Maharashtra State Board of Technical Education, Mumbai

Teaching And Examination Scheme For Post S.S.C. Diploma Courses

Program Name : Diploma in Plastic Engineering

Program Code : PS **With Effect From Academic Year: 2017 - 18**

Duration of Program : 6 Semesters **Duration : 16 Weeks**

Semester : Second **Scheme : I**

S. N.	Course Title	Course Abbreviation	Course Code	Teaching Scheme			Credit (L+T+P)	Examination Scheme												Grand Total
								Theory							Practical					
								Exam Duration in Hrs.	ESE		PA		Total		ESE		PA		Total	
				L	T	P			Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	
1	Basic Electrical and Electronics Engineering	BEE	22208	4	-	2	6	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
2	Instrumentation in Plastic Processes	IPP	22227	3	-	2	5	3	70	28	30*	00	100	40	25#	10	25	10	50	20	150
3	Mechanical Engineering In Plastic Production Engg.	MEP	22228	3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
4	Organic Chemistry	OCH	22229	3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
5	Polymer Science	PSC	22230	3	-	2	5	3	70	28	30*	00	100	40	25#	10	25	10	50	20	150
6	Business Communication Using Computers	BCC	22009	-	-	2	2	--	--	--	--	--	--	--	35@^	14	15~	06	50	20	50
7	Computer Aided Drafting	CAD	22011	-	-	2	2	--	--	--	--	--	--	--	25@	10	25~	10	50	20	50
			Total	**16**	**-**	**14**	**30**	--	**350**	--	**150**	--	**500**	--	**185**	--	**165**	--	**350**	--	**850**

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

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

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

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

* Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment (5 marks each for Physics and Chemistry) to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain LOs required for the attainment of the COs.

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

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

Program Name : **Mechanical and Plastic Engineering Program Group**
Program Code : **AE/FG/ME/PT/PG/PS**
Semester : **Second**
Course Title : **Basic Electrical & Electronics Engineering**
Course Code : **22208**

1. RATIONALE

Diploma engineers (also called technologists) passouts have to deal with electrical and electronics engineering principles and applications in industrial processes of different fields. It is therefore necessary for them to apply the principles of electrical and electronics engineering. This course will make them conversant with electrical / electronic engineering aspects of manufacturing, production, fabrication, automobile and mechanical engineering based processes in industries.

2. COMPETENCY

This course is to be taught and implemented with the aim to develop in the student, the course outcomes (COs) leading to the attainment of following industry identified competency expected from this course:

- **Use electrical and electronic equipment safely in mechanical engineering applications.**

3. COURSE OUTCOMES (COs)

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

a. Use principles of electric and magnetic circuits to solve engineering problems.
b. Determine voltage and current in A.C. circuits.
c. Connect transformers and electric motors for specific requirements.
d. Identify electronic components in electric circuits.
e. Use relevant electronic components safely.
f. Use relevant electric/electronic protective devices safely.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory						Practical					
				Paper	ESE		PA		Total		ESE		PA		Total	
L	T	P		Hrs.	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
4	-	2	6	3	70	28	30*	00	100	40	25@	10	25	10	50	20

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

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

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

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

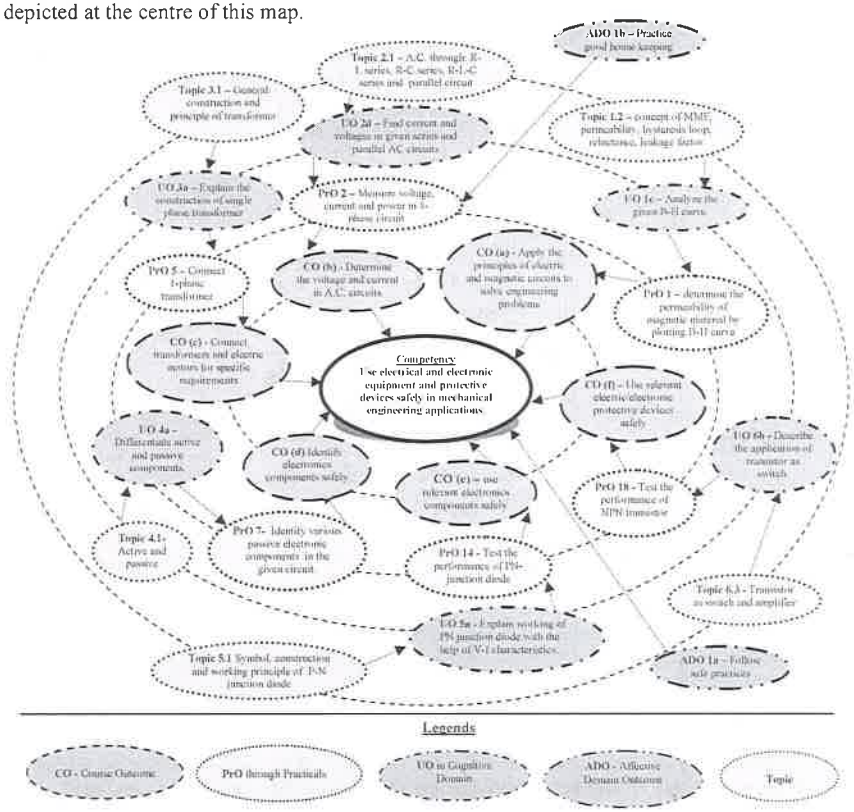

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

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

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

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Determine the permeability of magnetic material by plotting its B-H curve.	I	02*
2	Measure voltage, current and power in 1-phase circuit (with resistive load).	II	02*
3	Measure voltage, current and power in R-L series circuit.	II	02*
4	Measure transformation ratio (K) of 1-phase transformer.	III	02
5	Connect single phase transformer and measure input and output quantities.	III	02
6	Make Star and Delta connection in induction motor starters and measure the line and phase values	III	02
7	Identify various passive electronic components in the given circuit	IV	02
8	Connect resistors in series and parallel combination on bread board and measure its value using digital multimeter.	IV	02
9	Connect capacitors in series and parallel combination on bread board and measure its value using multimeter.	IV	02*
10	Identify various active electronic components in the given circuit	IV	02
11	Measure the value of given resistor using multimeter	IV	02
12	Measure the value of given capacitor ad inductor using LCR-Q tester	IV	02
13	Determine the value of given resistor using digital multimeter to confirm with colour code.	IV	02*
14	Test the PN-junction diodes using digital multimeter.	V	02*
15	Test the performance of PN-junction diode.	V	02
16	Test the performance of Zener diode.	V	02
17	Test the performance of LED.	V	02
18	Identify three terminals of a transistor using digital multimeter.	VI	02
19	Test the performance of NPN transistor.	VI	02*
20	Determine the current gain of CE transistor configuration.	VI	02
21	Test the performance of transistor switch circuit.	VI	02
22	Test the performance of transistor amplifier circuit.	VI	02
	Total		**44**

Note

i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

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

S. No.	Performance Indicators	Weightage in %
1	Preparation of experimental set up	20
2	Setting and operation	20
3	Safety measures	10

S. No.	Performance Indicators	Weightage in %
4	Observations and Recording	10
5	Interpretation of result and Conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
	Total	**100**

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

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

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

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Exp. S.No.
1	Single Phase Transformer: 1kVA, single-phase, 230/115 V, air cooled, enclosed type.	1,5
2	Single phase auto transformer (Dimmerstat) - Single-Phase, Air cooled, enclosed model, Input: 0 ~ 230, 10A, Output: 0 ~ 270Volts	2,3,4
3	Lamp Bank - 230 V 0-20 A	17
4	Single phase Induction motor – ½ HP,230 V,50 Hz. AC supply	5
5	Different types of starters	6
6	Digital multimeter , 3and ½ digit, seprate range for resistancs and capacitance,component tester, AC and DC measurement.	7,8,11,13, 14,15,16
7	Dual trace CRO/DSO, 50MHz.	4,5,19, 20
8	Function generator,:0-2MHz. for generation of Sin ,square, pulse and triangular wave shapes	17,21,22
9	LCR-Q Meter/Tester	12

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	Electrical Engineering	
Unit – I Electric and Magnetic Circuits	1a. Explain the given technical terms related to electric and magnetic circuits. 1b. Intrepret the given B-H curve. 1c. Intrepret hysteresis loop of the given material. 1d. Apply Fleming's right hand rule and Lenz's law for determination of direction of induced emf in the given situation.	1.1 EMF, Current, Potential Difference, Power and Energy. 1.2 M.M.F, magnetic force, permeability, hysteresis loop, reluctance, leakage factor and B-H curve. 1.3 Electromagnetic induction, Faraday's laws of electromagnetic induction, Lenz's law. 1.4 Dynamically induced emf. 1.5 Statically induced emf.-(a) Self induced emf (b) Mutually induced emf. 1.6 Equations of self and mutual inductance. 1.7 Analogy between electric and magnetic circuits.
Unit– II A.C. Circuits	2a. Explain attributes of the given AC quantities. 2b. Find currents and voltages in the given series and parallel AC circuits. 2c. Derive the current and voltage relationship in the given star and delta connected circuits 2d. Determine the current and voltage in the given star and delta connection. 2e. Solve simple numerical problems related to the given AC circuits	2.1 Cycle, Frequency, Periodic time, Amplitude, Angular velocity, RMS value, Average value, Form Factor , Peak Factor, impedance, phase angle, and power factor. 2.2 Mathematical and phasor representation of alternating emf and current. 2.3 Voltage and Current relationship in Star and Delta connections. 2.4 A.C in resistors, inductors and capacitors. 2.5 A.C in R-L series, R-C series, R-L-C series and parallel circuits. 2.6 Power in A. C. Circuits, power triangle.
Unit– III Transformer and single phase induction motors	3a Explain the construction and principle of the given type of single phase transformer. 3b Explain working principle of the given Autotransformer. 3c Describe the construction of the given single phase motor. 3d Explain working principle of the given single phase induction motors.	3.1 General construction and principle of different type of transformers. 3.2 Emf equation and transformation ratio of transformers. 3.3 Auto transformers. 3.4 Construction and Working principle of single phase A.C. motor. 3.5 Types of single phase motors, applications of single phase motors.
	Electronics Engineering	
Unit – IV Electronic Components and Signals	4a. Differentiate between the given active and passive electronic components. 4b. Calculate value of the given resistor and capacitor using colour code. 4c. Explain the given signal parameters with sketches. 4d. Identify the given type of ICs based on the IC number.	4.1 Active and passive components. 4.2 Resistor, capacitor, inductor symbols, colour codes, specifications. 4.3 Voltage and Current Sources. 4.4 Signals: waveform (sinusoidal, triangular and square), time and frequency domain representation, amplitude, frequency, phase, wavelength. 4.5 Integrated Circuits – analog and digital.
Unit– V Diodes and Applications	5a. Explain working of the given type of diode usiing V-I characteristics. 5b. Locate the zener voltage on the given V-I characteristic with justification. 5c. Explain the working of the given type of rectifier using circuit diagrams. 5d. Justify selection of power supply and LEDs for the given circuit.	5.1 P-N junction diode: symbol, construction , working and applications. 5.2 Zener diode: working, symbol, voltage regulator. 5.3 Rectifiers: Half wave, Full wave and Bridge Rectifier, Performance parameters: PIV, ripple factor, efficiency. 5.4 Filters: circuit diagram and working of 'L', 'C' and 'π' filter 5.5 Light Emitting Diodes: symbol, construction, working principle and applications.
Unit– VI Bipolar Junction Transistor	6a. Describe the application of the given type of transistor as a switch. 6b. Determine the current gain of the given type of transistor configurations using transfer characteristic curve. 6c. Compare performance paramenters of the given transistor configurations. 6d. Select the type of transistors and their configurations for the given application.	6.1 BJT: symbol, construction and working principle. 6.2 Transistor as switch and amplifier. 6.3 Input and Output characteristics: CE, CB and CC configurations. 6.4 Operating regions: Cut-off, saturation and Active. 6.5 Transistor parameters: CB gain α, CE gain β, input resistance, output resistance, relation between (α) and (β).

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

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
	Electrical Engineering					
I	Electric and Magnetic Circuits	04	02	02	04	08
II	A.C. Circuits	08	02	04	06	12
III	Transformer and single phase induction motors	10	04	06	06	16
	Electronics Engineering					
IV	Electronic components and Signals	08	02	04	06	12
V	Diodes and applications	08	02	04	06	12
VI	Bipolar Junction Transistor	10	02	04	04	10
Total		**48**	**14**	**24**	**32**	**70**

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

10. SUGGESTED STUDENT ACTIVITIES

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

a. Make star delta connections of transformer.
b. Connect the various meters to measure the current and voltage of induction motor.
c. Visit site and interpret the name plate ratings and identify the parts of a transformer.
d. Present seminar on any of the above or relevant topic.
e. Conduct market survey and interpret the name plate ratings and identify the parts of an induction motor.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

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

12. SUGGESTED MICRO-PROJECTS

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

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

a. **Electric and magnetic circuit**: Each batch will prepare a coil without core. Students will note the deflection of galvanometer connected across the coil for: movement of the North Pole of permanent magnet towards and away from the coil (slow and fast movement), movement of the South Pole of permanent magnet towards and away from the coil (slow and fast movement). Students will demonstrate and prepare a report based on their observations. **(Duration: 8 hours)**
b. **Transformer**: Each batch will visit nearby pole mounted sub-station and prepare a report based on the following points:
   i. Rating: kVA rating, primary and secondary voltage, connections
   ii. Different parts and their functions
   iii. Earthing arrangement
c. **Single phase induction motor:** Each batch will select a three phase squirrel cage type induction motor for a particular application (assume suitable rating). They will visit local electrical market (if the market is not nearby you may use the Internet) and prepare a report based on the following points:
   i. Manufactures
   ii. Technical specifications
   iii. Features offered by different manufacturers
   iv. Price range
d. **Transistor as a switch:** Each batch (3-4 students) will search and study datasheet of transistor and relevant component and will build / test transistor switch circuit on breadboard/General purpose PCB for various input signal.
e. **Prepare display boards consisting of electronic components**: Each batch (3-4 students) will prepare display boards/ models/ charts/ Posters to visualize the appearance of electronic active and passive components.
f. **Diode:** Build a circuit on general purpose PCB to clamp a waveform at 3.0V using diode and passive components.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Fundamentals of Electrical Engineering	Saxena, S. B. Lal	Cambridge University Press, latest edition ISBN : 9781107464353

S. No.	Title of Book	Author	Publication
2	Basic Electrical Engineering	Mittle and Mittal	McGraw Education, New Delhi, 2015, ISBN : 978-0-07-0088572-5
3	Electrical Technology Vol – I	Theraja, B. L.	S. Chand publications, New Delhi, 2015, ISBN: 9788121924405
4	Electrical Technology Vol – II	Theraja, B. L.	S. Chand publications, New Delhi, 2015, ISBN: 9788121924375
5	Basic Electrical and Electronics Engineering	Jegathesan, V.	Wiley India, New Delhi, 2015 ISBN : 97881236529513
6	A text book of Applied Electronics	Sedha, R.S.	S.Chand ,New Delhi, 2008 ISBN-13: 978-8121927833
7	Electronics Principles	Malvino, Albert Paul, David	McGraw Hill Eduction, New Delhi, 2015, ISBN-13: 978-0070634244
8	Principles of Electronics	Mehta, V.K. Mehta, Rohit	S. Chand and Company, New Delhi, 2014, ISBN-13-9788121924504
9	Fundamental of Electronic Devices and Circuits	Bell Devid	Oxford University Press, New Delhi 2015 ISBN : 9780195425239

14. SOFTWARE/LEARNING WEBSITES

a. Electronics Workbench
b. www.nptel.iitm.ac.in
c. en.wikipedia.org/wiki/Transformer
d. www.animations.physics.unsw.edu.au//jw/AC.html
e. www.alpharubicon.com/altenergy/understandingAC.htm
f. www.electronics-tutorials
g. learn.sparkfun.com/tutorials/transistors
h. www.pitt.edu/~qiw4/Academic/ME2082/Transistor%20Basics.pdf
i. www.technologystudent.com/elec1/transis1.htm
j. www.learningaboutelectronics.com/
k. www.electrical4u.com

Program Name : **Diploma in Plastic Engineering**

Program Code : **PS**

Semester : **Second**

Course Title : **Instrumentation in Plastic Processes**

Course Code : **22227**

1. RATIONALE

The art of measurement plays an important role in plastic processing. With advances in technology, measurement techniques have also taken rapid strides, with many types of instrumentation devices, innovations, refinements in plastic manufacturing processes. The course aims at making a plastics diploma technocrat student measure parameters like temperature, pressure, flow, speed, force, strain with instruments, transducers and to control systems of engineering processes. This expertise will be essential for higher semester courses like mould manufacturing and plastics processing.

2. COMPETENCY

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

- **Maintain instrumentation systems used in plastic processing plants.**

3. COURSE OUTCOMES (COs)

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

a. Select transducers for specific requirements.
b. Measure pressure parameters.
c. Measure temperature parameters.
d. Measure flow parameters.
e. Measure humidity, speed, liquid level and strain parameters.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory						Practical					
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
L	T	P			Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	2	5	3	70	28	30*	00	100	40	25#	10	25	10	50	20

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

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

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

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

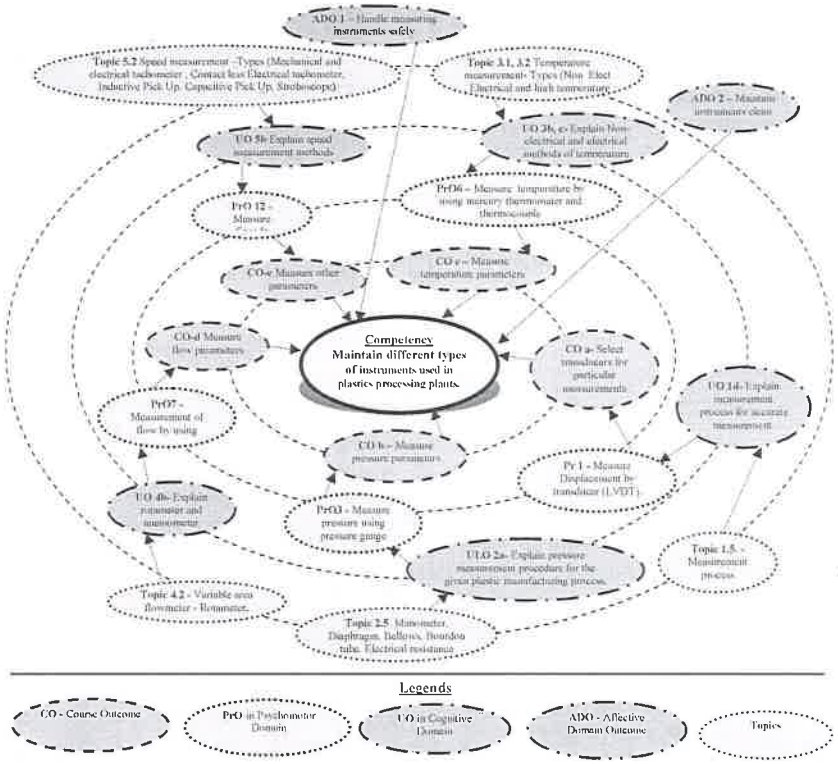

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

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

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Measure displacement by transducer (LVDT).	I	02*
2	Repair/preventive maintenance/troubleshoot/modify LVDT.	I	02
3	Measure pressure using pressure gauge.	II	02*
4	Repair/Maintain/troubleshoot/modify pressure gauge.	II	02
5	Measure temperature by using mercury thermometer and	III	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	thermocouple.		
6	Repair/Maintain/troubleshoot/modify thermocouple.	III	02
7	Measure flow using rotameter.	IV	02*
8	Repair/Maintain/troubleshoot/modify rotameter.	IV	02
9	Measure Liquid Level.	IV	02
10	Repair/Maintain/troubleshoot/modify liquid level measuring instruments.	IV	02
11	Measure strain by using a strain gauge.	V	02*
12	Measure speed by using Stroboscope/ Magnetic / Inductive Pick Up.	V	02
13	Repair/Maintain/troubleshoot/modify stroboscope /magnetic / inductive pick up speed measuring instruments.	V	02
14	Measure humidity.	V	02
15	Measure shaft power using rope brake dynamometer.	V	02
16	Repair/Maintain/troubleshoot/modify shaft power measuring instruments.	V	02
	Total		**32**

Note

i. *A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

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

S. No.	Performance Indicators	Weightage in %
1	Setting of experimental set up	20
2	Operate equipment skillfully	30
3	Follow Safety measures	10
4	Work in team	10
5	Record Observations	10
6	Interpret Results to conclude	10
7	Answer to sample questions	5
8	Submit report in time	5
	Total	**100**

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

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

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

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Exp. S.No.
1	Displacement measurement trainer (LVDT). (220-240VAC, Input Frequency 50Hz, Outputs :+5 V / 1 A-5 V /500 mA+12 V / 500 mA-12 V / 500 mA/)	1
2	Pressure measurement trainer. (Range: 0 -10 KG/300mm., 3.5 digit DPM indication of Pressure, 220V, Built in IC regulated power supply)	3,4
3	Mercury thermometer (temperature range 0 -300^{0}C)	5,6
4	Thermocouple (temperature range 0 -500^{0}C)	5,6
5	Rotameter (Flow Rate: 1-26 L/min water)	7,8
6	Strain gauge (230V, 50Hz AC., Bridge: of 4 strain gauges mounted on alloy materials type load cell, Built in 3.5 digit seven segment display in Kg.)	9
7	Stroboscope Pick Up measuring instrument.	10,11
8	Inductive Pick Up speed measuring instruments.(Motor: bi-directional, permanent magnet armature controlled DC motor, Power:6W, Speed : 3500 R.P.M Max., Voltage : 12V DC, Torque : 0.3 Kg. cm^2)	0,11
9	Magnetic Pick Up measuring instruments. (12 V, 2400 RPM permanent magnet DC motor, Speed controller (0 - 2400 RPM), 4 digit digital counter for speed display, Electronic tachogeneration, Built in IC regulated supplies)	0,11
10	Liquid level measuring devices. (A transparent tank of height 150mm)	2,13
8	Humidity meter (Sensor: Capacitive, 3 ½ digit digital display. Standard Accessories: 1. Humidity Chamber 2. Humidifier 3. Instruction Manual 4. Supplementary dry / wet bulb thermometer.)	14
9	Tool kit	All
10	Rope brake	15,16
11	Eddy current dynamometer. (1/10th HP DC motor max speed 2500 RPM, Transducer: Load cell, RPM Measurement: Proximity sensor with toothed wheel to sense & indicate motor RPM, 3.5 digit digital display of Torque in KgM, Controls: 1. Multi – turn Load potentiometer with Dial 2. Interlock of water flow switch 3. Electronic Controller for Dynamometer, Test Points: Multi – coloured test points to observe the waveforms and voltages, Indicator: Mains ON / OFF, Connector: Facility for connecting transducer, 230V, + 10% AC 50Hz, 1 phase.)	15,16

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Basic measurement process.	1a. Differentiate concept of static and dynamic characteristics of measurement in the given application. 1b. Describe the types of errors in measurements in the given application. 1c. Explain the measurement process for accuracy of measurement in the given application. 1d. Select transducer for the given situation with justification .	1.1 Types of measurement and classification of instruments 1.2 Static terms and characteristics 1.3 Dynamic characteristics 1.4 Errors in measurement 1.5 Measurement process 1.6 Transducers
Unit– II Displacement and Pressure measurement	2a. Select relevant type of displacement transducer for the given situation with justification. 2b. Describe with sketches the displacement measurement process in the given application. 2c. Differentiate between the given two types of pressures. 2d. Justify the selection of pressure measurement procedure for the given plastic manufacturing process.	2.1 Displacement transducer , types (Capacitive transducer, Potentiometer, LVDT, RVDT) 2.2 Selection and application of displacement transducer. 2.3 Measurement of vacuum, atmospheric, gauge and absolute pressure. 2.4 McLeod Gauge and Pirani gauge. 2.5 Manometer, Diaphragm, Bellows, Bourdon tube , Electrical resistance type, Photoelectric pressure , transducers, piezoelectric type, Variable capacitor type
Unit– III Temperature and humidity measurement	3a. Describe with sketches the given non – electrical method of temperature measurements. 3b. Describe with sketches the given type of electrical method of temperature measurement. 3c. Explain with sketches the given method (s) of high temperature measurement. 3d. Describe with sketches the given method of humidity measurement. 3e. Justify the selection of temperature and humidity measurement method for the given plastic manufacturing process.	3.1 Temperature measurement- Types (Non Electrical , Electrical and high temperature) 3.2 Non-electrical methods- Bimetal, Liquid in glass thermometer and Pressure thermometer 3.3 Electrical methods- RTD, Platinum resistance thermometer, Thermistor, Thermoelectric methods - elements of thermocouple, Seebek effect, pettier effect, law of intermediate temperature, law of intermediate metals, thermo emf measurement. 3.4 High temperature - Radiation and

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
		optical Pyrometers 3.5 Humidity measurement –Hair hygrometer , Sling psychomotor
Unit– IV Flow and liquid level measurement	4a. Differentiate salient features of the given type of liquid measurement transducer. 4b. Explain with sketches the working of the given special type of flow meters. 4c. Describe with sketches the construction of the the given type of flowmeter. 4d. Explain with sketches the given liquid level measurement method. 4e. Validate the rationale of selecting a given flow and liquid level measurement technique for the given plastic manufacturing process.	4.1 Flow measurement – Types (Variable area meter and special flow meters) 4.2 Variable area flow meter - Rota meter, Anemometer. 4.3 Special flow meter - Electromagnetic flow meter, Ultrasonic flow meter, Turbine meter, Vortex shedding flow meter 4.4 Liquid level measurement- Direct and Indirect methods.
Unit– V Miscellaneous Measurement	5a. Explain with sketches shaft power measurement procedurein the given application. 5b. Explain with sketches the working principle of the given type of speed measurement sensor for the given plastic manufacturing process. 5c. Explain strain measurement principles for the given application. 5d. Select relevant strain gauge for the given situation with justification. 5e. Rationalise the criteria of selecting shaft power measurement, speed and strain measurement gauges for the given situation.	5.1 Shaft power measurement – Types (Eddy Current Dynamometer, Strain Gauge Transmission Dynamometer) 5.2 Speed measurement –Types (Mechanical and electrical tachometer , Contact less Electrical tachometer, Inductive Pick Up, Capacitive Pick Up, Stroboscope) 5.3 Strain measurement- Stress-strain relation, types (resistance strain gauge- bonded and unbounded types -foil, semiconductor, wire wound gauges), strain gauge material.

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

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Basic measurement process	06	02	02	02	06
II	Displacement and Pressure measurement	12	02	06	10	18
III	Temperature and humidity measurement	10	02	06	10	18
IV	Flow and liquid level measurement	08	02	02	06	10
V	Miscellaneous Measurement	12	04	06	08	18
Total		**48**	**12**	**22**	**36**	**70**

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

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

10. SUGGESTED STUDENT ACTIVITIES

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

a. Collect types, specification, price and manufacturer of pressure measurement gauges for plastic processes. Write letters of enquiry to suppliers.
b. Collect types, specification, price and manufacturer of temperature measurement devices for plastic processes. Write letters of enquiry to suppliers.
c. Collect types, specification, price and manufacturer of flow measurement meters for plastic processes. Write letters of enquiry to suppliers, make comparative charts.
d. Collect types, specification, price and manufacturer of liquid level measurement devices for plastic processes. Write letters of enquiry to suppliers.
e. Collect types, specification, price and manufacturer of speed measurement devices for plastic processes. Write letters of enquiry to suppliers.
f. Collect types, specification, price and manufacturer of strain measurement gauges for plastic processes. Write letters of enquiry to suppliers.
g. Prepare a chart of safety precautions for measurement processes. Give class presentation.
h. List common troubleshooting problems and remedies for measuring instruments. Give class presentation.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

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

c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.
f. Demonstrate measurement process of instruments.
g. Use instructional manual for measurement process, troubleshooting and maintenance.
h. Show calibration certificate of instruments.
i. Assign different types of micro projects.
j. Guide student(s) in using measuring instruments.
k. Give instructions regarding safety in using electrical connections of instruments.
l. Assign micro projects to group of 4 to 5 students and let them prepare and present the project through PPT. Group shall submit a report which is limited to 5 pages.
m. Use of video, animation films to explain concepts, facts and applications related to instrumentation.
n. In respect of item 10 above, teachers need to ensure to create opportunities and provisions for such co-curricular activities.
o. Guide student(s) in using measuring instruments.
p. Give instructions regarding safety in using electrical connections of instruments.

12. SUGGESTED MICRO PROJECTS

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

In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty. Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews.

a. **Maintenance**: Students should do preventive maintenance of measuring instruments.
b. **Innovation:** Students should modify/calibrate measuring instruments.
c. **Working Principles:** Draw flow diagrams for working principle of instruments.
d. **SOPs:** Identify standard operating procedure and best practices for measurement in plastic processing. Give class presentation.
e. **LLL:** Download plastic processing videos. Give class presentation.
f. **Troubleshooting:** Student should repair non working measuring instruments.

Program Name : **Diploma in Plastic Engineering**
Program Code : **PS**
Semester : **Second**
Course Title : **Mechanical Engineering in Plastics Production**
Course Code : **22228**

1. RATIONALE

In the era of technology integration, diploma plastics technologists require skills in various engineering disciplines. The motive of this course is to enhance skill level in the inter-disciplinary area of mechanical engineering which is used by plastics engineers in plastic process industry. A plastics diploma technocrat has to apply mechanical engineering concepts, hand and power tools, machine tools, power transmission system, material handling and heat transfer in plastic manufacturing following standard mechanical engineering practices. This course aims at building a foundation of mechanical engineering principles essential for plastic processing which includes developing ability to use mechanical machine tools, safety, troubleshooting and remedial measures for mechanical systems in plastic processing industry.

2. COMPETENCY

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

- **Use basic principles of mechanical engineering to solve plastic engineering problems.**

3. COURSE OUTCOMES (COs)

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

a. Select hand/power tools for plastic processing.
b. Use relevant manufacturing processes for plastic processing.
c. Analyse the plastic parts used in the renewable energy systems.
d. Select power transmission system for plastic processing system.
e. Apply heat transfer mode for plastic processing and energy conservation methods.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory						Practical					
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
L	T	P			Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20

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

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

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

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

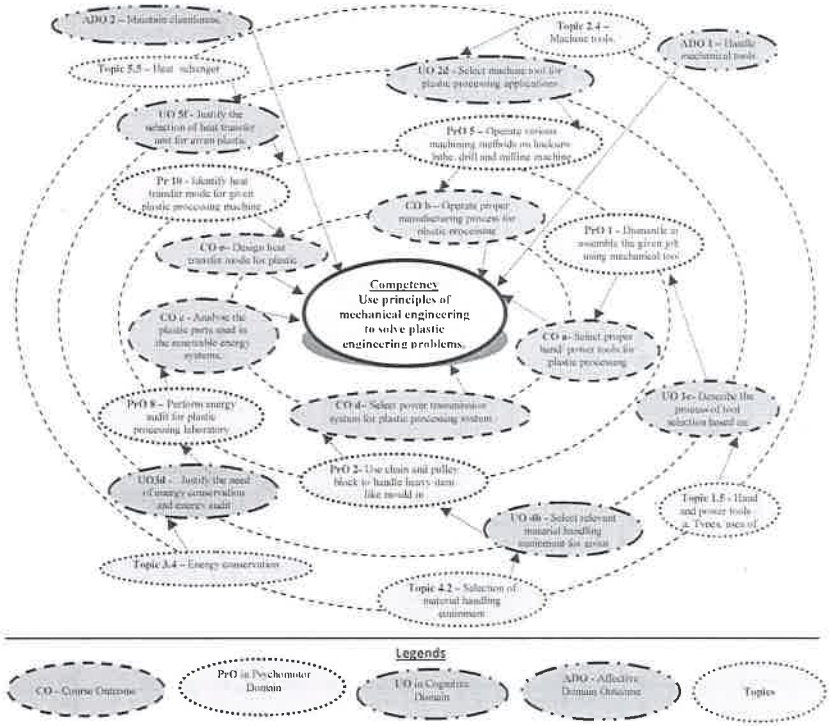

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

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

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Dismantle and assemble the given job by using mechanical tools.	I	02*
2	Identify power transmission system used in plastic processing machine tool.	I	02
3	Execute plastic joining process.	II	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
4	Prepare joint of two pieces of any plastic material. Part I	II	02*
5	Prepare joint of two pieces of any plastic material. Part II	II	02
6	Prepare joint of two pieces of any plastic material. Part III	II	02
7	Operate various machining methods on hacksaw, lathe, drill and milling machine in plastic processing.	II	02
8	Produce the given job by using relevant manufacturing process – cutting, drilling, turning, milling of plastic material. Part I	II	02
9	Produce the given job by using relevant manufacturing process – cutting, drilling, turning, milling of plastic material. Part II	II	02
10	Produce the given job by using relevant manufacturing process – cutting, drilling, turning, milling of plastic material. Part III	II	02
11	Perform energy audit for laboratory.	III	02*
12	Use solar flat collector for water heating/lighting.	III	02
13	Use chain and pulley block to handle heavy item like mould in workshop/plastics processing laboratory. Part I	IV	02
14	Use chain and pulley block to handle heavy item like mould in workshop/plastics processing laboratory. Part II	IV	02
15	Identify heat transfer mode for given plastic processing machine.	V	02*
16	Operate heat exchanger used in given plastic processing machine.	V	02
	Total		**32**

Note

i. *A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

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

S. No.	Performance Indicators	Weightage in %
1	Setting of experimental set up	20
2	Operate equipment skillfully	30
3	Follow Safety measures	10
4	Work in team	10
5	Record Observations	10
6	Interpret Results to conclude	10
7	Answer to sample questions	5
8	Submit report in time	5
	Total	**100**

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

a. Follow safety practices.
b. Practice good housekeeping.

c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical practices.

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

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Exp. S.No.
1	Mechanical items –spanner, hand tools, springs and power tools.	All
2	Brazing equipment with accessories. (Standard size)	3,4
3	Soldering equipment with accessories. (Standard size)	3,4
4	Chain and pulley block for lifting load. (Capacity 1 ton)	9
5	Solar flat collector system. (Lab model)	8
6	Milling machine. (Lab model)	5,6
7	Lathe machine. (Lab model)	5,6
8	Drilling machine. (Lab model)	5,6
9	Cutter.	5,6
10	Heat exchanger- double pipe type. (Lab model)	10,11
11	Heat exchanger shell and tube type. (Lab model)	10,11
12	Mechanical items as per IS such as – nuts, bolts, screws, pipe fittings.	1,2,9

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Mechanical engineering tools and power transmission	1a. Explain applications of mechanical engineering concepts in the given plastics processing. 1b. Describe types of pipes and pipe fittings used in the given plastic processing machines. 1c. Differentiate on the basis of utility between hand and power tools used in the given plasticS processing.	1.1 Mechanical engineering concepts used in plastics engineering 1.2 Items of general use: major types, specification and uses: bolts, nuts, washers, bearings, springs, brakes, screws, and keys. 1.3 Pipes: types, specification and uses. Pipe fittings in Plastics engineering. 1.4 Spanners: Types, specification and uses of spanners (Fix, ring,

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	1d. Describe modes of power transmission and their suitable the given applications. 1e. Describe the troubleshooting process of the given power transmission systems. 1f. Explain general safety norms of the given mechanical engineering shop. 1g. Justify the selection of relevant power transmission system for the given plastic manufacturing process.	box, pipe, allen, adjustable). Other Hand tools: Types, specification and uses of hand tools (pliers, screw driver, saws, hammers, chisels, files, planes) 1.5 Power tools: Types, specifications and uses of power tools (Drill, chipper, cutters). 1.6 Power transmission: Importance, Modes (belt, rope, chain, gear drives), Types of belt drives, Types of gear drives, applications. 1.7 Couplings: Types - rigid and flexible; applications. 1.8 Causes and remedies of general failures in power transmission. 1.9 Safety norms to be followed for preventive and breakdown of power transmission system
Unit– II Manufacturing processes	2a. Explain process of joining the given plastic materials. 2b. Explain the basis of selection between cutting and forming process application for the given job based on its geometry. 2c. Explain safety norms for the given plastic processing machine shop. 2d. Explain utility of the given machine tools for plastic processing applications. 2e. Justify the use of machining process for the given situation.	2.1 Plastics Joining: soldering and brazing, Working set up of soldering and brazing, accessories and consumables for plastic materials. Precaution and safety during soldering and brazing. 2.2 Foundry: Concept, Process of casting, Applications in plastic manufacturing. 2.3 Plastics cutting and forming process: bending , shearing, concept and applications 2.4 Machine tools: Working principle of power hacksaw, lathe, drill and milling machine. Operations to be performed on above machines in plastic processing.
Unit- III Plastics in Renewable energy systems	3a. Explain the function of the given components of the solar PV system with sketches. 3b. Justify the use of the given plastic parts in the solar PV systems 3c. Compare the working of the given types of solar heating systems. 3d. Explain the principle of	3.1 Solar PV technology and the plastic parts associated with it. 3.2 Solar Heating systems 3.3 Large wind turbines – construction, parts and working principle of geared and direct drive 3.4 Small wind turbines – construction, parts and working principle of geared and direct drive 3.5 Biomass power system

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	working of the given wind turbine system with sketches. 3e. Justify the use of the given plastic parts used in the given type of wind turbine. 3f. Describe the working principle of the given type of biomass power with sketches.	
Unit– IV Material handling	4a. Explain utility and working of given type of material handling equipment of plastics in the plastics industry. 4b. Select relevant material handling equipment for given processing unit. 4c. Describe standard safety precautions for the given material handling equipment. 4d. Explain routine troubleshooting of the given material handling equipment.	4.1 Material handling: Need, Types, Principle of working and applications (hoisting equipment, conveying equipment, surface and overhead equipment) 4.2 Selection of material handling equipment. 4.3 Safety precautions for material handling equipment. 4.4 Troubleshooting and remedies for material handling equipment.
Unit– V Heat transfer and Energy Conservation	5a. Explain heat transfer by conduction for the given plastic processing. 5b. Explain heat transfer by convection for the given plastic processing. 5c. Explain heat transfer by radiation for the given plastic processing. 5d. Justify the criteria of selecting the cooling tower for the given plastic processing unit. 5e. Justify the selection of heat transfer unit for given plastic processing machine. 5f. Justify the need of energy conservation and energy audit for the given process.	5.1 Heat transfer: Modes (Conduction, Convection, Radiation) 5.2 Heat transfer by conduction in plastic processing. 5.3 Heat transfer by convection in plastics processing. 5.4 Heat transfer by radiation in Plastics processing. 5.5 Heat exchanger: Types (Double pipe, Shell and tube, parallel flow, counter flow), Selection of heat exchanger for Plastics processing unit. 5.6 Cooling System – Cooling towers in Plastics processing unit. 5.7 Different methods of energy conservation.

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

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Mechanical engineering tools and power transmission.	10	02	04	10	16
II	Manufacturing processes.	12	02	04 -	10	16
III	Plastics in renewable energy systems.	10	02	06	06	14
IV	Material handling.	08	02	04	06	12
V	Heat transfer and energy conservation	08	02	04	06	12
Total		**48**	**10**	**22**	**38**	**70**

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

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

10. SUGGESTED STUDENT ACTIVITIES

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

a. Collect any 5 different mechanical items like nuts, bolts, screws, springs, pipe joints of plastic materials and prepare report including sketch, application, and specification of items as per IS.
b. Write a report on working of power transmission including sketch after observing any Plastics processing machine alongwith its specification.
c. Identify standard operating procedure, best practices, and safety precautions to be taken for any mechanical tools used in Plastics processing shop.
d. Prepare charts, slogans, pictures, visual instructional diagrams for safety to be taken in Plastics processing shop.
e. Download videos related to foundry, lathe, drilling and milling machine and make class presentation.
f. Collect information of different heat exchangers from internet (specification, manufacturer, and price) used in Plastics processing and give presentation.
g. Prepare a tool board (for storing tools) of mechanical hand and power tools.
h. Visit any workshop practicing 5S and prepare a report.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

a. Massive Open Online courses (MOOCs) may be used to teach various topics and sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.
f. Guide student(s) in using mechanical tools.
g. Give instructions regarding safety in using tools.
h. Show video/animation films to explain Plastics processing on mechanical machine tools.
i. Demonstrate use of tools as per standard practices.
j. Use charts and models to demonstrate heat exchanger.
k. Use charts and models of to demonstrate non conventional energy generation system.
l. Assign different types of micro projects.

12. SUGGESTED MICRO PROJECTS

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

In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty. Students should conduct following activities in group and prepare reports of about 4 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews.

a. **Applications:** Collect applications of mechanical engineering principles used in plastic processing units and prepare a chart or model.
b. **Component Identification:** Assemble and dissemble solar flat heating/lightening system for component identification.
c. **Machining Processes:** Collect information for machining of plastic material on lathe, drilling, milling machine regarding properties of plastic material to be machined, required machining process, speed, feed rate, depth of cut, tools required, cooling required for machining process and machines. Give class presentation.
d. **Heat Exchanger:** Collect information of heat exchanger used in Plastics processing machine and make a model showing constructional details of heat exchanger.
e. **Transmission System:** Examine transmission system of Plastics processing machine. Dismantle and assemble the system component, lubricate, tighten system parts as per manufacturer instructions given in maintenance schedule and instruction manual.
f. **Assembly:** Examine heat exchanger of Plastics processing machine. Dismantle and assemble the system component, clean, tighten system parts as per manufacturer instructions given in maintenance schedule and instruction manual.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Theory of Machines	Khurmi, R.S. and Gupta, J.K.	S.Chand Publishing, New Delhi.2015 ISBN 13: 9788121925242
2	Elements of Workshop Technology (Vol. 1,2)	Chaudhary, Hazara	Asia Publishing House, Mumbai, 2010 ISBN: 9788185099156
3	Wind Power Technology	Earnest, Joshua	PHI Learning, New Delhi, 2015 ISBN: 978-81-203-5166-0
4	Material Handling equipment	Rundenko, M.	MIR Publishers, Moscow, 2012 ISBN:- 978-0714702858
5	Heat Transfer	Sukhatme, S. P.	Universities Press India Pvt. Ltd. 2005 ISBN 13: 9788173715440
6	Non-conventional Energy Sources	Rai, G.D.	Khanna Publications New Delhi.2011 ISBN: 978-8174090737
7	Heat and Mass Transfer	Kumar, D.S.	S.K.Kataria and Sons, Delhi. 2014 ISBN 13: 9789350142691
8	Industrial Energy Conservation	Ray, D.A.	Pergaman Press New York 1978 ISBN: 978-1-4503-2138-9

14. SOFTWARE/LEARNING WEBSITES

a. https://www.youtube.com/watch?v=6UlNL2K9g1s
b. https://www.youtube.com/watch?v=C-BbH1C03Ko
c. https://www.youtube.com/watch?v=dzYU7afKA8Y
d. https://www.youtube.com/watch?v=Rs8nZpzmZO0
e. https://www.youtube.com/watch?v=VQxNjCxi4_A
f. https://www.youtube.com/watch?v=mEExlOX458Y
g. https://www.youtube.com/watch?v=FshsDmeiQL4
h. https://www.youtube.com/watch?v=iIRbhZY8MpE
i. https://www.youtube.com/watch?v=bZUoLo5t7kg
j. https://www.youtube.com/watch?v=1-p1xPYCTzQ
k. https://www.youtube.com/watch?v=5uwvUzCRLtM

Program Name : **Diploma in Plastic Engineering**
Program Code : **PS**
Semester : **Second**
Course Title : **Organic Chemistry**
Course Code : **22229**

1. RATIONALE

Diploma plastics technologists have to deal with various plastic materials. This course develops the concepts and principles of organic chemistry such as organic compounds, their preparation, properties and uses. The course will also help to understand organic reactions in plastics and plastic manufacturing processes. It lays foundation for future courses in higher semesters.

2. COMPETENCY

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

- **Solve broad-based plastics technology related problems using principles of organic chemistry.**

3. COURSE OUTCOMES (COs)

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

a. Apply relevant chemical reactions for particular polymer manufacturing synthesis.
b. Select organic compounds for polymer manufacturing process.
c. Identify the organic compound for relevant polymer synthesis.
d. Use relevant organic compound after identifying its stereoregularity for a polymer synthesis.
e. Purify monomer for polymer synthesis.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory						Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.
***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment.*

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

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

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

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

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Identify type of reaction on the basis of exothermicity.	I	02*
2	Identify urea by element detection method, boiling point and melting point.	II	02*
3	Identify halide functional group by element detection method, boiling point and melting point.	II	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
4	Identify carbon as element in given sample by element detection method, boiling point and melting point.		02
5	Identify hydrogen as element in given sample by element detection method, boiling point and melting point.	II	02
6	Identify chlorobenzene as functional group in given sample by element detection method, boiling point and melting point.	II	02
7	Identify sulphur as element in given sample by element detection method, boiling point and melting point.	III	02
8	Identify alcohol as functional group by element detection method, boiling point and melting point.	III	02*
9	Identify ester as functional group by element detection method, boiling point and melting point.	III	02
10	Identify acid by element detection method, boiling point and melting point.	III	02
11	Identify monomers with several double bonds.	IV	02*
12	Purify monomer by using solvent.	V	02
13	Test Solubility of low molecular weight compound (for example NaCl) and polymer.	V	02*
14	Test heating of low molecular weight compound (for example Benzene) and polymer.	V	02
	Total		**28**

Note

i. *A suggestive list of* ***PrOs*** *is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

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

S. No.	Performance Indicators	Weightage in %
1	Setting of experimental set up	20
2	Operate equipment skillfully	30
3	Follow Safety measures	10
4	Work in team	10
5	Record Observations	10
6	Interpret Results to conclude	10
7	Answer to sample questions	5
8	Submit report in time	5
	Total	**100**

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

a. Follow safety practices.
b. Practice good housekeeping.

c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical practices.

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

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Exp. S.No.
1	Chemicals and solvents.	All
2	Purification setup with stand and separating funnel (500 ml).	All
3	Test tubes (18 x 150 mm).	All
4	Stirring rod (glass).	All
5	Bunsen burner.	All
6	Beakers(50 ml, 100 ml, 150 ml, 200 ml, and 250 ml)	All
7	Measuring cylinder (10 ml, 50 ml and 100 ml).	All
8	Tongs (standard size).	All
9	Forceps.	All
10	Ring stand and ring with wire gauze.	All
11	Safety equipments (gloves and goggles).	All
12	Wooden stick.	All
13	Styrofoam cup.	All
14	Thermometer (0-300 ^{0} C).	All
15	Capillary tubes.	All
16	Burettes (100 ml) and pipettes (10 ml).	All
17	Retort stand (standard size)	All

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Fundamentals of chemistry	1a. Describe the given bond types and different organic compounds. 1b. Explain the given type of chemical bond. 1c. Compare the given types of	1.1 Concept of atom, molecule and compound. 1.2 Types of bonds, properties and applications: ionic bond, co-valent bond and co-ordinate bond. 1.3 Bond angle, bond length, bond energy.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	bonds on the given criteria. 1d. Explain relevant chemical reactions for manufacturing of the given type of plastic compound.	elctronegativity, polar bond, bond polarity and dipole moment. 1.4 Types of chemical reactions.
Unit– II Chemistry of aromatic and aliphatic compounds	2a. Classify the given organic compounds on the basis of their functional groups. 2b. Calculate empirical and molecular formula of the given organic compound. 2c. Distinguish the given aromatic and aliphatic compounds. 2d. Describe the process of identifying the given organic compounds for polymer manufacturing process.	2.1 Concepts of organic chemistry and its importance. 2.2 Organic compounds: General characteristics, classification based on structure and functional group, empirical and molecular formula. 2.3 Aromatic compounds: Concept, general characteristics. 2.4 Aliphatic compounds: Concept 2.5 Benzene: General characteristics, structural formula chemical properties, addition reactions with hydrogen and chlorine, substitution, halogenation, nitration, sulphonation, and Friedel – Craft alkylation.
Unit– III Functional groups and organic reactions	3a. Identify the different functional groups for the given compounds. 3b. Describe the formation of formulae of the given functional groups with carbon. 3c. Distinguish the given organic reactions. 3d. Justify the use of organic compound for the given polymer manufacturing reaction.	3.1 Concept of functional groups. 3.2 Nomenclature of organic compounds (IUPAC). 3.3 Structural formula of following functional groups – alcohol, carboxylic acid, aldehyde, esters, ethers, ketones, amines, amides and alkyl halides. 3.4 Formation of formula for all above functional groups with carbon. 3.5 Types of organic reactions – addition, substitution, condensation, nitration, sulphonation, hydrogenation and oxidation.
Unit– IV Isomerism	4a. Describe the given type of isomerism. 4b. Explain the chemistry of the given compound with asymmetric carbon atom. 4c. Explain the criterion for selecting given organic compound. 4d. Identify stereo regularity of the given organic compound for its relevant polymer synthesis.	4.1 Isomerism: Concept, types, - geometrical and optical. 4.2 Stereochemistry 4.3 Chemistry of compounds with asymmetric carbon atom.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit– V Concept of monomers and polymers.	5a. Identify the given monomer and its functionality. 5b. Describe the given type of polymer with their structure. 5c. Distinguish the behavior of low molecular weight compound and polymer on the basis of their solubility and heat. 5d. Describe the process of purifying the given monomer.	5.1 Monomer: Concept, types, functionality- importance, purification. 5.2 Polymer: Concept, Effect of functionality on structure, comparison in behavior on heating a low molecular weight compound (e.g. benzene) and polymer (e.g. polyethylene) 5.3 Comparison in behavior on solubility of a low molecular weight compound (e.g. sodium chloride) and polymer (e.g. polyvinyl alcohol)

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

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamentals of chemistry	10	02	04	06	12
II	Chemistry of aromatic and aliphatic compounds	10	04	04	06	14
III	Functional groups and organic reactions	10	04	06	8	18
IV	Isomerism	06	02	02	04	8
V	Concept of monomers and polymers.	12	04	06	8	18
Total		**48**	**16**	**22**	**32**	**70**

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

10. SUGGESTED STUDENT ACTIVITIES

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

a. Prepare chart showing structural formulae and IUPAC name of organic compounds.
b. Gather the information about safe handling of organic compounds from MSDS and hazards thereof.
c. Collect information of different monomers used for polymer synthesis. This group work should be presented in class.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

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

12. SUGGESTED MICRO PROJECTS

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

In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty:
list is given here. Similar micro-projects could be added by the concerned faculty:
Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews.

a. **Organic Compounds**: Collect information (addresses) regarding manufacturers, suppliers, grades and cost of organic compounds (any ten) by using journals and catalogs.
b. **Organic Compound Applications**: List five organic compounds and give their specifications, state their important properties and its applications.
c. **Safety:** Make a report of safety and hazards of organic compounds (any ten).
d. **Industrial Applications:** List various chemical reactions used in chemical industries with example (any ten).
e. **Organic Compound Manufacturing**: Chart and explain manufacturing of at least ten organic compounds with their flow sheet.
f. **Chemistry of aromatic and aliphatic compounds**: Prepare models for structures of organic compounds.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Polymer Science and Technology of Plastics and Rubbers	Ghosh, Pramamoy	McGraw Hill Education, New Delhi 2011, ISBN: 978-0-07-463994-8
2	Polymer Science of Technology	Fried, Jod R.	Pearson Education ; New Delhi, ISBN 978-0137039555
3	Advanced organic chemistry	Bahl and Bahl	S. Chand and sons; New Delhi, 2001 ISBN: 978-8121935159
4	Hand Book of Organic Chemistry	Morrison & Boyd	Western Publication, New Delhi, ISBN: 978-0136436690
5	Textbook of organic chemistry	Bahl and Tuli.	S. Chand and sons; New Delhi, 2002ISBN: 978-8121926140
6	Text Book of Polymer Science	Billmeyer	Wiley Interscience 1957. ISBN:978-0-47-103196-3
7	Polymer Science	Gowarikar, V.R.	New Age International; New Delhi, ISBN:978-0-85-226307-5
8	Text book of organic chemistry	Bansal, R. K.	New age publications. ; New Delhi, 2004 ISBN: 978-8122420258

14. SOFTWARE/LEARNING WEBSITES

a. https://plastics.americanchemistry.com/Lifecycle-of-a-Plastic-Product/Scilab
b. https://accessengineeringlibrary.com/browse/handbook-of-industrial-chemistry-organic-chemicals/c9780071410373ch06#c9780071410373ch06lev1sec08
c. http://www.chem1.com/acad/webtext/states/polymers.html
d. https://www.britannica.com/science/plastic

Program Name : **Diploma in Plastic Engineering**
Program Code : **PS**
Semester : **Second**
Course Title : **Polymer Science**
Course Code : **22230**

1. RATIONALE

New polymer materials are being invented and some are modified as per the present requirement of industry. Properties of these materials depend on the structure of polymer molecules. This course develops Plastics diploma technocrat students in monomers and organic chemical compounds. Polymerization reaction and its mechanism will enable students to classify polymers for different industrial applications. This course is a prerequisite course for higher semester courses.

2. COMPETENCY

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

- **Manufacture industrial polymers using polymerization techniques.**

3. COURSE OUTCOMES (COs)

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

a. Identify types of polymers for different plastic product manufacturing processes.
b. Control polymerization reactions.
c. Apply concepts of molecular weight and size of polymer for manufacturing process.
d. Use glass transition temperature for plastic manufacturing process.
e. Control polymer degradation temperature.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory						Practical					
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
L	T	P			Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	2	5	3	70	28	30*	00	100	40	25#	10	25	10	50	20

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.
***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment.*

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

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

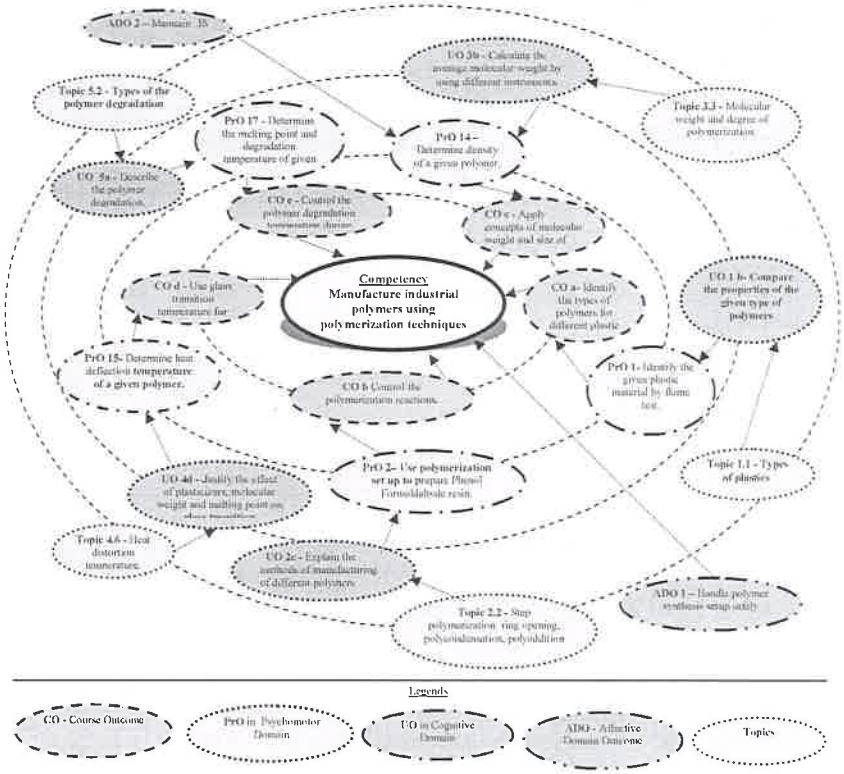

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

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

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Identify the given plastic material by flame test (PE/PP, PVC/PVA, PS/SAN, PF/UF/MF).	I	02*
2	Prepare Phenol Formaldehyde resin by using polymerization set up.	II	02
3	Prepare Urea Formaldehyde resin by using polymerization set up.	II	02
4	Prepare Melamine Formaldehyde resin by using polymerization set	II	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	up.		
5	Determine hydroxyl value of given polymer by titration.	II	02*
6	Prepare polystyrene by bulk technique using polymerization set up.	II	02
7	Prepare polystyrene by suspension technique using polymerization set up.	II	02
8	Prepare polystyrene by solution technique using polymerization set up.	II	02
9	Prepare polystyrene by emulsion technique using polymerization set up.	II	02
10	Prepare polyamide by interfacial condensation technique using polymerization set up.	II	02
11	Use polymerization set up to prepare unsaturated polyester by polycondensation technique.	II	02
12	Prepare epoxy resin by condensation technique using polymerization set up.	II	02
13	Prepare PMMA by addition reaction using polymerization set up.	II	02
14	Determine the viscosity of polymer solution by using Ostwald viscometer.	III	02*
15	Determine density of a given polymer by using density column.	III	02
16	Determine heat deflection temperature of a given polymer by using HDT/VSP apparatus.	IV	02*
17	Determine the melting point and degradation temperature of given polymer by using melting point apparatus.	V	02*
	Total		**34**

Note

*i. A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

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

S. No.	Performance Indicators	Weightage in %
1	Setting of experimental set up	20
2	Operate equipment skillfully	30
3	Follow Safety measures	10
4	Work in team	10
5	Record Observations	10
6	Interpret Results to conclude	10
7	Answer to sample questions	5
8	Submit report in time	5
	Total	**100**

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

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

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

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Exp. S.No.
1	Heat deflection temperature tester. (Temp range 0 to 300 ^{0}C, Temp resolution +/- 0.1°C, Temperature ramp rates of 50° or 120° C/hr)	5
2	Density gradient column.(0.9-3.0 g/cc)	4
3	Three necked round bottom flask. (Capacity of 1, 2, and 5 liter.)	2-12
4	Heating mantel. (Capacity-1000-5000 ml, 430 watts, 230VAC)	2-12
5	Glass Thermometer. (Temperature range 0-300 ^{0}C)	2-12
6	Water condenser.	2-12
7	Laboratory Water Bath. (20 liter, 100^{0}C, 35.6 x 30.5 x 20.3 cm, 600 Watts, 2.6 Amps, 11.3 kg weight.)	2-12
8	Mechanical stirrer (Motorised, 0-2000 rpm)	ALL
9	Digital weighing scale (0-100 g).	ALL
10	Required Chemicals and consumable	ALL
11	Spirit lamp, Spachula	1

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Polymers and co-polymers	1a. Classify the given polymers based on their origin. 1b. Compare the properties of the given types of polymers. 1c. Describe the co-polymers with	1.1 Polymers: Classification (on basis of their origin - natural, synthetic, organic, inorganic, elastomer, fibers, resins), Types- thermoplastics (Commodity and

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	justification for the given application. 1d. Justify selection of polymer and the criteria used for the given application.	engineering) and thermosetting (Commodity and engineering). 1.2 Types of co-polymers – alternate, block, random, graft. 1.3 Classification on the basis of structure- linear, branched, cross-linked, stereo regular polymers.
Unit– II Polymerization reactions and techniques	2a. Explain with sketches the given polymerization reaction. 2b. Distinguish given types of polymerization techniques. 2c. Explain with sketches the method of manufacturing the given type of polymer. 2d. Justify selection of the given manufacturing method for a given polymer.	2.1 Polymerization: Addition polymerization (initiation, propagation and termination)- free radical, cationic and anionic, co-ordination and chain transfer reaction. 2.2 Step polymerization: ring opening, poly condensation, poly addition. 2.3 Electrochemical polymerization. 2.4 Polymerization techniques: bulk, solution, suspension, emulsion, interfacial condensation-its merits, demerits and comparison of polymerization techniques.
Unit– III Molecular weight and size of polymer	3a. Select relevant polymer on the basis of the given molecular weight with justification. 3b. Describe the procedure to calculate the average molecular weight of the given polymer by using different instruments. 3c. Justify the relationship between molecular weight and size of the given polymer with properties. 3d. Describe with sketches the specified method for the determination of average molecular weight of the given polymer.	3.1 Molecular weight: Concept of average molecular weight, Concept of number average and weight average molecular weight, degree of polymerization. 3.2 Polydispersity and molecular weight distribution. 3.3 Practical significance of polymer molecular weight; Methods for the determination of average molecular weight of polymers- viscometry, cryoscopy, ebuliometry, osmosis, end group analysis.
Unit– IV Glass transition temperature in polymers	4a. Explain the concept of glass transition temperature and the factors affecting it for the given situation. 4b. Describe the significance of glass transition temperature for the given situation. 4c. Select suitable polymer on the	4.1 Glass transition: Concept, factors affecting the glass transition temperature. 4.2 Relation between glass transition temperature and molecular weight. 4.3 Effect of plasticizers on glass transition temperature.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	basis of the given glass transition temperature with justification 4d. Justify the effect of plasticizers, molecular weight and melting point on glass transition temperature for the given condition.	4.4 Glass transition temperature of co-polymers. 4.5 Relation between glass transition temperature and melting point. 4.6 Heat distortion temperature.
Unit– V Polymer degradation	5a. Describe the concept of polymer degradation in the given situation. 5b. Compare the salient features of the given types of polymer degradation methods. 5c. Select the mechanism for prevention of polymer degradation for the given polymer processing with justification	5.1 Polymer degradation. 5.2 Types of the polymer degradation- thermal, mechanical, oxidative, ultrasonic waves, photo degradation and high energy radiation. 5.3 Prevention of degradation.

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

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Polymers and co-polymers	08	02	04	06	12
II	Polymerization reactions and techniques	16	08	08	12	28
III	Molecular weight and size of polymer	08	04	04	06	14
IV	Glass transition temperature in polymers	08	02	02	04	8
V	Polymer degradation	08	02	02	04	8
Total		**48**	**18**	**20**	**32**	**70**

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

10. SUGGESTED STUDENT ACTIVITIES

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

a. Collect different thermoplastic and thermosetting materials from the surrounding area and prepare a collage.

b. Conduct awareness programmes in society for reduction, reuse and recycle of plastics.
c. Gather the information of plastic manufacturers and suppliers (grades, rates, minimum quantity, bulk discounts, taxes, delivery period etc.).
d. Collect information of different reactors used in polymerization industries (type, capacity, pressure, temperature, safety).

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

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

12. SUGGESTED MICRO PROJECTS

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

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

a. **Raw Material Analytics:** Collect information (specifications, rates, terms and conditions, discounts, addresses) of raw materials manufacturers and suppliers of polystyrene manufacturing. Make class presentation.
b. **Monomer Recovery:** Recover of monomers from waste polymers.
c. **Transition Temperature:** Make the list of glass transition temperature and processing temperature of different polymers (minimum 20 polymers).
d. **Testing of Plastics:** Collect different plastic materials (films, toys, articles, and packaging material) of daily use and test whether it is thermosetting plastics or thermoplastics.
e. **Photo Degradation:** Observe oxidative/photo degradation of Polymers articles (Plastic Bucket) by keeping it in the atmosphere for four weeks. Make a small report.
f. **Polymers:** Collect natural polymers and synthetic polymers from the surroundings.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1.	Outlines of Polymer Technology	Sinha, R.	PHI Learning, New Delhi, 2007. ISBN: 978-8120317284
2.	Text Book of Polymer Science	Billmeyer	Wiley Interscience 1957. ISBN:978-0-47-103196-3
3.	Polymer Science	Gowarikar, V.R.	New Age International New Delhi, ISBN:978-0-85-226307-5
4.	Textbook of Polymer Chemistry	Bhatnagar, M.S.	S. Chand 2012, New Delhi, ISBN: 9788121941129
5.	Polymer Science and Technology of Plastics and Rubbers	Ghosh. Pramamoy	Tata McGraw Hill, New Delhi, 2001. ISBN: 978-0-07-463994-8
6.	Principles of Polymerization	Odian, George	Wiley Interscience 2003 ISBN: 0-471-27400-3

14. SOFTWARE/LEARNING WEBSITES

a. https://www.zeus.plmsc.psu.edu/~manias/MatSE259/lecture6.pdf.
b. https://plc.cwru.edu/tutoril/enhanced/files/polymers/orient/orient.htm.
c. http://cuiet.info/download/chemistry/Types%20of%20Polymerization%20&%20Techniques.pdf.
d. http://web.stanford.edu/class/cheme160/lectures/lecture13.pdf.
e. https://www.agilent.com/cs/library/technicaloverviews/Public/5990-7890EN.pdf.
f. https://www3.nd.edu/~manufact/MPEM_pdf_files/Ch10.pdf.
g. https://www.lehigh.edu/imi/teched/Relax2010/papers/Frick_Science_1995.pdf.
h. https://www.dtic.mil/dtic/tr/fulltext/u2/774756.pdf.
i. http://sunil.cusat.ac.in/pages/pdf/Polymer%20Degradation.pdf.
j. http://nvlpubs.nist.gov/nistpubs/sp958-lide/344-346.pdf

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1.	Mechanical Measurements and Control	Kumar, D.S.	Metropolitan, New Delhi 2013 ISBN-13: 978-8120004238
2.	Mechanical and Industrial Measurements	Jain, R.K.	Khanna Pub., New Delhi 2013 ISBN: 978-81-7409-191-2
3.	Mechanical Measurements and Instrumentation	Sawhney, A.K	Dhanpat Rai and Sons, New Delhi, 2005; ISBN-13: 978-8177000238
4.	Measurement Systems	Doebelin, E. O.	McGraw Hill Education, New Delhi, 1984 ISBN:9780070699687
6.	Instrumentation, Measurement and Analysis	Nakra, B.C.; Chaudhary, K.K.	McGraw Hill Education, New Delhi, 2015, ISBN:9780070151277
7.	Instrumentation for Engg. Measurement	Dally, James W	Wiley, New Delhi, 2013 ISBN 13: 9780471551928

14. SOFTWARE/LEARNING WEBSITES

a. https://www.youtube.com/watch?v=sNuKhUBQZzo
b. https://www.youtube.com/watch?v=PplT3g5nhfs
c. https://www.youtube.com/watch?v=s4Bq8MvwbyU
d. https://www.youtube.com/watch?v=salNdW7gRvU
e. https://www.youtube.com/watch?v=JKuoQ5FV2c8
f. https://www.youtube.com/watch?v=UcyUEnE7v2k
g. https://www.youtube.com/watch?v=0du-QU1Q0T4
h. https://www.youtube.com/watch?v=0JXCw5pOecg

Program Name: All Branches of Diploma in Engineering and Technology.

Program Code: CE/CR/CS/CH/PS/CM/CO/IF/CW/DE/EJ/EN/EQ/ET/EX/IE/MU/EE/ EP/EU/IS/IC/AE /FG/ME/PG/PT/DC/TX/TC

Semester : Second

Course Title : Business Communication Using Computers

Course Code : 22009

1. RATIONALE

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

2. COMPETENCY

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

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

3. COURSE OUTCOMES (COs)

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

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

4. TEACHING AND EXAMINATION SCHEME

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

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

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

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

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

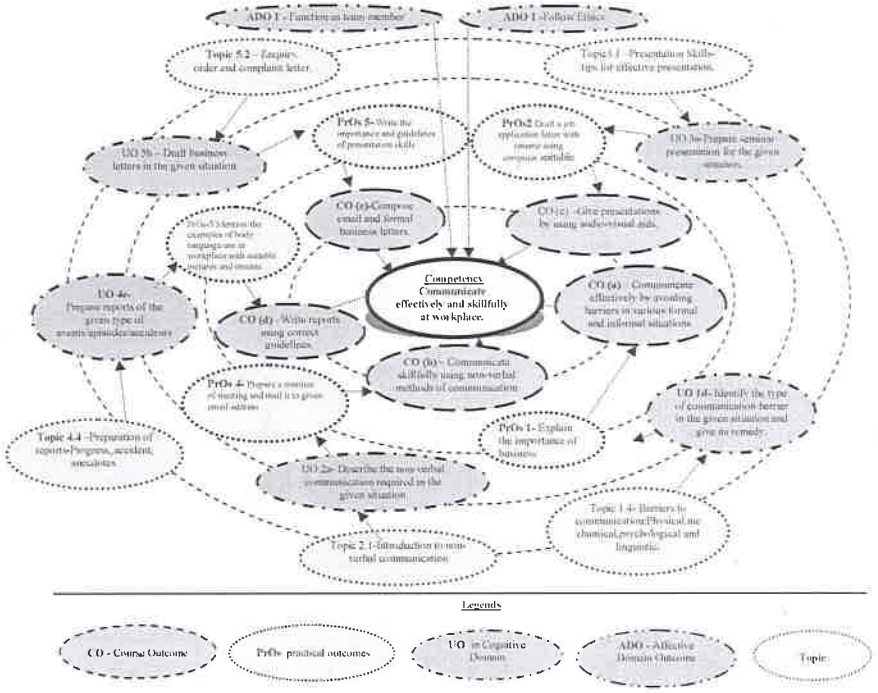

Figure 1 - Course Map

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

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

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

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

Note

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

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

7. MAJOR EQUIPMENTS / INSTRUMENTS REQUIRED

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

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

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Unit Outcomes (UOs) (in cognitive domain)		Topics and Sub-topics
	Writing Skills	Speaking Skills	
Unit – I Introduction to Business Communication	1a. Describe the importance of the business communication in the given situation. 1b. Identify the missing element in the given communication process. 1c. Identify the type of communication in the given situation. 1d. Identify the type of communication barrier in the given situation and its remedy.	1e. Use different types of verbal and non–verbal communication for the given situation.	1.1 Introduction to Communication- Elements, Importance, Functions. 1.2 Types (meaning and importance) –Verbal (Oral-Written), Formal, Informal, Vertical, Horizontal and Diagonal communication. 1.3 Principles of effective communication. 1.4 Barriers to communication - Physical, mechanical, psychological and linguistic. 1.5 Business communication: Meaning, characteristics and importance.
Unit– II Non-Verbal Communication	2a. Describe the non-verbal communication required in the given situation. 2b. Describe personal appearance required in the given communication situation. 2c. Describe the given facial expressions.	2d. Use relevant facial expressions in the given situation. 2e. Answer questions after listening to presentations.	2.1 Introduction to Non-Verbal communication (Meaning and importance) 2.2 Body Language: Aspects of body language: gestures, eye contact, posture, facial expressions, personal appearance (dressing and grooming) vocalics. 2.3 Body language - positive and negative body language.
Unit– III Presentation skills	3a. Prepare seminar presentation for the given situation. 3b. Prepare debate points 'for' and 'against' the given topic. 3c. Prepare the points for computer presentation	3d. Make seminar presentation 3e. Participate in debate speaking 'for' or 'against' the given topic. 3f. Make effective	3.1 Presentation skills- tips for effective presentation. 3.2 Guidelines for developing power point presentation. 3.3 Presenting Technical papers.

Unit	Unit Outcomes (UOs) (in cognitive domain)		Topics and Sub-topics
	Writing Skills	Speaking Skills	
	for the given topic.	computer presentations	
Unit– IV Office Drafting	4a. Draft the given notice using the relevant format. 4b. Draft the given memorandum using the relevant format. 4c. Prepare agenda for the given type of meetings. 4d. Prepare minutes of the given type of meetings. 4e. Prepare reports of the given type of events/episodes/ accidents	4f. Read the agenda of the given meeting. 4g. Read the report of the given event. 4h. Initiate telephone calls for given situation. 4i. Answer official phone calls for given situation.	4.1. Office drafting: Formats and Guidelines. 4.2. Formulating notices and memoranda. 4.3. Preparation of agenda and writing minutes of meetings. 4.4. Preparation of reports- progress reports, Accident reports, case study. 4.5. Summarizing techniques.
Unit-V Business Correspondence	5a. Respond to given job advertisements by writing your CV/ Resume. 5b. Draft business letters in the given situations. 5c. Draft complaint letters for the given situations. 5d. Compose E- mails with relevant for the given situation.		5.1 Business correspondence. 5.2 Enquiry, order and complaint letters. 5.3 E-mails- netiquettes. 5.4 Difference –Curriculum Vitae, Bio-data and Resume. 5.5 Job application and resume writing

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

9. SUGGESTED SPECIFICATION TABLE FOR INTERNAL END SEMISTER EXAMINATION

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

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

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

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

SUGGESTED STUDENT ACTIVITIES

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

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

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

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

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

12. SUGGESTED TITLES OF MICRO-PROJECTS

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

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

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

13. SUGGESTED LEARNING RESOURCES

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

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

14. SOFTWARE/LEARNING WEBSITES

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

Program Name : **Diploma in Automobile Engineering & Diploma in Plastic Engineering**

Program Code : **AE, PS**

Semester : **Second**

Course Title : **Computer Aided Drafting (AE PS, 3FG, 4th Sem ME)**

Course Code : **22011**

1. RATIONALE

The market driven economy demands frequent changes in product design to suit the customer needs. With the introduction of computers the task of incorporating frequent changes as per requirement is becoming simpler. Moreover, the technology driven competitive environment in today's market is compelling design/consulting engineering firms and manufacturing companies to seek CAD conversion of their existing paper based engineering documents. The focus of this course is to provide the student with hands-on experience in drafting and editing of an iindustrial production drawing using one of the commercial Computer Aided Drafting software with particular emphasis on the application of CAD software.

2. COMPETENCY

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

- **Prepare digital drawings using Computer aided drafting software.**

3. COURSE OUTCOMES (COs)

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

a. Use file management techniques in a CAD software.
b. Draw complex 2D geometric figures using a CAD software.
c. Modify complex 2D geometric figures using a CAD software
d. Use software to dimension and write text on existing 2D geometric entities.
e. Use software to plot existing drawing with desired plot parameters.
f. Create Isometric drawings using a CAD software
g. Use layers and blocks to create digital drawings using relevant softwares.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory						Practical					
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
L	T	P			Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
--	--	2	2	--	--	--	--	--	--	--	25@	10	25~	10	50	20

(**) marks should be awarded on the basis of internal end semester theory exam of 50 marks based on the specification table given in S. No. 9.

*(~): For the **practical only courses,** the PA has two components under practical marks i.e. the assessment of practicals (seen in section 6) has a weightage of 60% (i.e. 30 marks) and micro-project assessment (seen in section 12) has a weightage of 40% (i.e. 20 marks). This is designed to facilitate attainment of COs holistically, as there is no theory ESE.*

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

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

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

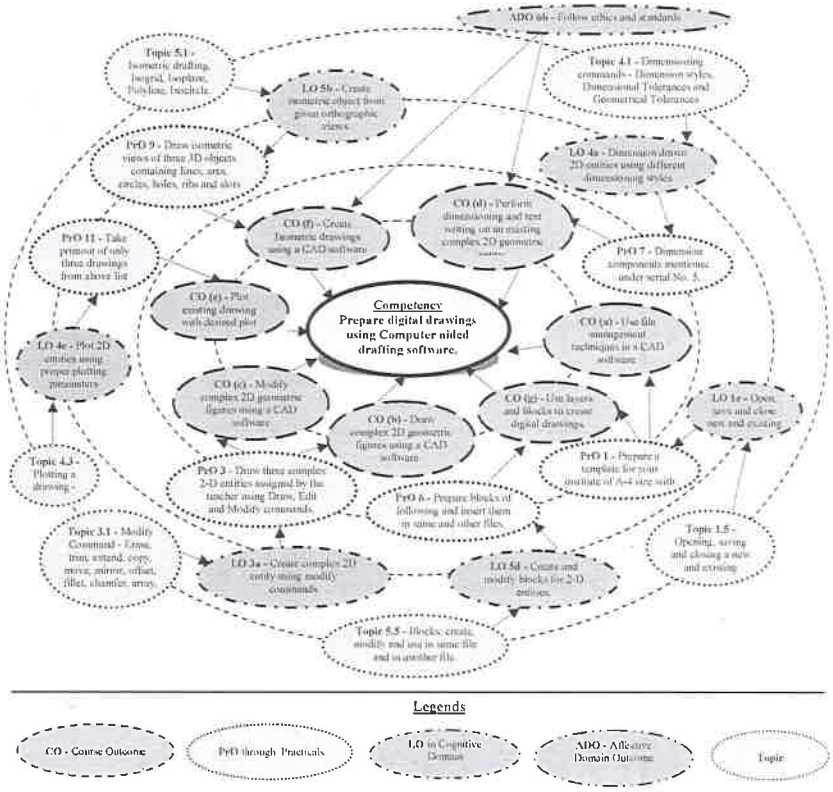

Figure 1 - Course Map

2. SUGGESTED PRACTICALS / EXERCISES

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

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	Prepare a template for your institute of A-4 size with title block and institute logo.	All	02
2.	Use the software to draw one simple 2-D entities using Draw commands individually. Part I	II	02
3.	Use the software to draw another simple 2-D entities using Draw commands individually. Part II	II	02
4.	Use the software to draw another simple 2-D entities using Draw commands individually. Part III	II	02
5.	Use the software to draw four complex 2-D entities assigned by the teacher using Draw, Edit and Modify commands. Part I	II, III	02
6.	Use the software to draw four complex 2-D entities assigned by the teacher using Draw, Edit and Modify commands. Part II	II, III	02
7.	Use the software to draw four complex 2-D entities assigned by the teacher using Draw, Edit and Modify commands. Part III	II, III	02
8.	Use the software to draw four complex 2-D entities assigned by the teacher using Draw, Edit and Modify commands. Part IV	II, III	02
9.	Use the software to draw to estimate Area, Perimeter, and Centroid for the given 2D entities like Circle, Pentagon, Trapezium, hexagon and 2D entity with arcs and spline curves using 'Enquiry' and 'List' commands.	II	02
10.	Use the software to draw Epicycloid and Hypocycloid curves using pitch circle as directing circle of a cycloidal gear and an appropriate size smaller circle as generating circle. Part I	II	02
11.	Use the software to draw Epicycloid and Hypocycloid curves using pitch circle as directing circle of a cycloidal gear and an appropriate size smaller circle as generating circle. Part II	II	02
12.	Use the software to create Hexagonal nut and Bolt (similar objects can be taken up) using Computer Aided Drafting approach.	II, III	02
13.	Use the software to create Front view and side view of V-Groove Pulley (similar objects can be taken up) using Computer Aided Drafting approach.	II, III	02
14.	Use the software to create Spherical and Flat headed Rivet (similar objects can be taken up) using Computer Aided Drafting approach.	II, III	02
15.	Use the software to create Front view of 2-Wheeler Piston (similar objects can be taken up) using Computer Aided Drafting approach.	II, III	02
16.	Use the software to create Front view of typical Open Ended Spanner (similar objects can be taken up) using Computer Aided Drafting approach.	II, III	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
17.	Use the software to create Front view of Connecting Rod (similar objects can be taken up) using Computer Aided Drafting approach.	II, III	02
18.	Use the software to create Front view of Poppet valve (similar objects can be taken up) using Computer Aided Drafting approach.	II, III	02
19.	Use the software to create Front view of Deep groove ball bearing (similar objects can be taken up) using Computer Aided Drafting approach.	II, III	02
20.	Use the software to prepare blocks of Hexagonal nut and bolt and insert them in same and other files (similar objects can be taken up). Part I	V	02
21.	Use the software to prepare blocks of Ball bearing and insert it in same and other files (similar objects can be taken up). Part II	V	02
22.	Use the software to prepare blocks of Chain sprocket and insert it in same and other files (similar objects can be taken up). Part III	V	02
23.	Use the software to dimension all above components mentioned under serial No.12-19. Also insert relevant text in the drawing. Part I	IV	02
24.	Use the software to draw sectional view of piston of a two-wheeler. Main drawing of Piston in one layer, hatching in another layer and dimensioning and text in third layer. Part I	IV,V	02
25.	Hatch above drawing using layer facility and write dimensions and text using on another layer. Part II	IV,V	02
26.	Use the software to draw isometric views of three 3D objects containing lines, arcs, circles, holes, ribs and slots. Part I	V	02
27.	Use the software to draw isometric views of three 3D objects containing lines, arcs, circles, holes, ribs and slots. Part II	V	02
28.	Use the software to draw isometric views of three 3D objects containing lines, arcs, circles, holes, ribs and slots. Part III	V	02
29.	Draw three Isometric drawings from given Isometric views and dimension it. Part I	V	02
30.	Draw three Isometric drawings from given Isometric views and dimension it. Part II	V	02
31.	Draw three Isometric drawings from given Isometric views and dimension it. Part III	V	02
32.	Take printout of only three drawings from above list using template developed in S. No. 01	IV	02
	Total		**64**

Note

i. A suggestive list of PrOs is given in the above table, more such PrOs can be added to attain the COs and competency.

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

S. No.	Performance Indicators	Weightage in %
1	Developing/ using Institute Template	20
2	Selecting relevant set up parameters	05
3	Creating given drawing using relevant Commands.	40
4	Dimensioning the given drawing and writing text using blocks and layers effectively.	15
5	Answer to sample questions	10
6	Submission of digital drawing file/plot in time	10
	Total	**100**

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

a. Follow safe practices to operate CAD workstations.
b. Practice energy conservation.
c. Follow ethics and standards.

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

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

33. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment/Instruments/Other resources name with Broad Specifications	Exp. No.
1	Networked Licensed latest version of Computer Aided Drafting software	All
2	CAD workstation with latest configurations for each student.	All
3	Plotter/Printer with latest versions.	All
4	LCD projector and Screen/ Interactive board	All

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Fundamentals of CAD Drawing Setup	1a. Explain use of computer in drafting and designing. 1b. Use the AutoCAD workspace and interface. 1c. Work with the User Coordinate System and World Coordinate System. 1d. Apply different object selection methods in a given situation 1e. Open, save and close new and given drawings/ templates	1.1 Fundamentals of Computer Aided Drafting (CAD) and its applications, Various Softwares for Computer Aided Drafting. 1.2 Co-ordinate System- Cartesian and Polar Absolute, Relative mode, UCS,WCS. 1.3 CAD initial setting commands- Snap, grid, Ortho, Osnap, Limits, Units, Ltscale, Object tracking. 1.4 Object Selection methods- picking, window, crossing, fence, last and previous. 1.5 Opening, saving and closing a new and existing drawing/template
Unit– II Draw, Enquiry, Zoom and Formatting Commands	2a. Use viewing commands. 2b. Apply formatting commands 2c. Draw simple 2D entities using given draw commands 2d. Determine coordinates, distance, area, length, centroid of the given 2D entity	2.1 Zoom Commands – all, previous, out, in, extent, Realtime, dynamic, window, pan. 2.2 Formatting commands - Layers, block, linetype, lineweight, color. 2.3 Draw Command - Line, arc, circle, rectangle, polygon, ellipse, spline, block, hatch 2.4 Enquiry commands – distance, area.
Unit– III Edit and Modify Commands	3a. Create given complex 2D entity using modify commands 3b. Use grip command to manipulate given 2D entity	3.1 Modify Command - Erase, trim, extend, copy, move, mirror, offset, fillet, chamfer, array, rotate, scale, lengthen, stretch, measure, break, divide, explode, align. 3.2 Grips editing- Move, Copy, Stretch.
Unit– IV Dimensioning, Text and Plot Commands	4a. Dimension given 2D entities using different dimensioning styles 4b. Apply Geometric and dimension tolerance symbols on the given entity. 4c. Write text on given 2D entity. 1f. Create user defined dimension and text styles for a given situation 4d. Plot given 2D entities using proper plotting parameters.	4.1 Dimensioning commands - Dimension styles, Dimensional Tolerances and Geometrical Tolerances, Modify dimension style. 4.2 Text commands - dtext, mtext command. 4.3 Plotting a drawing - paper space, model space, creating table, plot commands.
Unit– V	5a. Draw isometric entities.	5.1 Isometric drafting, Isogrid, Isoplane,

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Isometric Drawings, Layers, and Blocks	5b. Create isometric object from given orthographic views. 5c. Use Layers for 2D drawings. 5d. Create and modify blocks for given 2D entities. 5e. Use blocks in same and in another given file.	Polyline, Isocircle. 5.2 Dimensioning Isometric drawings. 5.3 Text writing on Isometric drawing. 5.4 Layer, Layer properties and applications. 5.5 Blocks: create, modify and use in same file and in another file.

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

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER (INTERNAL) DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamentals of CAD Drawing Setup	08	-	02	02	04
II	Draw, Enquiry, Zoom and Formatting Commands	14	02	02	08	12
III	Edit and Modify Commands	14	-	02	10	12
IV	Dimensioning, Text and Plot Commands	08	02	-	06	08
V	Isometric Drawings, Layers, and Blocks	16	02	02	10	14
Total		**60**	**06**	**08**	**36**	**50**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note: *This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of LOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table. This specification table also provides a general guideline for teachers to frame internal end semester practical exam paper which students have to perform on computers with relevant Computer Aided Drafting software like AutoCAD etc.*

10. SUGGESTED STUDENT ACTIVITIES

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

a. Maintain a separate folder on Computer workstation allotted, in which all above mentioned practicals should be saved and will be submitted/ mailed as a part of term work.
b. Collect at least one 2D drawing like Production drawings, Layouts from nearby workshops/industries/builders/contractors and develop them using computer aided drafting approach.
c. Explain at least one problem for drafting to all batch colleagues. Teacher will assign the problem to be explained by student.

d. Assess at least one 2D drawing of other students (A group of 5-6 students may be identified by teacher) and note down the mistakes committed by the group. Selected students will also guide other students for correcting mistakes, if any.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Bring real objects in the classroom for demonstration purpose.
f. Demonstrate use of various commands of CAD using LCD projector/ interactive board, during hands on sessions.
g. Show videos and animations to explain use of layers, blocks and other relevant commands.
h. Demonstrate use of hardware like plotter.

12. SUGGESTED MICRO-PROJECTS

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

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

a. **2D Transmission**: Each batch will identify fasteners, couplings, joints used in plastic machines and using CAD software prepare drawings. The figures should be labeled and dimensioned using software.
b. **2D Machinery components**: Each batch will identify machinery components used in plastic machines and using CAD software prepare drawings. The figures should be labeled and dimensioned using software.
c. **3D Transmission**: Each batch will identify fasteners, couplings, joints used in plastic machines and using CAD software prepare isometric drawings. The figures should be labeled and dimensioned using software.
d. **3D Machinery components**: Each batch will identify machinery components used in plastic machines and using CAD software prepare isometric drawings. The figures should be labeled and dimensioned using software.

e. **Digital Drawings:** Each batch will identify manual drawings of machinery components used in plastic machines and using CAD software create digital drawings using relevant software.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1.	Engineering Drawing Practice for Schools and Colleges IS: SP-46	Bureau of Indian Standards	BIS, GOI, Third Reprint, October 1998, ISBN: 81-7061-091-2
2.	Engineering Drawing	Bhatt, N.D.	Charotar Publishing House, Anand, Gujarat, 2010, ISBN:978-93-80358-17-8
3.	Machine Drawing	Bhatt, N.D.; Panchal, V. M.	Charotar Publishing House, Anand, Gujarat, 2010, ISBN:978-93-80358-11-6
4.	Engineering Graphics with AutoCAD	Kulkarni D. M.; Rastogi A. P.; Sarkar A. K.	PHI Learning, New Delhi (2010), ISBN: 978-8120337831
5.	Essentials of Engineering Drawing and Graphics using AutoCAD	Jeyapoovan T.	Vikas Publishing House Pvt. Ltd, Noida, 2011, ISBN: 978-8125953005
6.	AutoCAD User Guide	Autodesk	Autodesk Press, USA, 2015
7.	AutoCAD 2016 for Engineers and Designers	Sham Tickoo	Dreamtech Press; Galgotia Publication New Delhi, Twenty Second edition, 2015, ISBN-13: 978-9351199113

14. SOFTWARE/LEARNING WEBSITES

a. http://www.mycadsite.com/tutorials/
b. http://tutorial45.com/learn-autocad-basics-in-21-days/
c. https://www.lynda.com/AutoCAD-training-tutorials/160-0.html
d. http://www.investintech.com/resources/blog/archives/5947-free-online-autocad-tutorials-courses.html
e. http://www.cad-training-course.com/
f. http://au.autodesk.com/au-online/overview
g. https://www.youtube.com/watch?v=yruPUj_61bw
h. https://www.youtube.com/watch?v=xquI8gcdwbs
i. https://www.youtube.com/watch?v=JTOP6TV4Mvw
j. https://www.youtube.com/watch?v=x7X25Xpa07o
k. https://www.youtube.com/watch?v=Si93Y36tUmY
l. https://www.youtube.com/watch?v=D8dPWKihkEo