-Electrical Supply System and Motors

Types of electrical supply system, Single line diagram, Losses in electrical power distribution system, Understanding Electricity Bill: Transformers Tariff structure, Components of power (kW, kVA and kVAR) and power factor, improvement of power factor, Concept of sanctioned load, maximum demand, contract demand and monthly minimum charges (MMC)

Transformers:

Introduction, Losses in transformer, transformer Loading, Tips for energy savings in transformers, Electric Motors Types of motors, Losses in induction motors Features and characteristics of energy efficient motors, Estimation of motor loading, Variation in efficiency and power factor with loading, Tips for energy savings in motors.

Energy Efficiency in Electrical Utilities

Pumps: Introduction to pump and its applications, Efficient pumping system operation, Energy efficiency in agriculture pumps, Tips for energy saving in pumps

Compressed Air System:

Types of air compressor and its applications, Leakage test, Energy saving opportunities in compressors. Energy Conservation in HVAC and Refrigeration System: Introduction, Concept of Energy Efficiency Ratio (EER), Energy saving opportunities in Heating, Ventilation and Air Conditioning (HVAC) and Refrigeration Systems.

Unit 3-Lighting and DG Systems

Lighting Systems: Basic definitions- Lux, lumen and efficacy, Types of different lamps and their features, Energy efficient practices in lighting.

DG Systems: Introduction, Energy efficiency opportunities in DG systems, Loading estimation Energy Efficiency in Thermal Utilities

Thermal Basics: Thermal energy, Energy content in fuels, Energy Units and its conversions in terms of Metric Tonne of Oil Equivalent (MTOE).

Energy Conservation in boilers and furnaces

Introduction and types of boilers, Energy performance assessment of boilers, Concept of stoichiometric air and excess air for combustion, Energy conservation in boilers and furnaces, Do's and Don'ts for efficient use of boilers and furnaces.

Cooling Towers:

Basic concept of cooling towers, Tips for energy savings in cooling towers, Efficient Steam Utilization.

Unit 4-Energy Conservation Building Code (ECBC)

ECBC and its salient features, Tips for energy savings in buildings: New Buildings, Existing Buildings. Waste Heat Recovery and Co-Generation

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Concept, classification and benefits of waste heat recovery, Concept and types of co-generation system

Unit 5-General Energy Saving Tips

Energy saving tips in: Lighting, Room Air Conditioner, Refrigerator, Water Heater, Computer, Fan, Heater, Blower and Washing Machine, Colour Television, Water Pump, Cooking, Transport, Energy Audit, Types and methodology, Energy audit instruments, Energy auditing reporting format

Ex. No.	Name of Experiment	Hours
1.	*To conduct load survey and power consumption calculations of small building.*	*4*
2.	*To check efficacy of different lamps by measuring power consumption and lumens using lux meter.*	*5*
3.	*To measure energy efficiency ratio (EER) of an air conditioner.*	*5*
4.	*To measure effect of valve throttling and variable frequency drive (VFD) on energy consumption by centrifugal pump.*	*5*
5.	*To measure and calculate energy saving by arresting air leakages in compressor.*	*5*
6.	To measure the effect of blower speed on energy consumed by it.	4

1. REFERENCE BOOKS:

1. Electric Energy Generation, Utilization and Conservation Sivaganaraju, S Pearson, New Delhi, 2012
2. Project Management, Prasanna Chandra, Tata Mcgraw Hill, New Delhi
3. Energy Conservations in Buildings, O.P. Jakhar, Khanna Publishing House, New Delhi
4. Financial Management, Prasanna Chandra Tata Mcgraw Hill, New Delhi.
5. Energy management Handbook, Prasanna Chandra, Tata Mcgraw Hill, New Delhi.
6. Energy Technology, O.P. Gupta, Khanna Publishing House, New Delhi (ed. 2018)
7. E-books/e-tools to be used as recommended by AICTE/NITTTR, Chandigarh.

Websites for Reference:

http://swayam.gov.in

5. INSTRUCTIONAL STRATEGY

Engage students in experiments and demonstrate that illustrate principles of Energy Conservation, incorporate case studies and examples from everyday life to demonstrate the importance of Energy Conservation.

OR
OPEN ELECTIVE 2

Open Elective	5.7 INDUSTRIAL AUTOMATION & MES (OE-2.2)	L T P
		2 0 -

COURSE OVERVIEW

This course is designed to provide a comprehensive understanding and hands on experience on Industrial Automation and Manufacturing Execution Systems (MES) to excel in the automation sector across various manufacturing domains. This includes Programmable Logic Controllers (PLC), Supervisory Control and Data Acquisition (SCADA), Human Machine Interfaces (HMI), Variable Frequency Drives (VFD), Manufacturing Execution System (MES), and the integration of these components to create cohesive and efficient systems. Participants will gain hands-on experience with the latest software and hardware tools, enabling them to adopt modern automation techniques in line with industry standards and build competency in the automation sector.

COURSE OUTCOME

After completion of this course, the students will be able to:

CO1 : Understand industrial safety practices including fire protection systems, safe handling of tools and equipment, occupational safety and health standards and preventive safety measures in industrial environments.

CO2 :Describe the fundamentals of industrial automation including types of automation, automation components, manufacturing systems, control strategies and basic industrial communication concepts.

CO3 Apply Programmable Logic Controller concepts including hardware components, memory organization, programming techniques, logic instructions, communication protocols and troubleshooting for industrial applications.

CO4 Understand the working, configuration and application of Variable Frequency Drives for motor control, energy efficiency optimization, fault diagnosis and industrial automation integration.

CO5 Develop and operate Human Machine Interface systems including screen design, alarms, data logging, security management and communication with PLC and SCADA systems.

CO6 Understand Supervisory Control and Data Acquisition systems including architecture, communication protocols, real-time monitoring, data logging, alarm management and Industry 4.0 integration.

CO7 Describe Flexible Manufacturing Systems including pneumatics, machine vision, pick and place systems and automation techniques used in modern manufacturing environments.

CO8 Understand Manufacturing Execution Systems architecture, core functionalities, data flow, integration with Industry 4.0 technologies and smart factory implementation concepts.

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SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	–	–	3	2	2	*	*
CO2	3	2	2	2	2	–	1	*	*
CO3	3	3	3	2	2	–	1	*	*
CO4	3	3	2	2	3	–	1	*	*
CO5	3	2	2	3	2	–	1	*	*
CO6	3	3	2	3	2	–	2	*	*
CO7	3	2	2	2	2	–	1	*	*
CO8	3	2	2	3	2	1	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)
*PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

CONTENTS

Sr No	Course contents
1	**Industrial Safety Practices** • Fire Extinguishers & its Types • Safely handling Tools & Equipment • Use of proper Tools & Equipment & its maintenance • OSH & practices to be observed as a precaution
2	**Fundamentals of Industrial Automation** • Introduction to industrial automation • Need and application of automation • Benefits of automation • Types of Industrial automation • Important Components of Automation • Discrete, Continuous and Batch Manufacturing • Open-loop vs. Closed-loop systems • Introduction to PLC, HMI, VFD, SCADA, MES • Industrial sensors: types and applications • Actuators: motors, valves, pneumatics • Signal conditioning and A/D conversion • Process variables: temperature, pressure, flow, level • PID control and its applications • Control panel components and wiring standards • Industrial communication protocols
3	**Programmable Logic Controller (PLC)** • Introduction to Programmable Logic Controller (PLC)

	• Types of PLCs and selection criteria. • Application and advantages of PLC. • Important components of PLC • Numbering systems: binary, hexadecimal, BCD • PLC memory organization and addressing. • Explain sink and source concept. • Interfacing of PLC with field devices. • PLC communication protocols: Modbus, Profibus, ethernet/IP • Types of PLC programming • Ladder logic programming basics. • Conditional logic: AND, OR, NOT, NAND, NOR XOR, XNOR Gates • Timers and counters in PLC. • Explain advance instruction used in PLC. • Fault handling and troubleshooting in PLCs • Industrial case study of PLC.
4	**Variable Frequency Drive (VFD)** • Introduction to Variable Frequency Drive (VFD) • Basics of AC motors • Application of VFD • Components of a VFD: rectifier, DC bus, inverter • Types of VFDs: scalar control vs. vector control • Connections and control mechanism • VFD parameter configuration and settings • Study motor protection and overload prevention • Understand energy efficiency optimization using VFD • Troubleshooting and fault diagnosis in VFDs • Regenerative braking and energy recovery in VFD • Learn Modbus and ethernet communication for VFDs • Industry applications of VFD in HVAC, pumps, and conveyors • Case study: VFD implementation for smart energy saving • Interfacing of VFD with PLC & SCADA.
5	**Human Machine Interface** • Introduction to HMI • Role of HMI in industrial automation • Components of HMI • Compare HMI and SCADA • Communication protocols in HMI • User interface of HMI software. • Building basic HMI control animations. • Alarms and event logging • Security and user access management • Multi-screen navigation in HMI systems • Study trending and historical data logging • Communication between HMI and PLC • SCADA-HMI integration • Troubleshooting common issues in HMI. • Industrial case study: HMI in production line
6	**Supervisory Control and Data Acquisition (SCADA)**

	• Introduction to Supervisory Control and Data Acquisition (SCADA). • Application and advantages of SCADA • Important components of SCADA • Block diagram of SCADA • SCADA communication protocols. • Types of tags and its usage. • Explore the features of SCADA. • User interface of SCADA software • Building basic SCADA screens with animation. • Dynamic properties like sizing, location, blinking, visibility, percentage filling, object size, orientation, etc. • Alarm management and event logging in SCADA • Historical data logging and trending in SCADA. • Recipe management. • Script programming. • Security options and administrative levels in SCADA. • Explore data transfer feature in SCADA software. • SCADA and PLC interfacing for real-time control • Troubleshooting and fault detection. • Role of SCADA in industry 4.0 and IIoT. • SCADA applications in water treatment, energy, and manufacturing.
7	**Flexible Manufacturing System (FMS)** • Introduction to FMS and its importance in modern manufacturing • Important Components of FMS, Advantages and Disadvantages of FMS • Applications of Pneumatics in Manufacturing • Use of Machine Vision, important components, sorting application • Pick and Place concept and its important components
8	**Overview of Manufacturing Execution Systems (MES)** • Introduction to manufacturing execution systems (MES) • ISA 88 AND ISA 95 • MES architecture and MES core functionalities. • Key functions of MES: production scheduling, quality control, tracking. • MES data flow and communication protocols • Real-time work order management in MES • Resource allocation via MES • MES reporting and dashboards for production insights • Barcode integration for MES automation • Exploring MES and industry 4.0: digital twin and smart manufacturing • Case study: MES implementation in a smart factory.

1. PRACTICALS

- Explain different safety tools & Kits, Hazard identification & avoidance, proper waste management.
- Demonstrate various components of the automation simulator panel.
- Demonstrate signal measurement using Multimeter

- Identifying and testing of different type of sensors
- Demonstrate wiring and testing of various output devices.
- Show on-off control using relays.
- Test Emergency stop and safety interlock
- Decode alarm and status indications.
- Configuring and opening PLC programming software.
- Use of basic commands and instructions.
- Demonstrate XIC, XIO, coil and addressing concept.
- Interfacing digital I/O with PLC.
- Configuring analog, I/O with PLC.
- Writing basic ladder logic programs
- Implementing start-stop logic using push buttons
- Design logic gates concept using ladder diagram.
- Design and practice various real time scenarios.
- Configuring and programming timers and counters.
- Create various programs based on timer's application.
- Create various programs based on timer, counter and comparators.
- Design a PLC program to execute the elevator system in a 3-floor apartment.
- Troubleshooting faulty I/O modules in a PLC system.
- Programming safety interlocks for emergency shutdown.
- Demonstration of buttons/keys present on VFD.
- Configuring basic VFD parameters for motor speed control.
- Implementing start/stop and forward/reverse operation
- Adjusting acceleration and deceleration ramp times.
- Interfacing VFD with PLC for automated speed control.
- Implementing emergency stop and safety interlocks.
- Analysing VFD faults and troubleshooting issues.
- Opening the HMI programming software.
- Designing HMI screens with buttons and indicators
- Configuring alarms and event logging in HMI
- Setting up data entry fields in HMI for operator input
- Creating HMI screens for tank level monitoring
- Implementing multi-screen navigation and setting up trends in HMI.
- Integration of HMI with PLC.
- Debugging HMI-PLC communication issues
- Demonstrate the SCADA software interface.
- Design program for a switch and a lamp and check out results in runtime.
- Designing start/stop control for pumps and motors via SCADA
- Configuring alarm management system with alerts
- Logging and retrieving historical data for analysis
- Creating live graphs and trend displays for process monitoring
- Interfacing SCADA with PLC, HMI and VFD for motor control applications
- Implementing data export and report generation in SCADA
- Using SCADA for batch processing and recipe management.

- Designing a SCADA simulation for a smart dashboard energy monitoring system.
- Integrate pneumatic systems, sorting, and pick and place.
- Configuring MES software for the first time.
- Setting up work order tracking in MES.
- Implementing barcode/RFIDs-based inventory management
- Creating automated production reports using MES dashboards.
- Setting up automated work scheduling for assembly line operations.
- Demonstrate integration of MES with PLC for process automation.
- Setting up role-based user access for MES data security.

Identify and resolve common issues in the MES assembly line like communication failure, alarms, equipment malfunction and data irregularity.

INTERNSHIP	5.8 SUMMER INTERNSHIP-II (6 Weeks)	L	T	P
		-	-	-

It is needless to emphasize further the importance of Industrial Training of students during their 3 years of studies at Polytechnics. It is industrial training, which provides an opportunity to students to experience the environment and culture of industrial production units and commercial activities undertaken in field organizations. It prepares student for their future role as diploma engineers in the world of work and enables them to integrate theory with practice. Polytechnics have been arranging industrial training of students of various durations to meet the above objectives.

This document includes guided and supervised industrial training of 4 weeks duration to be organized during the semester break starting after second year i.e. after 4th semester examinations. The concerned HODs along with other teachers will guide and help students in arranging appropriate training places relevant to their specific branch. It is suggested that a training schedule may be drawn for each student before starting of the training in consultation with the training providers. Students should also be briefed in advance about the organizational setup, product range, manufacturing process, important machines and materials used in the training organization.

Equally important with the guidance is supervision of students training in the industry/organization by the teachers. Students should be encouraged to write daily report in their diary to enable them to write final report and its presentation later.

An external assessment of 40 marks has been provided in the study and evaluation scheme of 5th Semester. Evaluation of professional industrial training report through viva- voce/presentation aims at assessing students understanding of materials, industrial process, practices in industry/field organization and their ability to engage in activities related to problem solving in industrial setup as well as understanding of application of knowledge and skills learnt in real life situations.

Teachers and students are requested to see the footnote below the study and evaluation scheme of 4th semester for further details.

The teacher along with field supervisors will conduct performance assessment of students. The components of evaluation will include the following:

Punctuality and regularity	15%
Initiative in learning new things	15%
Presentation and VIVA	15%
Industrial training report	55%

AUDIT COURSE	5.9 INDIAN CONSTITUTION	L	T	P
		2	-	-

COURSE OBJECTIVES

1. Understand the history, principles, and key interpretations of the Indian Constitution.
2. Understand the structure and key roles of the Indian Union Government, including the President, Prime Minister, and Council of Ministers.
3. Understand the composition, powers, and functions of the Lok Sabha, Rajya Sabha, and the Supreme Court.
4. Understand the roles and powers of the Governor, Chief Minister, Council of Ministers, and the State Secretariat.
5. Understand the structure and functions of local administration, including District, Municipal, and Zila Panchayat levels.
6. Understand the structure, role, and functions of the Election Commission of India.

COURSE OUTCOMES

After completion of this course, the students will be able to:

CO1 Understand the historical background, philosophy, basic structure, fundamental rights and duties enshrined in the Indian Constitution and interpret their significance in governance.

CO2 Describe the structure, powers and functions of the Union Government including the President, Prime Minister and Council of Ministers.

CO3 Describe the composition, powers and functions of the Indian Legislature and Judiciary with special reference to Parliament and the Supreme Court of India.

CO4 Describe the structure, roles and functions of the State Government including the Governor, Chief Minister, Council of Ministers and State Secretariat.

CO5 Explain the structure and functioning of local administration in India including district administration, municipal corporations and Zila Panchayats.

CO6 Understand the structure, role and functions of the Election Commission of India and its importance in maintaining democratic governance.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

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CO1	3	2	–	–	2	–	2	*	*
CO2	3	2	–	–	2	2	1	*	*
CO3	3	2	–	–	2	–	1	*	*
CO4	3	2	–	–	2	2	1	*	*
CO5	3	2	–	–	2	–	1	*	*
CO6	3	2	–	–	2	–	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

*PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

COURSE CONTENTS

Unit 1 – The Constitution – Introduction **(06 Periods)**

• The History of the Making of the Indian Constitution
• Preamble and the Basic Structure, and its interpretation
• Fundamental Rights and Duties and their interpretation

Unit 2 – Union Government **(06 Periods)**

• Structure of the Indian Union Government
• President – Election, Role and Power
• Prime Minister and Council of Ministers

Unit 3- Indian Legislature & Judiciary **(06 Periods)**

- Composition of Lok Sabha and Rajya Sabha
- Powers & Functions of Lok Sabha and Rajya Sabha
- Structure of Supreme Court including Appointment of Judges
- Powers & Functions of Supreme Court

Unit 4 – State Government **(03 Periods)**

• Governor – Role and Power
• Chief Minister and Council of Ministers
• State Secretariat

Unit 5 – Local Administration **(04 Periods)**

• District Administration
• Municipal Corporation
• Zila Panchayat

Unit 6 – Election Commission **(03 Periods)**

- Structure of Election Commission of India
- Role and Function of Election Commission

Suggested Distribution of Books

1. Ethics and Politics of the Indian Constitution Rajeev Bhargava Oxford University Press, New Delhi, 2008
2. The Constitution of India B.L. Fadia Sahitya Bhawan; New edition (2017)
3. Introduction to the Constitution of India DD Basu Lexis Nexis; Twenty-Third 2018 edition
4. Our Constitution Subhash Chand Kashyap NBT New Delhi.

Suggested Software/Learning Websites:

a. https://www.constitution.org/cons/india/const.html
b. http://www.legislative.gov.in/constitution-of-india
c. https://www.sci.gov.in/constitution
d. https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/
e. https://ncert.nic.in/textbook.php

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SUGGESTED DISTRIBUTION OF MARKS

SR No	Topic Time Allotted (periods)	Marks Allotted
1	6	20
2	6	20
3	6	20
4	3	12
5	4	16
6	3	12
TOTAL	**28**	**100**

PRACTICUM	6.1 ARCHITECTURE AND INDUSTRIAL COATING	L	T	P
		3	-	2

COURSE OBJECTIVES

The objective of this course is to enable the students about fundamental concepts of various Architectural and Industrial coatings such as Eco-friendly Coatings e.g. High Solids, Radiation curable, water based and Powder Coatings etc.

COURSE OUTCOMES

After completion of this course, the students will be able to:

CO1 Understand formulation, composition and selection criteria of interior and exterior coating systems for different substrates
CO2 Describe decorative coatings, emulsion paints, binders, colorants and their drying mechanisms
CO3 Understand industrial and automotive coating systems with respect to application methods and curing processes
CO4 Understand high performance coatings including marine and heavy duty industrial coatings
CO5 Describe powder coating technology and miscellaneous specialty coatings

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	1	–	2	–	2	*	*
CO2	3	2	1	–	2	–	2	*	*
CO3	3	2	2	1	2	–	2	*	*
CO4	3	2	1	–	2	–	2	*	*
CO5	3	2	2	1	2	–	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)
***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

COURSE CONTENTS

UNIT -1 INTERIOR AND EXTERIOR COATINGS (6 Periods)

Solvent and water based coatings, their formulation consideration, compositions, manufacturing process and testing for sealer, primer, stopper, undercoat and finish coat for wood, masonry, metal.
Concept of substrates selecting criteria for different coating systems.

Experiment:

1. Preparation of solvent based coating (primer and enamel paint).

UNIT -2 DECORATIVE COATINGS (8 Periods)

Criteria and factors for selecting decorative paints, types of decorative paints-solvent based and water based, use of colorants as tinters, universal tinters, application of tinter machines
Water soluble and water reducible binders such as oils, alkyds acrylics, etc.;
Emulsion paints; phase of emulsion (oil in water and water in oil emulsion), emulsifying agents and

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manufacturing process of emulsion paints.
Drying mechanism, application of architectural paint.

Experiment:

1. Preparation of phases of emulsion
2. Preparation of water based paint emulsion paints for exterior coating. (Acrylic emulsion paint)
3. Preparation of water based paint emulsion paints for interior coating.

UNIT -3 INDUSTRIAL COATINGS (15 Periods)

Industrial coatings: Understanding of industrial Primer, base coat, top coat and clear coat/lacquers and their selection criteria for different substrates (metal, plastics, wood),surface application and drying/curing mechanism such as air drying, forced drying and stoving.
Automotive coatings: Primers, fillers, base coats, top coats, clear coats refinishing, etc.

Experiment: 1. Application of any industrial paint on metal surface through conventional spray/dip/electrostatic method.

UNIT-4 HIGH PERFORMANCE COATINGS (06 Periods)

Marine coatings; dock and harbor installations, offshore structures , ships paints , fouling, organisms leaching rate, types of antifouling paints,
Industrial structures and industrial buildings (heavy duty coating/chemical plants), substrate types and their preparation, primers (red oxide, zinc chromate, zinc rich primers /etch primers), undercoats, finish coats.

UNIT-5 POWDER COATING & MISCELLANEOUS COATINGS (07 Periods)

Powder coating: Thermoplastic and Thermoset: manufacture of powders, powder classifications, types of powder coatings,
Application methods: electrostatic, fluidization and hybrid application
Miscellaneous coating:
Swimming pool coating
Can coating
Coil coatings
Coatings for metal container
Coating on plastic
Floor paint
Road marking paint

INSTRUCTIONAL STRATEGY

Industrial visit industry can be organized. Audio-visual should be used in teaching.

MEANS OF ASSESSMENT

- Assignment and quiz/class tests
- Mid semester and end semester written tests
- Practical note book
- Hands on practical knowledge
- Viva

RECOMMENDED BOOKS

1. Organic Coating Technology, Vol I & II by H.F Payne.
2. Surface Coatings , Vol, I & II by , OCCA, Australia

3. Outlines of Paint Technology by W M Morgan
4. Organic Coating Technology vol-2 By Henry Fleming, Payne Publisher John Wiley & Sons.
5. Surface Coatings: Science & Technology By Swaraj Paul Publisher John Wiley& Sons.
6. Basics of Paint Technology (Part II), By: Malshe & Sikchi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	06	17
2	08	22
3	15	25
4	06	16
5	07	20
Total	**42**	**100**

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THEORY	6.2 ENTREPRENEURSHIP AND START UPs	L	T	P
		2	-	-

COURSE OBJECTIVES

1. Acquiring Entrepreneurial spirit and resourcefulness.
2. Familiarization with various uses of human resource for earning dignified means of living.
3. Understanding the concept and process of entrepreneurship - its contribution and role in the growth and development of individual and the nation.
4. Acquiring entrepreneurial quality, competency, and motivation.
5. Learning the process and skills of creation and management of entrepreneurial venture.

COURSE OUTCOMES

Upon completion of the course, the student will be able to:

CO1: Understand the concepts, traits, types, and roles of entrepreneurs and differences from managers.
CO2: Identify and develop business ideas, visualize opportunities, and create a business plan.
CO3: Analyze market, competition, strategy, and risks to convert an idea into a startup.
CO4: Understand management concepts, organization structure, recruitment, and training processes.
CO5: Understand financing methods, intellectual property rights, and communicate ideas to investors.
CO6: Understand succession, dissolution, and harvesting strategies for startups.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	1	–	–	–	–	1	*	*
CO2	3	2	2	–	–	2	2	*	*
CO3	3	2	3	–	–	2	2	*	*
CO4	3	2	2	–	1	2	1	*	*
CO5	3	2	2	3	2	2	2	*	*
CO6	2	2	2	–	1	2	3	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)
*PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

COURSE CONTENTS

Unit-1 : Introduction to Entrepreneurship and Start – Ups (09 Periods)

1. Definitions, Classification of Entrepreneur
2. Traits of an Entrepreneur, Entrepreneurship, Motivation
3. Types of Business Structures- On the Basis of size and On the basis of ownership
4. Similarities/differences between entrepreneurs and managers

Unit-2: Business Ideas and their implementation (08 Periods)

1. Discovering ideas and visualizing the business
2. Activity map
3. Business Plan (Case Study)

Unit-3: Idea to Start-up (12 Periods)

- Marketing and Accounting- Definition and Importance.
- Market Analysis–STP (Segmentation, Targeting, Positioning)
- Competition evaluation and Strategy Development – Vision, Mission, Goal, Objectives.
- Risk analysis- SWOT Analysis.

Unit-4 : Management (09 Periods)

1. Definition Concept and Functions of Management
2. Company's Organization Structure- Concept and Classification
3. Recruitment and Selection- Definition,
4. Training and Development- Importance.

Unit-5 :Financing and Protection of Ideas (12 Periods)

1. Financing methods available for Entrepreneurship/Startups in India (Government Scheme, Banking, NBFCs, SHG and Micro Financing).
2. Intellectual Property Rights- Overview of - Copyrights, Trademark, Geographical Indicators, Patenting and Licenses
3. Communication of Ideas to potential investors–Investor Pitch.

Unit-6 Succession, Dissolution and Harvesting strategy (06 Periods)

1. Ways of succession
2. Types of Dissolution

RECOMMENDED BOOKS

1. The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company, Steve Blank and Bob Dorf, K&S Ranch, ISBN–978-0984999392
2. Entrepreneurship Development (A new Venture creation) Vasant Desai, Himalaya Publication.
3. Entrepreneurship Development, Khanka S.S, S Chand & Company Limited New Delhi.
4. Entrepreneurship Development, Gupta and Srinivsan, S Chand & Company Limited New Delhi.
5. Demand: Creating What People Love Before They Know They Want It, Adrian J. Slywotzky with Karl Weber, Head line Book Publishing ISBN–978-0755388974
6. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Clayton M. Christensen, Harvard business ISBN:978-142219602

WEBSITES FOR REFERENCE:

1. https://www.fundable.com/learn/resources/guides/startup
2. https://corporatefinanceinstitute.com/resources/knowledge/finance/corporate-structure/
3. https://www.finder.com/small-business-finance-tips
4. https://www.profitbooks.net/funding-options-to-raise-startup-capital-for-your-business/
5. NPTEL Course on Entrepreneurship https://onlinecourses.nptel.ac.in/noc23_mg74/preview
6. National Geographic Channel you tube Video on "GI Tag Crafts of Bharat"

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SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	09	17
2	08	14
3	12	20
4	09	17
5	12	21
6	6	11
Total	56	100

PROJECT	6.3 IN HOUSE PROJECT	L	T	P
		4	-	16

COURSE OBJECTIVES

Project Work aims at developing innovative skills in the students whereby they apply in totality the knowledge and skills gained through the course work in the solution of particular problem or by undertaking a project. In addition, the project work is intended to place students for project oriented practical training in actual work situation for the stipulated period.

COURSE OUTCOMES

After undergoing the project work, the students will be able to:

1. Apply in totality the knowledge and skills gained through the course work in the solution of particular problem or by undertaking a project.
2. Develop understanding regarding the size and scale of operations and nature of field-work in which students are going to play their role after completing the courses of study
3. Develop understanding of subject based knowledge given in the classroom in the context of its application at work places.
4. Develop firsthand experience and confidence amongst the students to enable them to use and apply polytechnic/institute based knowledge and skills to solve practical problems related to the world of work.
5. Develop abilities like interpersonal skills, communication skills, positive attitudes and values etc.
6. Assemble/fabricate and test an electronics gadget.

GENERAL GUIDELINES

The individual students have different aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work, they would like to execute. The activity of problem identification should begin well in advance (say at the end of second year). Students should be allotted a problem of interest to him/her as a major project work. It is also essential that the faculty of the respective department may have a brainstorming session to identify suitable project assignments for their students. The project assignment can be individual assignment or a group assignment. There should not be more than 3 students if the project work is given to a group. The project work identified in collaboration with industry should be preferred.

This practical training cum project work should not be considered as merely conventional industrial training in which students are sent at work places with either minimal or nosupervision. This experience is required to be planned in advance and supervised on regular basis by the polytechnic faculty. For the fulfillment of above objectives, polytechnics may establish close linkage with 8-10 relevant organization for providing such an experience to students. It is necessary that each organization is visited well in advance and activities to be performed by students are well defined. The chosen activities should be such that it matches with the curricular interest to students and of professional value to industrial/ field organizations. Each teacher is expected to supervise and guide 5-6 students.

THE PROJECT ASSIGNMENTS MAY CONSIST OF:

1. Development of prototypes
2. Study of different types of :
3. heat exchangers
4. distillation columns
5. evaporators
6. reactors
7. driying unit etc.
8. Study of different types of vessels, heads and joints (can be done through factory visit)
9. Study of pumps and valves used in process industries
10. Fabrication of components/equipments
11. Fault diagnosis and rectification experiences
12. Bringing improvements in the existing system/equipment
13. Audits of industry- energy audit, water audit, material audit etc.
14. Case Studies

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NOTE:

1. The list is only the guideline for selecting a project; however, a student is at liberty to select any other related project of his choice independently under guidance of his teacher.

2. A suggestive criterion for assessing student performance by the external (person from industry) and internal (teacher) examiner is given in table below:

Sr. No.	Performance Criteria	Max.** Marks	Rating Scale				
			Excellent	Very Good	Good	Fair	Poor
1.	Selection of project assignment	10%	10	8	6	4	2
2.	Planning and execution of considerations	10%	10	8	6	4	2
3.	Quality of performance	20%	20	16	12	8	4
4.	Providing solution of the problems or production of final product	20%	20	16	12	8	4
5.	Sense of responsibility	10%	10	8	6	4	2
6.	Self-expression/ communication skills	5%	5	4	3	2	1
7.	Interpersonal skills/human relations	5%	5	4	3	2	1
8.	Report writing skills	10%	10	8	6	4	2
9.	Viva voce	10%	10	8	6	4	2
	Total marks	100 %	100	80	60	40	20

The overall grading of the practical training shall be made as per following table.

S.No.	Range of maximum marks	Overall grade
1.	More than 80	Excellent
2.	79 <> 65	Very good
3.	64 <> 50	Good
4.	49 <> 40	Fair
5.	Less than 40	Poor

In order to qualify for the diploma, students must get “Overall Good grade” failing which the students may be given one more chance to improve and re-evaluate before being disqualified and declared “not eligible to receive diploma ”. It is also important to note that the students must get more than six “goods” or above “good” grade in different performance criteria items in order to get “Overall Good” grade.

IMPORTANT NOTES

1. This criterion must be followed by the internal and external examiner and they should see the daily, weekly and monthly reports while awarding marks as per the above criteria.
2. The criteria for evaluation of the students have been worked out for 200 maximum marks. The internal and external examiners will evaluate students separately and give marks as per the study and evaluation scheme of examination.
3. The external examiner, preferably, a person from industry/organization, who has been associated with the project-oriented professional training of the students, should evaluate the students performance as per the above criteria.
4. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific nearby industries are approached for instituting such awards.
5. The teachers are free to evolve other criteria of assessment, depending upon the type of project work.
6. It is proposed that the institute may organize an annual exhibition of the project work done by the students and invite leading Industrial organizations in such an exhibited.

Open Elective -3`

OPEN ELECTIVE (THEORY)	6.4.1 ECONOMIC POLICIES IN INDIA OE 3.1	L	T	P
		2	-	-

Course Objectives:
The objective of this course is to familiarize the students of different streams with the basic concepts, structure, problems and issues concerning Indian economy.

COURSE OUTCOMES:
After completion of the course, the student will be able to:
CO1: Understand the basic features, demographic aspects, and major economic problems of India such as poverty, unemployment, inflation, and income inequality.
CO2: Understand the sectoral composition of Indian economy, focusing on agriculture, land reforms, Green Revolution, and agricultural policies.
CO3: Understand industrial development, including small-scale and cottage industries, public sector, industrial policies, and service sector growth.
CO4: Understand economic policies, including planning, monetary and fiscal policies, Centre–State financial relations, and LPG reforms.
CO5: Understand India's external sector, foreign trade, balance of payments, FDI, globalization impact, and WTO relations.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	–	–	1	–	1	*	*
CO2	3	2	–	–	2	–	1	*	*
CO3	3	2	1	–	2	–	1	*	*
CO4	3	3	2	–	2	1	1	*	*
CO5	3	3	2	–	3	–	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)
*PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

Course Content

UNIT-I: (06 PERIODS)
Basic features and problems of Indian Economy: Economic History of India; Nature of Indian Economy, demographic features and Human Development Index, Problems of Poverty, Unemployment, Inflation, income inequality, Black money in India.

UNIT-II: (06 PERIODS)
Sectoral composition of Indian Economy: Issues in Agriculture sector in India, land reforms Green Revolution and agriculture policies of India,

UNIT-III: (06 PERIODS)
Industrial development, small scale and cottage industries, industrial Policy, Public sector in India, service sector in India.

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UNIT-IV: **(05 PERIODS)**

Economic Policies: Economic Planning in India, Planning commission v/s NITI Aayog, Five Year Plans, monetary policy in India, Fiscal Policy in India, Centre state Finance Relations, Finance commission in India. LPG policy in India

UNIT-V: **(05 PERIODS)**

External sector in India: - India's foreign trade value composition and direction, India Balance of payment since 1991, FDI in India, Impact of Globalization on Indian Economy, WTO and India.

Reference Books:

1. Dutt Rudder and K.P.M Sunderam (2017). Indian Economy. S Chand & Co. Ltd. New Delhi.
2. Mishra S.K & V.K Puri (2017). Indian Economy and –Its Development Experience. Himalaya Publishing House.
3. Singh, Ramesh, (2016): Indian Economy, Tata-McGraw Hill Publications, New Delhi.
4. Dhingra, I.C., (2017): March of the Indian Economy, Heed Publications Pvt. Ltd.
5. Karam Singh Gill, (1978): Evolution of the Indian Economy, NCERT, New Delhi
6. Kaushik Basu (2007): The Oxford Companion to Economics of India, Oxford University Press.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted(%)
1	6	25
2	6	25
3	6	20
4	5	15
5	5	15
Total	28	100

THEORY	6.4 PROJECT MANAGEMENT (O.E-3)	L	T	P
		2	-	-

COURSE OBJECTIVES:

The aim of this course is to help the students to develop the idea of project plan, from defining and confirming the project goals and objectives, identifying tasks and how goals will be achieved.

COURSE OUTCOMES:

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

CO1: Explain the fundamental concepts of project management, including the project life cycle and priorities, and construct a Work Breakdown Structure (WBS) for a given project.

CO2: Apply the capital budgeting process to generate and screen project ideas and analyze market feasibility using demand forecasting techniques.

CO3: Estimate project costs, working capital requirements, and prepare projected financial statements including Cash Flow and Break-Even analysis.

CO4: Evaluate the financial viability of projects using discounting (NPV, IRR) and non-discounting (Payback, ARR) capital budgeting techniques and social cost-benefit analysis.

CO5: Develop project schedules using Network Planning techniques (CPM/PERT) to analyze time-cost trade-offs and determine the least cost duration.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	2	1	1	-	-	3	1	*	*
CO2	2	2	-	-	1	3	2	*	*
CO3	2	2	-	-	-	3	1	*	*
CO4	2	2	-	-	2	3	2	*	*
CO5	2	3	1	2	-	3	1	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

Course Content

UNIT-I: (06 PERIODS)

Concept of a project: Classification of projects- importance of project management- The project life cycle- establishing project priorities (scope-cost-time)project priority matrix- work break down structure.

UNIT-II: (06 PERIODS)

Capital budgeting process: Planning- Analysis-Selection-Financing-Implementation-Review. Generation and screening of project ideas- market and demand analysis- Demand forecasting techniques. Market planning and marketing research process- Technical analysis

UNIT-III: (06 PERIODS)

Financial estimates and projections: Cost of projects-means of financing-estimates of sales and production-cost of production-working capital requirement and its financing-profitability projected cash flow statement and balance sheet. Break even analysis.

UNIT-IV: (05 PERIODS)

Basic techniques in capital budgeting: Non discounting and discounting methods- payback period- Accounting rate of return-net present value-Benefit cost ratio-internal rate of return. Project risk. Social cost benefit analysis and economic rate of return. Non-financial justification of projects**.**

UNIT-V: (05 PERIODS)

Project administration: progress payments, expenditure planning, project scheduling and network planning, use of Critical Path Method (CPM), schedule of payments and physical progress, time-cost trade off.
Concepts and uses of PERT cost as a function of time, Project Evaluation and Review Techniques/cost mechanisms. Determination of least cost duration. Post project evaluation. Introduction to various Project management softwares.

Reference Books:

1. Project planning, analysis, selection, implementation and review – Prasannachandra – Tata McGraw Hill
2. Project Management – the Managerial Process – Clifford F. Gray & Erik W. Larson - McGraw Hill
3. Project management - David I Cleland - Mcgraw Hill International Edition, 1999
4. Project Management – Gopala krishnan – Mcmillan India Ltd.
5. Project Management-Harry-Maylor-Peason Publication

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted(%)
1	6	25
2	6	25
3	6	20
4	5	15
5	5	15
Total	28	100

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8- GUIDELINES FOR ASSESSMENT OF STUDENT-CENTRED ACTIVITIES (SCA)

It was discussed and decided that the maximum marks for SCA should be 50 as it involves a lot of subjectivity in the evaluation. The marks may be distributed as follows-

1- 15 Marks for general behaviour and discipline
(by HODs in consultation with all the teachers of the department)

2- 10 Marks for attendance as per following:
(by HODs in consultation with all the teachers of the department)

a) 75 - 80% 06 Marks

b) 80 - 85% 08 Marks

c) Above 85% 10 Marks

3- *** Even Semester:**

25 Marks maximum for Sports/NCC/Cultural/Co-curricular/NSSactivities as per following: (by In-charge Sports/NCC/Cultural/Co-curricular/NSS)

a) State/National Level participation
b) Participation in two of above activities
c) Inter-Polytechnic level participation

****Odd Semester:**

25 Marks maximum

a) Language Lab Practices / foreign language practices
b) Group Discussion and Personality Development
c) Industrial Visits/Industrial Talks
d) Power Point Presentations and Resume Making
e) Development of Aptitude and Reasoning Skills
f) Participation in the technical Exhibitions, Symposiums, Seminars, Workshops at the Institute /District/State/National Level.

INSTRUMENT LIST

Paint lab 3 :AIC & CPEQC				
S. N.	**Equipment Name**	**Qty**	**Approx Cost (In Rs/Unit)**	**Total cost**
1	High speed stirrer	1	35000	35000
2	China clay pot and stirrer	10	1000	10000
3	Lab ball mill/bead ball mill with motor	1	36000	36000
4	Hot Plate	1	5000	5000
5	Iron Rod	1	2000	2000
6	Distilled water unit (electrical)	1	25000	25000
7	Automatic Pigment Muller	1	125000	125000
8	Weight per litre pot	2	1200	2400
9	Hegman gauge	2	5500	11000
10	Brookfield Viscometer	2	40000	80000
11	Glass Plate	3	200	600
12	B.K drying recorder	2	28500	57000
13	DFT gauge	2	17990	35980
14	Scratch hardness tester	1	25855	25855
15	Conical mandrel	2	5000	10000
16	Ford cup with stand	2	5300	10600
17	Impact tester	1	48000	48000
18	Gloss-meter	1	120000	120000
19	Humidity Chamber	1	65000	65000
20	Salt pray Chamber	1	135000	135000
21	Cross cut adhesion tester	1	5000	5000
22	Pencil hardness tester	1	11500	11500
			Total cost	855935

POLLUTION CONTROL AND INDUSTRIAL SAFETY (P.O.E-4)		
S. N.	**Equipment Name**	**Qty**
1.	BOD incubator (5 C- 50C) with digital temperature indicator	1
2.	COD Heater	1
3.	Refrigerator, 280 ltrs.	1
4.	Laboratory oven 2’x2’x2’	1
5.	Turbidity meter (0-4000 NTU)	1
6.	TDS portable meter	1
7.	Electronic balance (0.001 grams)	1
8.	Beakers	1
9.	Conical flask, round bottom flasks	1
10.	Condenser, reflux condenser	1
11.	BOD bottles, rubber pipe, burette, pipette etc.	As per re-

		quirement
12.	LABORATORY RELATED GLASSWARES AND RAW MATERIALS	As per re-quirement

PROCESS CONTROL AND INSTRUMENTATION		
S. N.	**Equipment Name**	**Qty**
1.	Apparatus for calibration of pressure gauge- bourden tube	1
2.	Bimetallic Thermometer for temperature measurement	1
3.	U-tube Manometers for pressure measurement	1
4.	On-off Controller	1
5.	Thermocouple module setup	2
6.	Pneumatic valve setup	1
7.	Set up for study response of two tank in non-interacting and interacting system	1
8.	P controller, PD controller PID controller	1
9.	RTD module for temperature measurement	1
10.	LABORATORY RELATED GLASSWARES AND RAW MATERIALS	As per re-quirementt

MASS TRANSFER OPERATIONS-II		
S. N.	**Equipment Name**	**Qty**
1.	BATCH DISTILLATION EXPERIMENT SET-UP	1
2.	CONTINOUS DISTILLATION EXPERIMENT SET-UP	1
3.	LIQUID LIQUID EXTRACTOR EXPERIMENTAL SET-UP	1
4.	DISTILLATION PACKED COULMN APPARATUS	1
5.	LABORATORY ELECTRIACAL TRAY DRYER	1
6.	BUBBLE CAP DISTILLATION COLUMN	1
7.	LABOARATORY REFRACTOMETER	1
8.	LIQUID DIFFUSION APPARATUS	1
9.	LABORATORY COOLING TOWER SET-UP	1
10.	LABORATORY CRYSTALLIZER APPARATUS	1
11.	REVERSE OSMOSIS LABORATORY APPARATUS	1
12.	LABORATORY RELATED GLASSWARES AND RAW MATERIALS	MISC.

Fertilizer Technology		
S. N.	**Equipment Name**	**Qty**
1.	Carbon dioxide generator	1
2.	Combustion assembly	1
3.	K-Jeldahl flask (300.CC), connecting kjeldal flask, Distillation unit, receiver, Heater connecting pipings and suitable holding fixtures	6
4.	Electric Oven	2
5.	Electronics Balance 200-300 gm, 0.001 gm, back light LED with glass enclosure and lab weight for calibration	1
6.	Reflux Condenser with k-jacketed flask & fixture	1
7.	Round Bottom Flask with Joint B-24, 500ml	1
8.	LABORATORY RELATED GLASSWARES AND RAW MATERIALS	As per requiremen

POLLUTION CONTROL AND INDUSTRIAL SAFETY (P.O.E-4)		
S. N.	**Equipment Name**	**Qty**
13.	BOD incubator (5 C- 50C) with digital temperature indicator	1
14.	COD Heater	1
15.	Refrigerator, 280 ltrs.	1
16.	Laboratory oven 2'x2'x2'	1
17.	Turbidity meter (0-4000 NTU)	1
18.	TDS portable meter	1
19.	Electronic balance (0.001 grams)	1
20.	Beakers	1
21.	Conical flask, round bottom flasks	1
22.	Condenser, reflux condenser	1
23.	BOD bottles, rubber pipe, burette, pipette etc.	As per requirement
24.	LABORATORY RELATED GLASSWARES AND RAW MATERIALS	As per requirement

6.1 PROCESS CONTROL AND INSTRUMENTATION		
S. N.	**Equipment Name**	**Qty**
11.	Apparatus for calibration of pressure gauge- bourden tube	1
12.	Bimetallic Thermometer for temperature measurement	1
13.	U-tube Manometers for pressure measurement	1
14.	On-off Controller	1
15.	Thermocouple module setup	2
16.	Pneumatic valve setup	1
17.	Set up for study response of two tank in non-interacting and interacting system	1
18.	P controller, PD controller PID controller	1
19.	RTD module for temperature measurement	1
20.	LABORATORY RELATED GLASSWARES AND RAW MATERIALS	As per requirementt

10 - List of Participants / Experts

The following experts participated in various workshop for Developing the Curriculum's Structure and Contents of **Paint Technology** at I.R.D.T. Kanpur.

1. Mr. Rakesh Kumar, Head of Department (Chemical), Government Polytechnic, Kanpur
2. Dr. Shivcharan Prajapati, Lecturer (Paint Technology), Government Polytechnic, Bindki, Fatehpur
3. Mr. Vinod Prasad Sharma, Lecturer (Paint Technology), Government Polytechnic, Kanpur
4. Mr. Satyaveer Singh, Lecturer (Chemical), Government Polytechnic, Kotwan, Mathura
5. Dr. Shashi Bala Gautam, Lecturer (Chemical), Government Polytechnic, Kanpur
6. Mr. Mausam Kumar, Lecturer (P.M.T.), Government Polytechnic, Kanpur
7. Mr. Devesh Srivastava, Lecturer (Chemical), Government Polytechnic, Bindki, Fatehpur
8. Mrs. Kanchan Kushwaha, Lecturer (Petro-Chemical), Government Polytechnic, Kotwan, Mathura

Evaluation Method

ANNEXURE- 1

1. EVALUATION METHOD for THEORY

	Internal Assessment (40 marks)				External Assessment (60 marks)
	IA 1	**IA 2**	**IA 3**	**IA 4**	
Mode	**Written Test**	**Written Test**	**Attendance and Assignments**	**Pre – Semester Examination**	**End Semester Examination**
Portion	2 units	2 units	Regularly	All units	All units
Duration1hr	1hr	1hr	-	3hrs	3hrs
Exam Marks	20	20	20	60	60
Converted to	10	10	15	15	60
Tentative Schedule	5^{th} Week	10^{th} Week	Regularly	12^{th} -13^{th} Week	

IA1 and IA2: A written assessment test worth 20 marks should be conducted for two units. The marks earned (20 marks) will be converted to 10 marks. The best of the two assessments will be evaluated for an internal 10-mark assessment.

IA3: Assignments given after the completion of each unit, along with attendance throughout the semester, will be assessed for a total of 15 marks.

IA4: The pre-semester examination should follow the end-semester examination question pattern. The marks should be adjusted to 15 for internal assessment.

2. EVALUATION METHOD for PRACTICAL

	Internal Assessment (60 marks)				External Assessment (40 marks)
	IA 1	**IA 2**	**IA 3**	**IA 4**	
Mode	**Practical Test**	**Practical Test**	**Attendance and Practical Documentation**	**Practical Test and Quiz – Viva Voce**	**Practical Examination**
Portion	50% Practical	50% practical	All practical	All practical	All practical
Duration	3hrs	3 hrs	Regularly	3 hrs	3hrs
Exam Marks	20	20	20	20	40
Tentative Schedule	5th Week	10th Week	Regularly	12th -13th Week	

IA1 and IA2: Complete all exercises and experiments as outlined and retain them for the practical test. The test should be conducted in accordance with the evaluation scheme. The best of the two practical tests will be internally evaluated for a total of 20 marks.

IA3: Maintain a practical file for each exercise while ensuring attendance throughout the semester. Submit the required documents for the practical file, quiz, and practical test along with a valid certificate (Progress Card). This will be assessed for 20 marks.

IA4: The pre-semester practical examination, quiz, and viva-voce should follow the end-semester practical examination pattern, with marks adjusted to 20 for internal assessment.

SUGGESTED DISTRIBUTION OF MARKS FOR **INTERNAL** EVALUATION

Part	Description	Marks Allotted
A.	Objective	**5**
B.	Diagram	**5**
C.	Procedure	**10**
D.	Observation Table and Calculation	**10**
E.	Result and its Discussion, Conclusion	**10**
F.	Practical Test	**20**
	Total	**60**

SUGGESTED DISTRIBUTION OF MARKS FOR **EXTERNAL** EVALUATION

Part	Description	Marks Allotted
A.	Objective	**5**
B.	Diagram	**5**
C.	Procedure	**5**
D.	Observation Table and Calculation	**5**
E.	Result and its Discussion, Conclusion	**10**
F.	Viva-Voce	**10**
	Total	**40**

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3. EVALUATION METHOD for PRACTICUM (End Exam-Practical)

	Internal Assessment (60 marks)				External Assessment (40 marks)
	IA 1	**IA 2**	**IA 3**	**IA 4**	
Mode	**Practical Test**	**Practical Test**	**Attendance and Practical Documentation**	**Micro Project**	**Practical Examination**
Portion	50% practical	50% practical	All practical	All practical	All practical
Duration	3hrs	3 hrs	Regularly	Regularly	3hrs
Exam Marks	20	20	20	20	40
Tentative Schedule	5th Week	10th Week	Regularly	12th -13th Week	

- **IA1 and IA2:** Complete all exercises and experiments as instructed and retain them for the practical test. The test should be conducted according to the evaluation scheme. The best of the two practical tests will be internally assessed for a total of 20 marks.
- **IA3:** Maintain a practical file for each exercise, ensuring attendance throughout the semester. Submit the required documents for the practical file, quiz, practical test, and end-semester examination, along with a valid certificate (Progress Card). This will be evaluated by 20 marks.
- **IA4:** Submit a micro-project report along with a fabrication model or analysis report. The performance of each student in the group will be assessed by both the laboratory supervisor and an internal examiner. This evaluation will contribute 20 marks.

SUGGESTED DISTRIBUTION OF MARKS FOR **INTERNAL** EVALUATION

Part	Description	Marks Allotted
A.	Objective	**5**
B.	Diagram	**5**
C.	Procedure	**10**
D.	Observation Table and Calculation	**10**
E.	Result and its Discussion, Conclusion	**10**
F.	Mini Project	**20**
	Total	**60**

SUGGESTED DISTRIBUTION OF MARKS FOR **EXTERNAL** EVALUATION

Part	Description	Marks Allotted
A.	Objective	**5**
B.	Diagram	**5**
C.	Procedure	**5**
D.	Observation Table and Calculation	**5**
E.	Result and its Discussion, Conclusion	**10**
F.	Viva-Voce	**10**
	Total	**40**

4. EVALUATION METHOD for PRACTICUM (End Exam-Theory)

	Internal Assessment (40 marks)						External Assessment (60marks)
	IA 1		IA 2		IA 3	IA 4	
Mode	**Written Test**	**Practical Test**	**Written Test**	**Practical Test**	**Attendance and Practical Documentation**	**Pre Semester Examination and Micro Project**	**End Semester Examination**
Portion	2 units	Practical related to the units	2 units	Practical related to the units	All unit	All Practical	All unit
Duration	1hr	3hrs	1hr	3 hrs	3hrs	Regularly	3hrs
Exam Marks	10	20	10	20	60	60	60
	30		30				
Converted to	10		10		15	15	60
Tentative Schedule	5th Week		10th Week		Regularly	12th -13th Week	

IA1 and IA2: A written assessment test worth 10 marks should be conducted for two **UNIT**s. Complete all exercises and experiments as outlined and retain them for the practical test worth 20 marks. The practical test should be conducted in accordance with the evaluation scheme. The total marks earned (30 marks) will be converted to 10 marks. The best of the two assessments will be internally evaluated for a total of 10 marks.

IA3: Attendance and the pre-semester examination should follow the end-semester examination question paper pattern. The marks should be adjusted to 15 for internal assessment.

IA4: Maintain a practical file for each exercise. Submit the required documents for the practical file, quiz/viva-voice, practical test, and end-semester examination, along with a valid certificate (Progress Card). This will be assessed for 40 marks. Additionally, submit a micro-project report along with a fabrication model or analysis report. The performance of each student in the group will be evaluated by both the laboratory supervisor and an internal examiner. The total of 60 marks will be converted to 15 marks.

(ANNEXURE-I)

PROCEDURES / FORMATS FOR ORGANIZING INTERNSHIPS.

STUDENT INTERNSHIP PROGRAM APPLICATION

Complete and submit to the TPO/ Internship Program Coordinator.

1. Student Name:			Enroll. No.:
2. Campus Address:			Phone:
3. Home Address:			Phone:
4. Student email address:			
5. Branch:		6. Internship Semester: _____	
7. Internship Preferences			
	Company/Industry	Core Area	Location
Preferance-1			
Preferance-2			
Preferance-3			
Faculty mentor Signature: _____Date_____.			
Student Signature: _____Date_____. Signature confirms that the student agrees to the terms, conditions, and requirements of the Internship Program			

Signature with seal
HOD/Principal

(ANNEXURE-I)

REQUEST LETTER FROM INSTITUTE TO INTERNSHIP/INDUSTRIAL TRAINING PROVIDER

Ref. No.: _____ Date: _____

To,
The HR Manager/Training Coordinator
……
……

Subject: Request for Internship/Industrial Training for Diploma Students

Sir/Madam,

We are pleased to introduce……., a premier institution affiliated with Board of Technical Education, Uttar Pradesh, offering diploma programs in various diploma disciplines.

As a part of the curriculum, our students are required to undergo Internship/Industrial Training to gain practical exposure and enhance their technical competencies. Therefore, we kindly request your esteemed organization to provide Internship/Training opportunities to our students during the period from …….. to ……..

S. No.	Name	Enroll. No.	Semester/Year	Discipline

Yours sincerely,

(Head of Department/Principal)

(ANNEXURE-II)

PROFORMA FOR EVALUATION OF INTERNSHIP BY INDUSTRY

Student Name: ……Evaluation Date: ……

Industry Supervisor Name: ……

Company/Organization: ……

Title of the Project……

Please evaluate your intern by indicating the frequency with which you observed the following behaviors:

Parameters	**Max. Marks**	**Marks Given**
Attendance and Punctuality	20	
Discipline and Professional Behavior	20	
Technical Knowledge and Understanding of Processes	30	
Practical Skills and Quality of Work	20	
Ability to Apply Theoretical Knowledge	20	
Problem Solving and Analytical Ability	10	
Communication and Interpersonal Skills	20	
Teamwork and Collaboration	10	
Internship Report/Documentation	20	
Presentation and Viva-Voce	30	
Total Marks	200	

Additional comments, if any:

Signature with seal of Industry supervisor HR Manager

(ANNEXURE-II)

INTERNSHIP REPORT

STUDENT'S DIARY/ DAILY LOG

The main purpose of writing daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the students' thought process and reasoning abilities. The students should record in the daily training diary the day to day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students.

The daily training diary should be signed after every day by the supervisor/ in charge of the section where the student has been working. The diary should also be shown to the Faculty Mentor visiting the industry from time to time and got ratified on the day of his visit.

Student's Diary and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the Institute immediately after the completion of the training. It will be evaluated on the basis of the following criteria:

- Regularity in maintenance of the diary.
- Adequacy & quality of information recorded.
- Drawings, sketches and data recorded.
- Thought process and recording techniques used.
- Organization of the information.

INTERNSHIP REPORT

After completion of Internship, the student should prepare a comprehensive report to indicate what he has observed and learnt in the training period. The student may contact Industrial Supervisor/ Faculty Mentor/TPO for assigning special topics and problems and should prepare the final report on the assigned topics. Daily diary will also help to a great extent in writing the industrial report since much of the information has already been incorporated by the student into the daily diary. The training report should be signed by the Internship Supervisor, TPO and Faculty Mentor. The Internship report will be evaluated on the basis of following criteria:

i. Originality.

ii. Adequacy and purposeful write-up.

iii. Organization, format, drawings, sketches, style, language etc.

iv. Variety and relevance of learning experience.

v. Practical applications, relationships with basic theory and concepts taught in the course.

(ANNEXURE-II)

MONITORING & EVALUATION OF INTERNSHIP

The industrial training of the students will be evaluated in three stages:

1. Evaluation by Industry.

2. Evaluation by faculty supervisor of Industry.

3. Evaluation through seminar presentation/viva-voce at the Institute.

1. EVALUATION BY INDUSTRY

The industry will evaluate the students based on the Punctuality, eagerness to learn, Maintenance of Daily Diary and skill test in addition to any remarks.

2. MONITORING/ SURPRISE VISIT BY TPO/ STAFF/ FACULTY MENTOR

TPO/Staff/ Faculty Mentor of the institutes will make a surprise visit to the internship site, to check the student's presence physically, if the student is found absent without prior intimation to the T & P Cell, entire training will be cancelled. Students should inform the TPO, faculty mentor as well as the industry supervisor at least one day prior to availing leave by email. Students are eligible to avail 1-day leave in 4 weeks and 2 days leave in 6 weeks of the internship period apart from holidays and weekly offs.

3. EVALUATION THROUGH SEMINAR PRESENTATION/VIVA-VOCE AT THE INSTITUTE

The student will give a seminar based on his training report, before an expert committee constituted by the concerned department as per norms of the institute. The evaluation will be based on the following criteria:

• Quality of content presented.

• Proper planning for presentation.

• Effectiveness of presentation.

• Depth of knowledge and skills.

• Attendance record, daily diary, departmental reports shall also be analyzed along with the Internship Report.

Seminar presentation will enable sharing knowledge & experience amongst students & teachers and build communication skills and confidence in students.