Maharashtra State Board of Technical Education, Mumbai

Teaching and Examination Scheme for Post S.S.C. Diploma Courses

Program Name : Diploma in Chemical Engineering

Program Code : CH | **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	Applied Mechanics	AME	22203	3	1	2	6	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
2	Applied Mathematics	AMP	22206	4	2	-	6	3	70	28	30*	00	100	40	--	--	--	--	--	--	100
3	Fundamental of Chemical Engineering	FCE	22231	4	-	2	6	3	70	28	30*	00	100	40	50#	20	50	20	100	40	200
4	Electrical & Eletronics Technology	EET	22232	4	-	2	6	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
5	Chemistry of Engineering Materials	CEM	22233	4	-	2	6	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
			Total	**19**	**3**	**10**	**32**	--	**350**	--	**150**	--	**500**	--	**160**	--	**140**	--	**300**	--	**800**

Student Contact Hours Per Week: **33 Hrs.** Medium of Instruction: **English**

Theory and practical periods of 60 minutes each. Total Marks : **800**

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, Civil Chemical and Fabrication Technology and Erection Engineering Program Group**

Program Code : **AE/CE/CH/FG/ME/PT/PG**

Semester : **Second**

Course Title : **Applied Mechanics**

Course Code : **22203**

1. RATIONALE

In day-to-day working we come across different types of structures created for different purposes and functions. While designing the structures, analysis of forces and stresses' is an important and prerequisite step. Correct analysis is possible only when one knows the types and effects of forces acting on the structures. This course provides the scope to understand fundamental concepts of laws of mechanics and their applications to different engineering problems. This course is designed to provide basic understanding about the different types of forces, moments and their effects on structural elements, which will analysing different structural systems.

2. COMPETENCY

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

- **Use principles of applied mechanics to solve broad-based engineering related 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. Identify the force systems for given conditions by applying the basics of mechanics.
b. Select the relevant simple lifting machine(s) for given purposes.
c. Determine unknown force(s) of different engineering systems.
d. Check the stability of various force systems.
e. Apply the principles of friction in various conditions for useful purposes.
f. Find the centroid and centre of gravity of various components in engineering systems.

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	1	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.

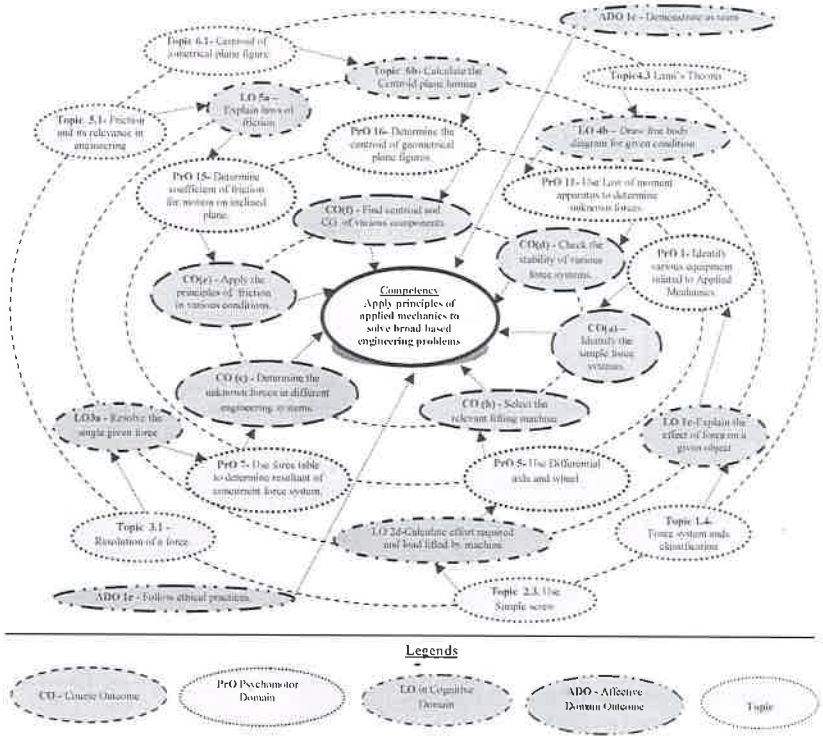

Figure 1 - Course Map

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
1	Identify various equipment related to Applied Mechanics.	I to VI	02
2	Use Differential axle and wheel.	II	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
3	Use Simple screw jack.	II	02
4	Use worm and worm wheel.	II	02
5	Use single or double purchase crab.	II	02
6	Use Weston's differential or wormed geared pulley block.	II	02
7	Use force table to determine resultant of concurrent force system applying Law of Polygon of forces. (Part-I)	III	02*
8	Use force table to determine resultant of concurrent force system applying Law of Polygon of forces. (Part-II)	III	02*
9	Graphically determine resultant of concurrent force system.	III	02
10	Graphically determine resultant of parallel force system.	III	02
11	Use Law of moment apparatus to determine unknown forces.	IV	02*
12	Apply Lami's theorem to determine unknown force.	IV	02
13	Determine support reactions for simply supported beam.	IV	02
14	Determine coefficient of friction for motion on horizontal plane.	V	02*
15	Determine coefficient of friction for motion on inclined plane.	V	02
16	Determine centroid of geometrical plane figures.	VI	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	Preparation of experimental set up	20
2	Setting and operation	20
3	Safety measures	10
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 administrators.

S. No.	Equipment Name with Broad Specifications	Exp. No.
1	Differential axle and wheel (wall mounted unit with the wheel of 40 cm diameter and axles are insteps of 20 cm and 10 cm reducing diameter .	2
2	Simple screw Jack (Table mounted metallic body , screw with a pitch of 5 mm carrying a double flanged turn table of 20 cm diameter.	3
3	Worm and worm wheel (wall mounted unit with threaded spindle, load drum, effort wheel; with necessary slotted weights, hanger and thread)	4
4	Single Purchase Crab winch (Table mounted heavy cast iron body. The effort wheel is of C.I. material of 25 cm diameter mounted on a shaft of about 40mm dia. On the same shaft a geared wheel of 15 cm dia.	5
5	Double Purchase Crab winch (Having assembly same as above but with double set of gearing arrangement.)	5
6	Weston's Differential pulley block (consisting of two pulleys; one bigger and other smaller.	6
7	Weston's Differential worm geared pulley block (Consists of a metallic (preferably steel) cogged wheel of about 20 cm along with a protruded load drum of 10 cm dia to suspend the weights of 10 kg, 20 kg-2 weights and a 50 kg weights)	6
8	Universal Force Table (Consists of a circular 40 cm dia. Aluminum disc, graduated into 360 degrees.) with all accessories..	7, 10
9	Law of moments apparatus consisting of a stainless steel graduated beam 12.5 mm square in section, 1m long, pivoted at centre.	9
10	Beam Reaction apparatus (The apparatus is with two circular dial type 10 kg.	11
11	Friction apparatus for motion along horizontal and inclined plane (base to which a sector with graduated arc and vertical scale is provided. The plane may be clamped at any angle up to 45 degrees. pan. Two weight boxes (each of 5 gm, 10 gm, 2-20 gm, 2-50 gm, 2-100 gm weight),	12
12	Models of geometrical figures.	13

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
Unit – I Mechanics and force system	1a. Explain concepts of the given terms. 1b. Use the relevant units of various quantities in the given situations. 1c. Explain effects of a force on the given object. 1d. Identify the force system for the given situation.	1.1. Significance and relevance: Mechanics, applied mechanics, statics, dynamics. 1.2. Space, time, mass, particle, body, rigid body. 1.3. Scalar and vector quantity, Units of measurement (SI units)- Fundamental units and derived units. 1.4. Force – unit, representation as a vector and by Bow's notation, characteristics and effects of a force, Principle of transmissibility of force, Force system and its classification.
Unit – II Simple lifting machine	2a. Describe the components of the given lifting machine. 2b. Differentiate the working principle of the given two types of simple lifting machines. 2c. Determine velocity ratio, efficiency and law of the given simple lifting machine. 2d. Calculate effort required and load lifted by the given simple lifting machine. 2e. Interpret the graphs after drawing them with the given data. 2f. Select the relevant simple lifting machine required for the given purpose with justification.	2.1 Simple lifting machine, load, effort, mechanical advantage, applications and advantages. Velocity ratio, efficiency of machines, law of machine. 2.2 Ideal machine, friction in machine, maximum Mechanical advantage and efficiency, reversible and non-reversible machines, condition for reversibility 2.3 Velocity ratios of Simple axle and wheel, Differential axle and wheel, Worm and worm wheel, Single purchase and double purchase crab winch, Simple screw jack, Weston's differential pulley block, geared pulley block. 2.4 Graphs of Load verses Effort, Load verses ideal Effort, Load verses Effort lost in friction, Load verses MA, Load verses Efficiency.
Unit- III Resolution and composition	3a. Resolve the given single force. 3b. Calculate the resultant of the given force system analytically. 3c. Determine graphically the resultant of the given force system. 3d. Find the resultant of the given force system using	3.1 Resolution of a force - Orthogonal and Non Orthogonal components of a force, moment of a force, Varignon's Theorem. 3.2 Composition of forces – Resultant, analytical method of determination of resultant for concurrent, non concurrent and parallel co-planar force systems – Law of triangle, parallelogram and polygon of forces. 3.3 Graphic statics, graphical representation

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	law of triangle and law of parallelogram.	of force, Space diagram, force diagram, polar diagram and funicular polygon, Graphical method of determination of resultant for concurrent and parallel co-planar force systems.
Unit– IV Equilibrium	4a. Draw the free body diagram for the given condition. 4b. Determine unknown force in the given situation using Lami's theorem. 4c. Identify the types of beams required for the given situation. 4d. Determine reactions in the given type of beam analytically and graphically.	4.1 Equilibrium and Equilibrant, Free body and Free body diagram, Analytical and graphical conditions of equilibrium. 4.2 Equilibrium of force systems analytically 4.3 Lami's Theorem, 4.4 Types of beam, supports (simple, hinged, roller and fixed) and loads acting on beam (vertical and inclined point load, UD load, couple), span of beam. 4.5 Beam reaction for cantilever, simply supported beam with or without overhang – subjected to combination of Point load and UD load or Vertical Point load and couple. 4.6 Beam reaction graphically for simply supported beam subjected to vertical loads only.
Unit– V Friction	5a. Determine force of friction and coefficient of friction for the given condition. 5b. Describe the conditions for friction for the give situation. 5c. Determine friction force in the given situation. 5d. Identify the various forces acting on a ladder for the given conditions using free body diagram.	5.1 Friction and its relevance in engineering, types and laws of friction, limiting equilibrium, limiting friction, co-efficient of friction, angle of friction, angle of repose, relation between co-efficient of friction and angle of friction. 5.2 Equilibrium of bodies on level surface subjected to force parallel and inclined to plane. 5.3 Equilibrium of bodies on inclined plane subjected to force parallel to the plane only. 5.4 FBD of ladder in friction
Unit– VI Centroid and centre of gravity	6a. Determine the centroid of geometrical plane figures and centre of gravity of the given simple solid. 6b. Calculate centroid of the given composite plane lamina 6c. Determine centre of gravity of the given solids. 6d. Determine centre of gravity of the given composite solid.	6.1 Centroid of geometrical plane figures (square, rectangle, triangle, circle, semi-circle, quarter circle) 6.2 Centroid of composite figures composed of not more than three geometrical figures 6.3 Centre of Gravity of simple solids (Cube, cuboid, cone, cylinder, sphere, hemisphere) 6.4 Centre of Gravity of composite solids composed of not more than two simple solids.

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	Mechanics and Force System	04	02	02	02	06
II	Simple Lifting Machines	08	02	04	06	12
III	Resolution and Composition	10	02	04	08	14
IV	Equilibrium	10	02	02	10	14
V	Friction	08	02	04	06	12
VI	Centroid and Centre of Gravity	08	02	02	08	12
Total		**48**	**12**	**18**	**40**	**70**

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

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

10. SUGGESTED STUDENT ACTIVITIES

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

a. Collect five different photographs indicating concurrent, parallel, general force system in equilibrium.
b. Prepare a table of type of machine and relevant industrial application.
c. Collect five different situations where law of moment plays an important role.
d. Prepare models representing various types of supports (hinged, roller and fixed)
e. Illustrate situations wherein friction is essential and not essential.
f. Prepare models in the form of geometrical figures and solids and locate centroid and centre of gravity of them.

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. Guide student(s) in undertaking 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:

a. **Types of Forces**: Prepare chart showing real-life examples indicating various types of forces
b. **Lifting Machine**: Collect photographs of specific simple lifting machine and relate these machines with the machines being studied and prepare models of simple lifting machines using tools in "MECHANO" and "MECHANIX"
c. **Types of support:** Prepare chart showing actual and corresponding schematic diagram of various type of support
d. **Beams:** Prepare models of beam subjected to point loads, uniformly distributed loads, simply supported, overhang and cantilever type beam.
e. **Friction:** Prepare chart regarding type of friction in various field conditions and collect data regarding coefficient of friction by referring books, Determine coefficient of friction for three different types of surfaces
f. **Centre of Gravity:** Prepare a chart of situations wherein concept of Centre of Gravity is vital.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Applied Mechanics	Khurmi, R.S.	S.Chand & Co. New Delhi 2014 ISBN: 9788121916431
2	Engineering Mechanics	Ramamrutham, S.	S Chand & Co. New Delhi 2008 ISBN:9788187433514
3	Foundations and Applications of Applied Mechanics	Ram, H. D.; Chauhan, A. K.	Cambridge University Press, Thomson Press India Ltd., New Delhi, 2015, ISBN: 9781107499836
4	Engineering Mechanics-Statics, Vol. 1	Meriam, J. L.; Kraige, L.G.	Wiley Publication, New Delhi, ISBN: 978-81-265-4396

14. SOFTWARE/LEARNING WEBSITES

a. http://www.asnu.com.au
b. www.youtube.com for videos regarding machines and applications, friction
c. www.nptel.ac.in
d. www.discoveryforengineers.com

Program Name : **Mechanical and Chemical Engineering Program Group**

Program Code : **AE, CH, FG, ME, PT**

Semester : **Second**

Course Title : **Applied Mathematics**

Course Code : **22206**

1. RATIONALE

Subject of applied mathematics is being introduced in diploma courses to provide mathematical background to the students. This course follows in developing theory and competency needed for a wide range of engineering applications. In particular the technique of calculus, differentiation, integration, differential equations and probability distribution for modeling and analysis in a wide range of applications. This course further develops the skills and understanding of mathematical concepts which underpin the investigative tools used in Mechanical engineering.

2. COMPETENCY

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

- **Solve mechanical engineering related problems using the principles of applied mathematics.**

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. Calculate the equation of tangent, maxima, minima, radius of curvature by differentiation.
b. Solve the given problem(s) of integration using suitable methods.
c. Apply the concept of integration to find area and volume.
d. Solve the differential equation of first order and first degree using suitable methods.
e. Utilize basic concepts of probability distribution to solve elementary engineering problems.

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
4	2	--	6	3	70	28	30*	00	100	40	--	--	--	--	--	--

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

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

5. COURSE MAP(with sample COs, Unit Outcomes i.e. UOs 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.

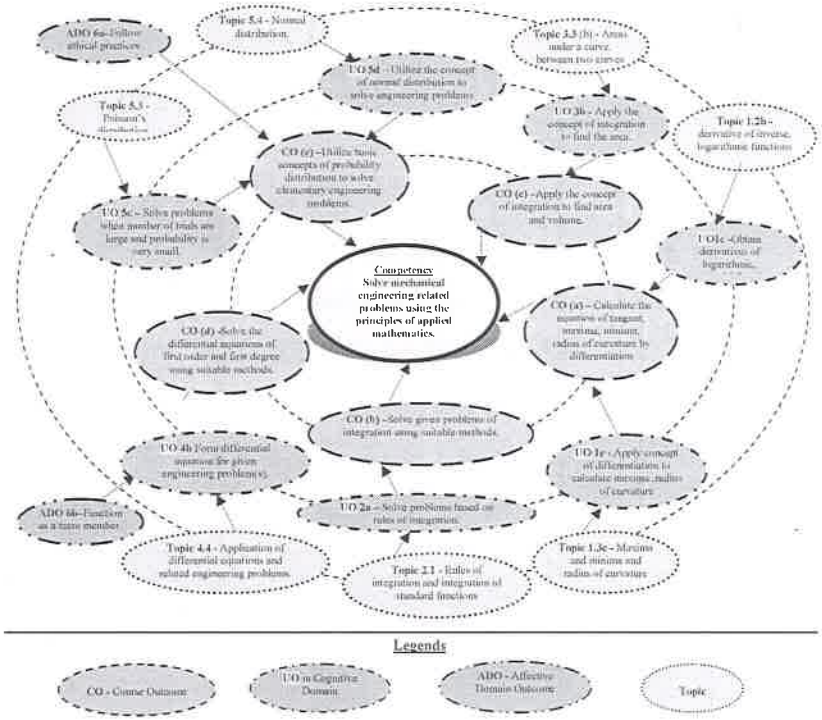

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The tutorials in this section are sub-components of the COs to be developed and assessed in the student to lead to the attainment of the competency.

S. No.	Tutorials	Unit No.	Approx. Hrs. Required
1	Solve problems based on finding value of the function at different points.	I	2
2	Solve problems to find derivatives of implicit function and parametric function	I	2
3	Solve problems to find derivative of logarithmic and exponential functions.	I	2

S. No.	Tutorials	Unit No.	Approx. Hrs. Required
4	Solve problems based on finding equation of tangent and normal.	I	2
5	Solveproblems based on finding maxima, minima of function and radius of curvature at a given point.	I	2
6	Solve the problems based on standard formulae of integration.	II	2
7	Solve problems based on methods of integration, substitution, partial fractions.	II	2
8	Solve problems based on integration by parts.	II	2
9	Solve practice problems based on properties of definite integration.	III	2
10	Solve practice problems based on finding area under curve, area between two curves and volume of revolutions.	III	2
11	Solve the problems based on formation, order and degree of differential equations.	IV	2
12	Develop a model using variable separable method to related engineering problem.	IV	2
13	Develop a model using the concept of linear differential equation to related engineering problem.	IV	2
14	Solve problems based on Binomial Distribution related to engineering problems.	V	2
15	Solve problems based on Poisson Distribution related to engineering problems.	V	2
16	Solve problems based on Normal Distribution related to engineering.	V	2
	Total		32

Note: The above tutorial sessions are for guideline only. The remaining tutorial hours are for revision and practice.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

- Not 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
Unit – I Differential Calculus	1a. Solve the given simple problems based on functions. 1b. Solve the given simple problems based on rules of differentiation. 1c. Obtain the derivatives of logarithmic, exponential functions. 1d. Apply the concept of differentiation to find given equation of tangent and normal 1e. Apply the concept of differentiation to calculate maxima and minima and radius of curvature of given problem.	1.1 Functions and Limits : a) Concept of function and simple examples b) Concept of limits without examples. 1.2 Derivatives : a) Rules of derivatives such as sum, product, quotient of functions. b) Derivative of composite functions (chain Rule), implicit and parametric functions. c) Derivatives of inverse, logarithmic and exponential functions. 1.3 Applications of derivative : a) Second order derivative without examples. b) Equation of tangent and normal c) Maxima and minima d) Radius of curvature
Unit– II Integral Calculus	2a. Solve the given simple problem(s) based on rules of integration. 2b. Obtain the given integral(s) using substitution method. 2c. Integrate given simple functions using the integration by parts. 2d. Evaluate the given simple integral by partial fractions.	2.1 Simple Integration: Rules of integration and integration of standard functions. 2.2 Methods of Integration: a) Integration by substitution. b) Integration by parts c) Integration by partial fractions.
Unit– III Applications of Definite Integration	3a. Solve given simple problems based on properties of definite integration. 3b. Apply the concept of definite integration to find the area under the given curve(s). 3c. Utilize the concept of definite integration to find area between given two curves. 3d. Invoke the concept of definite integration to find the volume of revolution of given surface.	3.1 Definite Integration: a) Simple examples b) Properties of definite integral (without proof) and simple examples. 3.2 Applications of integration : a) Area under the curve. b) Area between two curves. c) Volume of revolution.
Unit-IV First Order First Degree Differential Equations	4a. Find the order and degree of given differential equations. 4b. Form simple differential equations for simple given engineering problem(s). 4c. Solve given differential equations using the method of variable separable. 4d. Solve the given simple problem(s) based on linear differential equations.	4.1 Concept of differential equation 4.2 Order, degree and formation of differential equation. 4.3 Solution of differential equation a. Variable separable form. b. Linear differential equation. 4.4 Application of differential equations and related engineering problems.

Unit –V Probability Distribution	5a. Make use of probability distribution to identify discrete and continuous probability distribution 5b. Solve given problems based on repeated trials using Binomial distribution. 5c. Solve given problems when number of trials are large and probability is very small. 5d. Utilize the concept of normal distribution to solve related engineering problems.	5.1 Probability distribution a. Discrete Probability distribution b. Continuous Probability distribution. 5.2 Binomial distribution. 5.3 Poisson's distribution. 5.4 Normal distribution.

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	Differential calculus	20	04	08	12	24
II	Integral calculus	14	02	06	08	16
III	Applications of Definite Integration.	10	02	02	04	08
IV	First Order First Degree Differential Equations	08	02	02	04	08
V	Probability distribution.	12	02	05	07	14
Total		**64**	**12**	**23**	**35**	**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 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. Identify engineering problems based on real world problems and solve with the use of free tutorials available on the internet.
b. Use graphical software's: EXCEL, DPLOT, and GRAPH for related topics.
c. Use Mathcad as Mathematical Tools and solve the problems of Calculus.
d. Identify problems based on applications of differential equations and solve these problems.
e. Prepare models to explain different concepts of applied mathematics.
f. Prepare a seminar on any relevant topic based on applications of integration.
g. Prepare a seminar on any relevant topic based on applications of probability distribution to related engineering problems.

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 UOs/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.

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 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. Prepare models using the concept of tangent and normal to bending of roads in case of sliding of a vehicle.
b. Prepare models using the concept of radius of curvature to bending of railway track.
c. Prepare charts displaying the area of irregular shapes using the concept of integration.
d. Prepare charts displaying volume of irregular shapes using concept of integration.
e. Prepare models using the concept of differential equations for mixing problem.
f. Prepare models using the concept of differential equations for radio carbon decay.
g. Prepare models using the concept of differential equations for population growth.
h. Prepare models using the concept of differential equations for thermal cooling.
i. Prepare a chart of binomial distribution by collection of suitable manufacturing industry base data.
j. Prepare a chart of normal distribution by collection of suitable manufacturing industry base data
k. Prepare a chart of Poisson distribution by collection of suitable manufacturing industry base data

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Higher Engineering Mathematics	Grewal, B.S.	Khanna publications, New Delhi , 2013 ISBN: 8174091955
2	A Text Book of Engineering Mathematics	Dutta, D.	New Age Publications, New Delhi, 2006, ISBN-978-81-224-1689-3
3	Advanced Engineering Mathematics	Krezig, Ervin	Wiley Publications, New Delhi, 2016 ISBN:978-81-265-5423-2,
4	Advanced Engineering Mathematics	Das, H.K.	S. Chand Publications, New Delhi, 2008, ISBN:9788121903455
5	Engineering Mathematics, Volume 1 (4th edition)	Sastry, S.S.	PHI Learning, New Delhi, 2009 ISBN-978-81-203-3616-2,
6	Comprehensive Basic Mathematics, Volume 2	Veena, G.R.	New Age Publications, New Delhi, 2005 ISBN: 978-81-224-1684-8
7	Getting Started with MATLAB-7	Pratap, Rudra	Oxford University Press, New Delhi, 2009, ISBN: 10: 0199731241
8	Engineering Mathematics (3rd edition).	Croft, Anthony	Pearson Education, New Delhi,2010 ISBN: 978-81-317-2605-1

14. SOFTWARE/LEARNING WEBSITES

a. www.scilab.org/ - SCI Lab
b. www.mathworks.com/products/matlab/ - MATLAB
c. Spreadsheet applications
d. www.dplot.com/ - DPlot
e. www.allmathcad.com/ - MathCAD
f. www.wolfram.com/mathematica/ - Mathematica
g. http://fossee.in/
h. https://www.khanacademy.org/math?gclid=CNqHuabCys4CFdOJaAoddHoPig
i. www.easycalculation.com
j. www.math-magic.com

Program Name : **Diploma in Chemical Engineering**
Program Code : **CH**
Semester : **Second**
Course Title : **Fundamentals of Chemical Engineering**
Course Code : **22231**

1. RATIONALE

Diploma chemical engineers (also called technologists) work as first line managers in chemical process industries. While performing routine activities; knowledge of unit operations and unit processes, basic concepts like pH, solubility, specific gravity, electrical conductivity and methods of expressing composition of solutions and mixtures is necessary. In addition to this, awareness of safe working practices is also necessary for eliminating the causes of accidents. This course is designed to equip the students with necessary knowledge and skills for effectively performing the job role.

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 the fundamentals of chemical engineering in chemical industries**.

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 the chemicals for the given engineering application.
b. Implement standard safety practices in chemical laboratory
c. Prepare solutions and mixtures of different composition.
d. Determine the different properties of solution.
e. Select the relevant unit operations and unit processes for chemical industry.

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
4	-	2	6	3	70	28	30*	00	100	40	50#	20	50	20	100	40

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

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

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

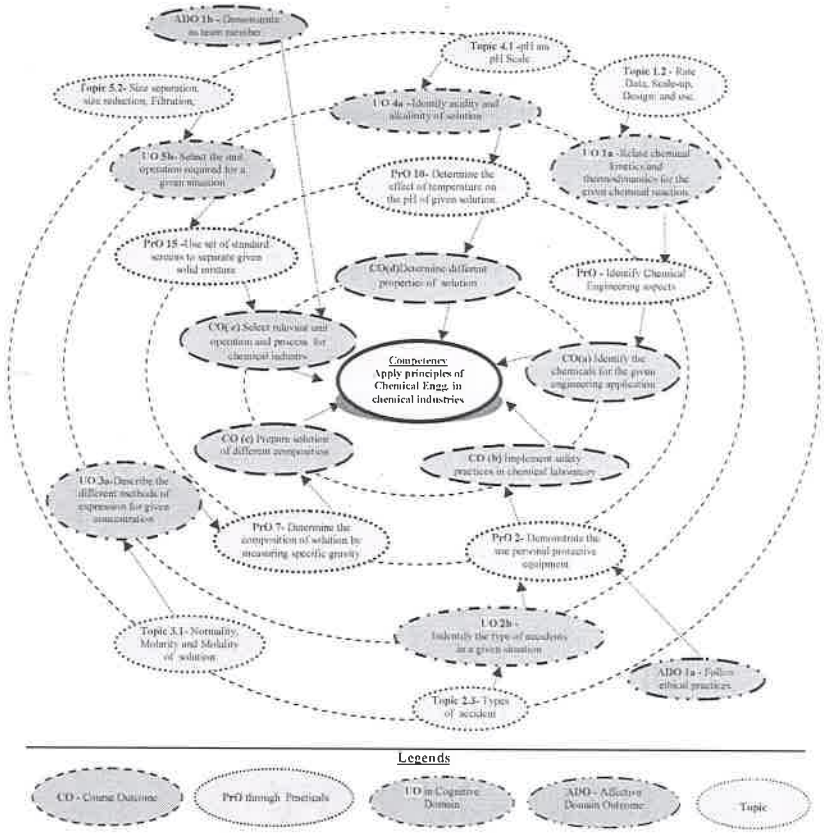

Figure 1 - Course Map

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	Visit chemical laboratory, identify hazards and write a report on safety provisions.	II	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
2	Demonstrate the use of personal protective equipments.	II	02
3	Prepare the solution of given Normality	III	02*
4	Prepare the solution of given Molarity	III	02
5	Prepare the solution of given Molality	III	02
6	Measure the dry bulb and wet bulb temperature using whirling hygrometer	III	02
7	Determine the composition of solution by measuring specific gravity.	III	02
8	Prepare mixture of petrol and kerosene and measure the specific gravity of mixture.	III	02
9	Prepare the solution of given pH	IV	02*
10	Determine the effect of temperature on the pH of given solution.	IV	02
11	Determine the electrical conductivity of salt solutions of the given concentration.	IV	02
12	Determine the composition of solution by measuring Refractive Index.	IV	02
13	Prepare the saturated solution of the given salt (e.g. KCl)	IV	02
14	Determine the moisture content in the given solid sample	V	02*
15	Use set of standard screens to separate given solid mixture.	V	02
16	Use magnetic separator to separation mixture of sawdust and iron fillings	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	Selection of suitable component, apparatus/instrument	20
2	Preparation of experimental set up	10
3	Setting and operation	10
4	Safety measures	10
5	Observations and Recording	10
6	Interpretation of result and Conclusion	20
7	Answer to sample questions	10
8	Submission of report in time	10
	Total	**100**

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

a. Follow safe practices.

b. Practice energy conservation
c. Follow ethics.

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 and
- '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	Personal Protective equipments a. Apron, b. Ear Plug , c. Ear Muff , d. Face shield, e. Splash goggle , f.Acid/ Alkali proof hand gloves, g. Thermal hand gloves, h. Safety Shoes, i. Helmet, j. Eye rinse bottle, k. Eye wash basin, l. Canister mask	02
2	Glass wares	02,03,04
3	Dry bulb and wet bulb thermometer	03
4	Digital Weighing balance (1 mg accuracy)	02,03,04
5	Specific gravity bottle	07
6	pH Meter	08
7	Electrical Conductivity Meter	09
8	Refracto Meter	10
9	Ceramic crucible	12
10	Laboratory oven	12
11	Set of standard screens	13
12	Magnetic Separator	14

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
Unit – I Chemistry and Chemical Engineering	1a. Describe the use of scale-up and design concept for the given chemical system. 1b. Relate chemical kinetics and thermodynamics for the given chemical reaction. 1c. Identify the reactors for the given Chemical Industries with justification.	1.1 Evolution of Chemical Engineering, Relationship between Chemistry and Chemical engineering 1.2 Rate Data, Scale-up, Design: Definition and use. 1.3 Chemical kinetics: Definition, use, relation between chemical kinetics and thermodynamics. 1.4 Reactors: Definition and classification

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	1d. Identify the chemicals for the given engineering application with justification.	1.5 Types of Chemical Industries on the basis of application, a. Basic Chemicals b. Fine Chemicals c. Specialty Chemicals.
Unit– II Safety in Chemical Laboratory	2a. Identify the given symbols related to chemical hazards with justification. 2b. Identify the type of accidents in the given situation. 2c. Select personnel protective equipments for the given situation with justification with justification. 2d. Choose the first aid measures for the given situation with justification.	2.1 Hazards, Hazards symbols (Bio Hazard, Toxic, Corrosive, Flammable) 2.2 Standard safety Instructions 2.3 Types of Accidents ; Trivial, Minor and Major, Causes of accidents in laboratories Unsafe conditions, Unsafe act 2.4 Apron, Splash goggle, Face shield, Helmet, Ear Plug, Ear Muff, Hand Gloves (Acid /Alkali proof) and Thermal gloves 2.5 First aid measure 2.6 Measures in case of eye injury (Chemical/impact), burn, accidental ingestion, skin contact , inhalation of toxic fumes 2.7 Emergency exit route and Assembly point
Unit– III Basic Concepts and calculations	3a. Describe the different methods of expression for the given concentration and composition of solution. 3b. Measure the density/ specific gravity of the given material. 3c. Measure the temperature of the given dry bulb and wet bulb. 3d. Use Dalton's and Amagat's law for determination of the given composition of gas.	3.1 Concentrations of solutions: Methods of expression, Strength, Molarity, Normality, Molality. 3.2 Composition of mixtures: Methods of expression, wt %, mole %, vol% and interconversions 3.3 Specific Gravity: measurement, specific gravity bottle 3.4 Temperature, dry bulb and wet bulb temperature 3.5 Daltons law and Amagats law and application of above laws
Unit-IV Properties of solutions	4a. Identify acidity and alkalinity of the given solutions by measuring pH with justification 4b. Describe the effect of the given composition and pH on electrical conductivity. 4c. Calculate refractive index of the given solution. 4d. Determine composition of the given solution. 4e. Determine the maximum solubility of the given salt.	4.1 pH and pH Scale: Principle, construction and working of pH meter with glass electrode Application of pH measurement in industry 4.2 Electrical Conductivity and its unit. Relationship between concentration of salt solution and electrical conductivity effect of pH on electrical conductivity Principle, Construction and Working of Conductivity Meter Application of electrical conductivity measurement 4.3 Refractive Index , Its dependence on composition and temperature 4.4 Principle, construction, working and application of Abbe's refractometer

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
		4.5 Solubility, saturation solubility, Effect of temperature and solvent on a solubility of a solute.
Unit –V Unit Operations and Unit Processes	5a. Identify the given unit operation with justification. 5b. Select the unit operation required for the given situation with justification. 5c. Describe the different unit processes in given situation. 5d. Identify Chemical engineering aspects in the given situation with justification.	5.1 Definition and classifications of Unit Operations:Mechanical operations, electro- Mechanical operation, thermal operations, Symbols of unit operations (as per IS 3232) 5.2 Size separation, size reduction, Filtration, Mixing, Sedimentation, Magnetic Separation, Electro dialysis, Electrostatic separation. 5.3 Distillation, Leaching, Drying, Evaporation, Crystallization, Absorption, Adsorption 5.4 Unit Process: Definition and applications 5.5 Oxidation, Reduction, Sulphonation, Nitration, Dehydrogenation, Pyrolysis, Calcination, Hydrogenation, Hydration, Dehydration, Esterification

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	Scope of Chemical Engineering	06	02	02	04	08
II	Laboratory safety	10	02	04	04	10
III	Basic Concepts and calculations	12	04	04	06	14
IV	Properties of solutions	16	04	04	08	16
V	Unit operations and Unit Processes	20	04	08	10	22
Total		**64**	**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:

a. Identify the unit operations and unit processes involved in a given chemical

processes.

b. Study the effect of temperature on the solubility of a given salt.
c. Compensation knob and note the change in value of pH displayed.
d. Visit all laboratories in the department and identify the types of equipments /setups.
e. Prepare chart of standard symbols for various equipments as per IS 3232.
f. Prepare chart based on various job roles performed by diploma chemical engineers.
g. Prepare presentation based on opportunities for chemical engineers in various chemical and allied industries.
h. prepare presentation of application of different unit processes in chemical manufacturing and prepare a table of unit process versus product manufactured.
i. Prepare list chemical name chemicals, their use in daily life.
j. List various types of pH meters, refractometers
k. Select any chemical manufacturing process and identify unit operations and unit processes involved.

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.

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. **Water treatment plant:** Visit nearby water treatment plant and prepare the report with Block diagram of water treatment process, List of unit operations used
b. **History of Chemical Engineering:** Prepare a power point presentation on a topic "Chemical Engineering history and evolution"

c. **Petroleum refinery (Internet based assignment):** Identify a petroleum refinery and Make the list of product manufactured, list of unit operations and unit processes identify the job role for a chemical engineer in petroleum industry with Safety aspects
d. **Domestic water purifier (Field assignment):** Visit 3 to 4 domestic water purifier from near by locality or service center, identify purification stages and prepare a report based on function of each stage
e. **Four wheeler service stations:** Visit the four wheeler service station and study wastewater recycling arrangement and prepare a report.
f. **Industrial disaster:** Prepare a report on **Bhopal Gas tragedy** containing cause of accident, Safety preparedness of a company and Impact of accident.
g. **Laboratory Chemicals:** Prepare the list of Chemicals used in Laboratory on the basis of physical state and Hazards and technical specification
h. **Profile of PSUs**: Prepare a chart demonstrating profile of typical public sector organization, BPCL, HPCL, IOCL, ONGC containing product manufactured, block diagram, technical specification of product manufactured, safety aspects related to product, unit operations and processes involved.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Unit Operations of Chemical Engineering	Mc Cabe, W. L. Smith, Harriott	Mc Graw Hill International; 2010; ISBN: 007-124710-6
2	Introduction to Chemical Engineering	Ghosal S. K., Sanyal Shyamal K., Datta S.	Tata Mc Graw Hill Publications; 2006; ISBN: 0-07-460140-7
3	Unit Operations of Chemical Engineering	Walter L. Badger, Julius T. Banchero	Mc Graw Hill International, 1955; ISBN: 9780070850279
4	Stoichiometry	Bhatt B. I., Vora S. M.	Tata Mc Graw Hill Publications New Delhi; 1984; ISBN: 9780070964044
5	Mechanical Operations	Swain Anup K., Patra Hemlata, Roy G. K.	Mc Graw Hill Publication; 2010; ISBN: 0070700222
6	Fundamentals of Chemical Engineering	S.N. Saha	Dhanpat Rai Publishing Company New Delhi, 2012, ISBN:81-87433-55-8

14. SOFTWARE/LEARNING WEBSITES

a. www. people.clarkson.edu
b. www.creatingtechnology.org
c. www.pafko.com/history
d. www.thechemicalengineer.com/
e. www.iisc.ernet.in
f. www.tep.engr.tu.ac.th
g. www.ichemeblog.org/
h. https://www.acs.org/chemicalsafety
i. www.chemistry.harvard.edu

Program Name : **Mechanical and Chemical Engineering Program Group**

Program Code : **CH/AE/FG/ME/PG/PT**

Semester : **Second**

Course Title : **Electrical & Electronics Technology**

Course Code : **22232**

1. RATIONALE

Electrical and electronics equipment are the most essential inputs of any chemical engineering based industry. Further, the various chemical processes and other services in the chemical industries are performed using different electrical and electronics equipment. Chemical engineering diploma passouts must have knowledge of basic electrical and electronics principles, working of equipment, protective devices and the safety measures while working in chemical industry. This course is developed in the way by which fundamental information will help the diploma engineers to apply the basic concepts and principles of electrical and electronic engineering in various engineering applications to solve broad based problems.

2. COMPETENCY

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

- **Use the electrical and electronics equipment in the chemical industry.**

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 the voltage and current in A.C. circuits.
c. Connect transformers and electrical machines for specific requirement.
d. Identify electronic components in electronic circuits.
e. Identify the types of diodes used in electronic circuits.
f. Identify the types of transistor used in electronic circuits.

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
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 (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 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 with the various levels of outcomes (details are in the subsequent sections) to be attained by the student by the end of the course, in all domains of learning terms of the industry/employer identified competency depicted at the centre of this map.

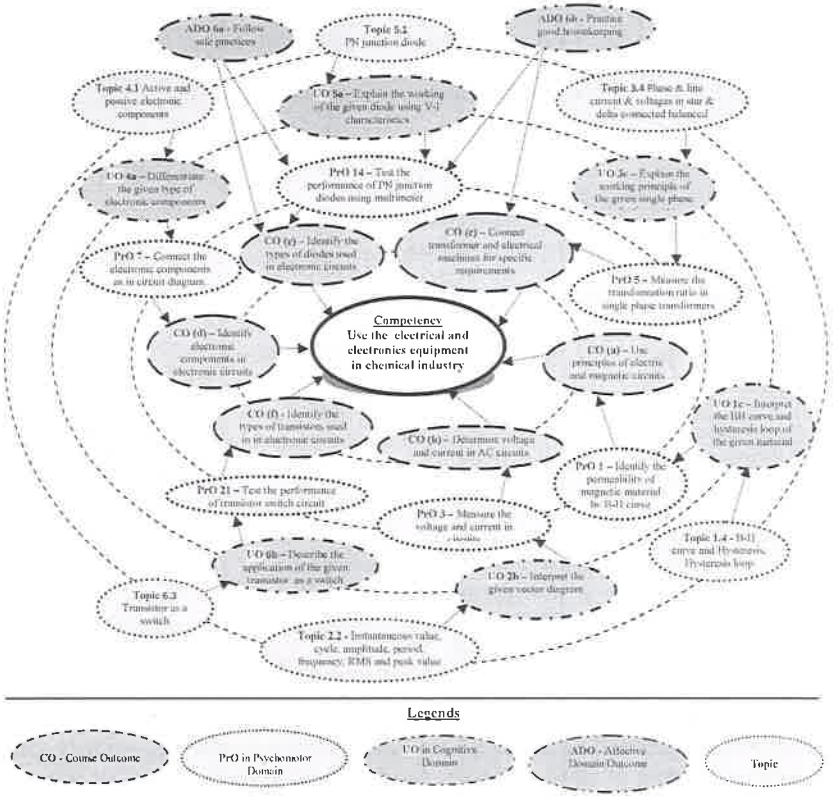

Figure 1 - Course Map

6. SUGGESTED PRACTICAL LEARNING OUTCOMES/TUTORIALS

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

S. No.	Practical Exercises 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	II	02*

S. No.	Practical Exercises Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	resistive load).		
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	Connect the passive electronic components as in circuit diagram	IV	02
8	Connect resistors in series and parallel combination on bread board to measure its value using digital multimeter.	IV	02*
9	Connect capacitors in series and parallel combination on bread board to 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 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	Selection of suitable component, apparatus/instrument	20
2	Preparation of experimental set up	10
3	Setting and operation	10
4	Safety measures	10
5	Observations and Recording	10
6	Interpretation of result and Conclusion	20
7	Answer to sample questions	10
8	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 administrators.

S. No.	Equipment Name with Broad Specifications	Expt. 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	common
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.	4,5,17,18,1 9,20,21,22
8	Function generator, 0-2MHz.,Sin ,square, pulse, triangular wave shape generation	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
Unit – I Electric and	1a. Explain the given terms related to electric and magnetic circuits.	1.1 Concepts of EMF, Current, Potential Difference, Power and Energy. 1.2 Concepts of M.M.F, magnetic force.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Magnetic Circuits	1b. Interpret the B-H curve and hysteresis loop of the given material. 1c. Apply Fleming's left hand rule and Lenz's law in the given situation. 1d. Derive the equations of self and mutual inductance for the given circuit.	permeability, hysteresis loop, reluctance, leakage factor. 1.3 magnetic and electric circuits, Faraday's laws of electromagnetic induction. 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.
Unit– II A.C. Circuits	2a. Explain the given AC parameters. 2b. Interpret the given vector diagram. 2c. Derive the current and voltage relationship of the given star and delta connections. 2d. Find currents and voltages in the given series and parallel AC circuits.	2.1 A.C. circuit parameter: Cycle, Frequency, Periodic time, Amplitude, Angular velocity, current, RMS value, Average value, Form Factor and Peak Factor, impedance, phase angle, and power factor. 2.2 Vector representation of emf and current; mathematical representation of an alternating emf and current. 2.3 A.C. through: resistors, inductors and capacitors; A.C. through: R-L series, R-C series, R-L-C series and parallel circuit; Power in A. C. Circuits. Concept of power triangle. 2.4 Voltage and Current relationship in Star and Delta connections.
Unit– III Transformer and single phase induction motors	3a Explain the working principle of the given single phase transformer. 3b Explain working principle of the given Autotransformer. 3c Explain working principle of the given single phase induction motors. 3d Explain the construction of the given FHP motors	3.1 General construction and working principle of transformers; Emf equation and transformation ratio of transformers; losses in transformers and efficiency equation. 3.2 Auto transformers. 3.3 Construction and Working principle of single phase A.C. motor. 3.4 Starting methods for induction motors. 3.5 Various types of FHP motors.
Unit – IV Electronic Components and Signals	4a. Differentiate the given type of electronic components. 4b. Calculate value of the given resistor and capacitor using colour code. 4c. Compare features of the voltage and current source on the basis of the given criteria. 4d. Describe the given signal	4.1 Active and passive electronic components 4.2 Resistor, capacitor, inductor symbols, working principals and applications, colour codes, specifications 4.3 Voltage and Current Source 4.4 Signal, waveform, Time and frequency domain representation, Amplitude, frequency, phase, wavelength

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	parameters with sketches. 4e. Distinguish the given analog and digital ICs on the basis of the given criteria.	4.5 Types of Signals: sinusoidal, triangular and square 4.6 Integrated Circuits – analog and digital
Unit– V Diodes and Applications	5a. Explain the working principle of the given diode using V-I characteristics. 5b. Describe the working principle of the given Zener diode. 5c. Interpret the zener voltage on the given Zener diode V-I characteristics. 5d. Explain the working principle of the given type of rectifiers. 5e. Describe the working of the given LED with sketches.	5.1 Symbol, construction and working principle of P-N junction diode 5.2 Rectifiers: Half wave, Full wave and Bridge Rectifier, working principle , circuit diagram, performance parameters PIV, ripple factor, efficiency, Need for filters: circuit diagram and working of 'L', 'C' and 'π" filter 5.3 Zener diode working principle, symbol, Zener diode as voltage regulator 5.4 Regulated power supply 5.5 Construction and working principle of light emitting diode(LED)
Unit– VI Bipolar Junction Transistor	6a. Differentiate the salient features of the given unipolar and bipolar devices. 6b. Describe the application of the given transistor as switch with sketches 6c. Determine the current gain of the given transistor configuration. 6d. Describe the effect of cascading on bandwidth and voltage gain of the given amplifiers.	6.1 Unipolar and Bipolar devices 6.2 Symbol, construction and working principle of NPN transistor. 6.3 Transistor as switch and amplifier. 6.4 Input and Output characteristics of CE, CB and CC configurations. 6.5 Regions – Cut-off, saturation and Active region. 6.6 Transistor parameters- alpha, beta, input and output resistance and relation between alpha and beta

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	Electric and magnetic circuits	06	-	04	06	10
II	A.C. circuits	12	02	04	06	12
III	Transformer and single phase Induction motors	12	04	04	06	14
IV	Electronic components and Signals	10	02	04	06	12
V	Diodes and applications	12	02	04	06	12

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
VI	Bipolar Junction Transistor	12	02	04	04	10
Total		**64**	**12**	**24**	**34**	**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. Massive Open Online courses (MOOCs) may be used to teach various topics and sub topics.
a. Market survey and interpret the name plate ratings and identify the parts of an induction motor.
b. Make star delta connections of transformer.
c. Connect the various types of meters to measure the current and voltage of induction motor.
d. Visit the site and interpret the name plate ratings and identify the parts of a transformer.
e. Seminar on any relevant topic.

11. 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.

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.
b. **Transformer**: Each batch will visit nearby pole mounted sub-station and prepare a report based on the following points:
   - Rating: kVA rating, primary and secondary voltage, connections
   - Different parts and their functions
   - 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 clip a positive half cycle at 1.5 v of a waveform with input signal 5Vpp., and prepare the report.
g. **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, New Delhi, 2014, ISBN: 9781107464353
2	Basic Electrical Engineering	Mittle and Mittal	McGraw Hill Education, New Delhi, 2014, ISBN: 978-0-07-0088572-5
3	Electrical Machines	Bhattacharya, S.K.	McGraw Hill Education, New Delhi, 2014, ISBN: 978-9332902855
4	Electrical Technology Vol – I & II	Theraja, B. L.	S. Chand and Co., New Delhi, 2014, ISBN: 9788121924405
5	Basic Electrical and Electronics Engineering	Jagathesan, V.	Wiley India, New Delhi, 2014, ISBN: 97881236529513
6	A text book of Applied	Sedha, R.S.	S Chand and Co., New Delhi,

S. No.	Title of Book	Author	Publication
	Electronics		2008,**ISBN:** 978-8121927833
7	Electronics Principles	Malvino, Albert Paul, David	McGraw Hill Education, New Delhi, 2014 , **ISBN:** 978-0070634244
8	Principles of Electronics	Mehta, V.K. Mehta, Rohit	S. Chand and Co., New Delhi-110 055, 2014 , ISBN-:13-9788121924504
9	Fundamental of Electronic Devices and Circuits	Bell, David	Oxford University Press , New Delhi, 2015, ISBN: 9780195425239

14. SOFTWARE/LEARNING WEBSITES

a. Electronics Workbench
b. Scilab
c. www.nptel.iitm.ac.in
d. en.wikipedia.org/wiki/Transformer
e. www.animations.physics.unsw.edu.au//jw/AC.html
f. www.alpharubicon.com/altenergy/understandingAC.htm
g. www.electronics-tutorials
h. learn.sparkfun.com/tutorials/transistors
i. www.pitt.edu/~qiw4/Academic/ME2082/Transistor%20Basics.pdf
j. faculty.cord.edu/luther/physics225/Handouts/transistors_handout.pdf
k. www.technologystudent.com/elec1/transis1.htm
l. www.learningaboutelectronics.com/
m. www.electrical4u.com

Program Name : **Diploma in Chemical Engineering**
Program Code : **CH**
Semester : **Second**
Course Title : **Chemistry of Engineering Materials**
Course Code : **22233**

1. RATIONALE

Diploma chemical engineers (also called technologists) are also responsible for various processes in chemical industry. Different types of metals, non-metals are used in chemical process industry, where lots of hazardous reactions are carried out, storage, transportation and material of construction are important area in chemical industry. Many metals, nonmetals and plastic materials are used in chemical industry as material of construction, as insulating material. Chemical Engineer should be familiar with basic concepts such as structure of metallic and non-metallic materials, its properties, applications. This course is developed in the way by which fundamental information will help the diploma engineer to apply the basic concepts, applications of metals in various engineering applications, while working in Chemical process industries.

2. COMPETENCY

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

- **Apply the principles of chemistry of engineering materials in chemical industries.**

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 the material structure.
b. Test physical, chemical, mechanical properties of the materials.
c. Select the relevant industrial materials for different applications.
d. Identify the type of corrosion in industrial environments.
e. Select the relevant ferrous metals for the different applications.

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 with the various levels of outcomes (details are in the subsequent sections) to be attained by the student by the end of the course, in all domains of learning terms of the industry/employer identified competency depicted at the centre of this map.

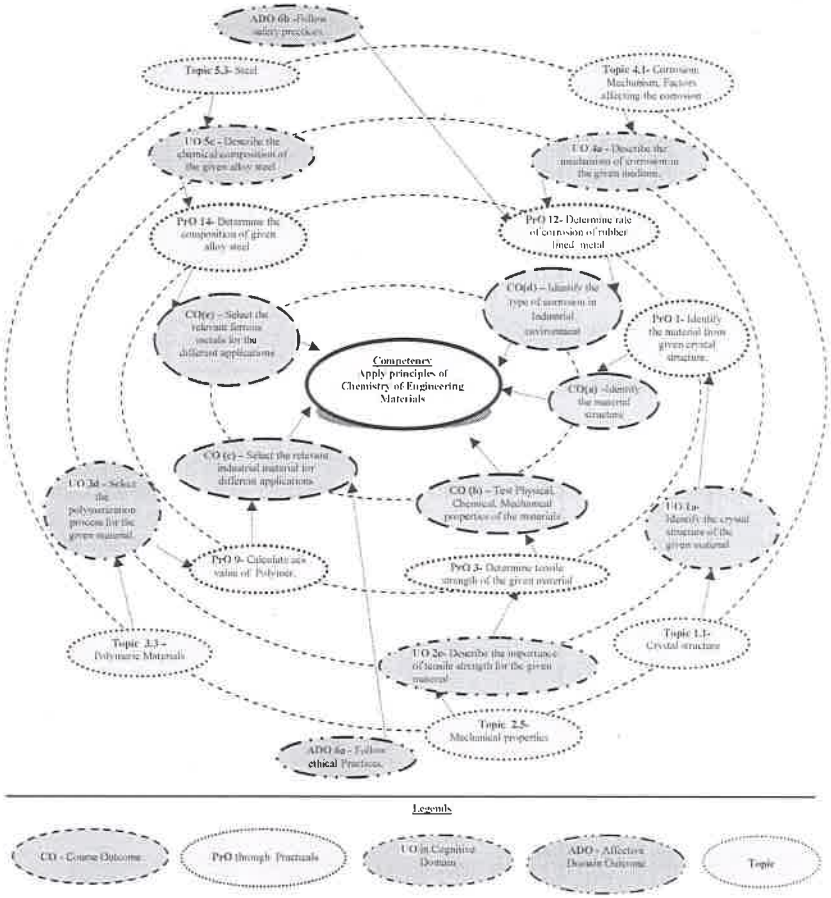

Figure 1 - Course Map

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 material from given crystal structure.	I	02*
2	Determine the thermal and electrical conductivity of given metal.	II	02*
3	Determine the Tensile strength, Yield strength, Impact Strength of given material.	II	02
4	Determine the melting point of given material.	II	02
5	Determine the porosity and density of given material.	II	02
6	Determine the Malleability, Ductility of given material.	II	02
7	Prepare the thermoplastic material.	III	02*
8	Prepare the thermosetting material.	III	02
9	Calculate acid value of Polymer.	III	02
10	Determine the rate of corrosion in acidic medium.	IV	02*
11	Determine the rate of corrosion in alkaline medium.	IV	02
12	Determine rate of corrosion of rubber lined metal.	IV	02
13	Determine electrode potential of metal and compare its rate of corrosion.	V	02*
14	Determine the composition of given alloy steel.	V	02
15	Determine copper content in Cu-alloy material.	V	02
16	Determine manganese in steel.	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 %
2	Preparation of experimental set up	20
3	Setting and operation	20
4	Safety measures	10
5	Observations and Recording	10
6	Interpretation of result and Conclusion	20
7	Answer to sample questions	10
8	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 and
- '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	Equipments Names with broad specifications	Expt. No.
1	Beakers (100 ml to 500 ml)	All Expt
2	Conical Flask (100 ml to 250 ml)	All Expt
3	Pipette (10 ml to 25 ml)	All Expt
4	Burette with stand	All Expt
5	Conductivity meter	1, 12
6	Different Metallic and Nonmetallic Material	2, 3, 8, 9, 12
7	Metal Sample, alloy sample	12
8	Measuring Cylinder (10 ml to 50 ml)	All Expt

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
Unit – I Structure of Material and Insulations	1a. Describe the crystal structure of the given material 1b. Describe the properties of the given biomaterial. 1c. Describe the properties of the given insulations. 1d. Identify relevant organic and inorganic insulations for the given system with justification.	1.1 Crystal Structure: Types of structure Atomic structure, Nano structure, Micro structure, Macro structure. Chemical Bonding. Fundamental laws of crystal structure, Bragg's Law. 1.2 Materials in research: Biomaterials, Nanomaterials, Electronic, optical and Magnetic Materials 1.3 Insulating Materials: Heat/Thermal insulations, Sound Insulations, Electrical Insulations. 1.4 Heat/Thermal Insulations: General aspects, requirements, classifications, Organic insulation,(e.g. wool, cotton wool, saw dust, corkboard) and Inorganic insulation (e.g. Slag wool, Glass wool, Charcoal, Asbestos, Gypsum powder)

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit– II Properties of Engineering Materials	2a. Describe chemical reactivity of the given material 2b. Describe the density and porosity of the given material. 2c. Describe thermal conductivity of the given material. 2d. Calculate resistivity and conductivity of the given material. 2e. Describe the importance of tensile strength for the given material	2.1 Chemical Properties: Composition, Chemical reactivity with air, water and acid 2.2 Physical Properties: Dimension, color, Appearance, density, porosity 2.3 Thermal Properties: Melting point, Specific Heat, Heat Capacity, thermal expansion, thermal conductivity, thermal stability, thermal shock resistance, heat resistance 2.4 Electrical Properties: Resistivity and conductivity, Dielectric constant, Dielectric strength, thermo electricity 2.5 Mechanical Properties: Tensile strength, Yield strength, Impact Strength, compressive strength, Hardness, Malleability, Ductility, Brittleness, Fatigue, Creep, Elasticity, Plasticity, Toughness
Unit– III Industrial Materials	3a. Describe properties of the given metallic substance 3b. Differentiate ceramic substances based on the given properties. 3c. Describe the properties of the given thermosetting and thermoplastic polymers. 3d. Select the polymerization process for the given material with justification..	3.1 Metals and Nonmetals: Classification, Properties and uses 3.2 Ceramics: Classification, Clay, Silica, Feldspar, Properties of ceramics: Mechanical, Electrical, Chemical, Thermal. Important Engineering Ceramics, Silicon Carbide, Aluminum Oxide, Engineering application of ceramics 3.3 Polymeric Materials: Thermoplastic and Thermosetting polymers, Polymerization reaction: Addition, Condensation, Co-polymerization
Unit-IV Chemical and Corrosive Environments	4a. Describe the mechanism of corrosion in the given medium. 4b. Identify the different factors affecting rate of corrosion for the given type of material with justification.. 4c. Differentiate the mechanism of corrosion in the given acidic and alkaline environment. 4d. Identify the material of construction for the given chemical process with	4.1 Corrosion: Mechanism, Factors affecting the corrosion 4.2 Corrosion by water, steam and soil 4.3 Corrosion in acidic and alkaline environments 4.4 Control and prevention of corrosion: Factors determining choice of materials 4.5 MOC: Process Equipments, handling chemicals (storage vessel and transportation) like Acid, Chlorine (Dry and Wet)

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	justification.	
Unit –V Ferrous metals and alloys	5a. Identify the properties of the given ferrous alloy with justification. 5b. Describe the effects of chemical elements on the given ferrous material. 5c. Describe chemical composition of the given alloy steel. 5d. Identify the special alloy steel for the given application with justification.	5.1 Types of Irons: Pig iron, cast iron, wrought iron 5.2 Effects of chemical elements on Iron: Chromium, copper, magnesium, manganese, Nickel, silicon, phosphorus 5.3 Steel: Classification of steel Based on carbon content, based on deoxidation practice 5.4 Alloy Steels: Purpose of alloying, Preparation of alloys, Classification of alloy, chemical composition, purpose, structural class 5.5 Special alloy steels: Heat resisting steel, Stainless Steel

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	Structure of material and insulations	08	02	02	04	08
II	Properties of engineering materials	14	04	06	08	18
III	Industrial Materials	14	04	06	08	18
IV	Chemical and corrosive environments	14	02	04	06	12
V	Ferrous metals and alloys	14	04	04	06	14
Total		**64**	**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:

a. Prepare journals based on practical performed in laboratory.
b. Enlists different types of metals and nonmetals in laboratory
c. Visit nearby metal foundry.
d. Prepare the chart for various grades of stainless steel.
e. Collect different types of Fe samples
f. Observe corrosion of different metals in different environments.
g. Draw the atomic structure of various metals. Display chart in Laboratory.

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.

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. **Metal and Nonmetal:** Collect samples of different metal and nonmetal and samples Test physical, chemical, thermal, electrical and mechanical properties
b. **Polymer Industry**: Visit nearby polymer industry and prepare detailed presentation based on the working of the equipment.
c. **Steel Industry**: Visit nearby steel industry and prepare detailed presentation based on the working of the equipment
d. **Corrosion rate**: Prepare chart showing corrosion rate of metals in different environments.
e. Visit nearby small scale industry to collect data about Material of construction.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Material Science and Metallurgy	Khanna O.P.	Dhanpat Rai publications Ltd.; New Delhi, 2014; ISBN-10: 9383182458
2	Material science and metallurgy	Daniel C. Yesudian D.G., Harris S.	SCITECH publications(India) Pvt. Ltd.; Chennai ; 2010; ISBN 10: 8188429449
3	Engineering Chemistry	Dr. Dara S. S. Dr. Umare S.S.	S. CHAND and Company Ltd.; New Delhi; 2011; ISBN: 9788121997652

S. No.	Title of Book	Author	Publication
4	Material Science	Narang B. S.	CBS Publishers and Distributors; Delhi; 1991; ISBN: 16825076329
5	Material Science and Processes	Chaoudhury Hajra S.K.	Indian Book Distributing Company; Mumbai; 1985; ISBN: 9780906216002
6	Engineering Materials	Rangawal S. C.	Charotar Publishing House; Anand; 2016; ISBN: 978-93-85039-17-1

14. SOFTWARE/LEARNING WEBSITES

i. https://en.wikipedia.org/wiki/Materials_science
ii. https://mse.stanford.edu
iii. http://ocw.mit.edu/courses/materials-science-and-engineering/

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	ESE		PA		Total		ESE		PA		Total	
L	T	P		Hrs.	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.

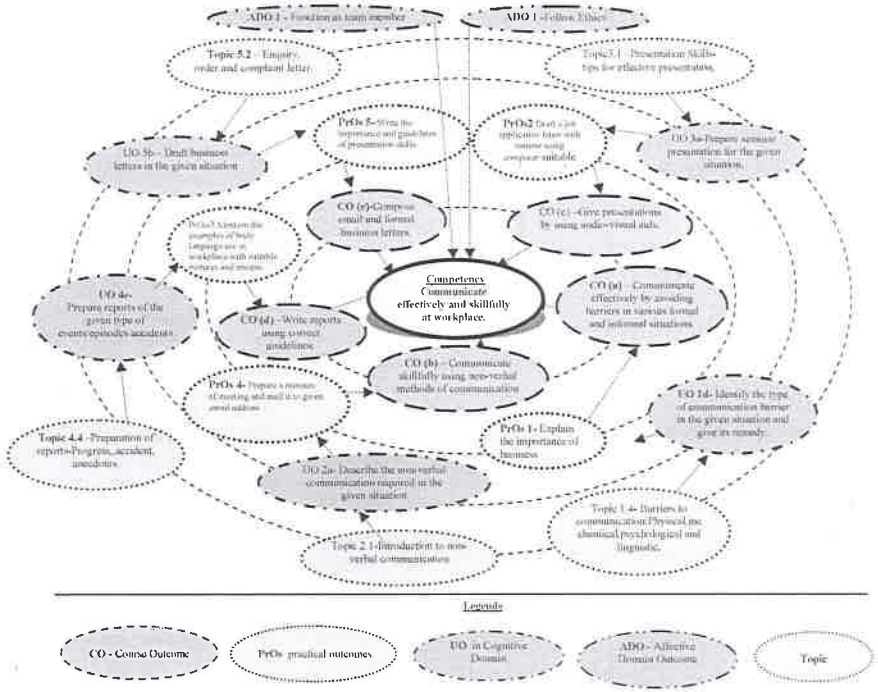

Figure 1 - Course Map

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