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

Course 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 : First

Subject Title : Basic Science (Physics & Chemistry)

Subject Code : 22102

1. RATIONALE

Diploma engineers (also called technologists) have to deal with various materials and machines. This course is designed with some fundamental information to help the technologists apply the basic concepts and principles of physics and chemistry to solve broad-based engineering problems. The study of basic principles of sciences and the concepts related to various materials such as metals, alloys, inorganic salts, polymers, lubricants, paints, varnishes, adhesives, heat, electricity, magnetism, optics, semiconductors and others will help in understanding the technology courses where emphasis is on the applications of these in different technology applications.

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 broad-based engineering problems applying principles of physics and chemistry.**

3. COURSE OUTCOMES (COs)

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

a. Estimate errors in the measurement of physical quantities.
b. Apply the principles of electricity and magnetism to solve engineering problems.
c. Use the basic principles of heat and optics in related engineering applications.
d. Apply the catalysis process in industries.
e. Use corrosion preventive measures in industry.
f. Use relevant engineering materials in industry.

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	4	2	70*#	28	15*	00	100	40	25@	10	25	10	50	20
2	--	2	4				15*	00			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 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.

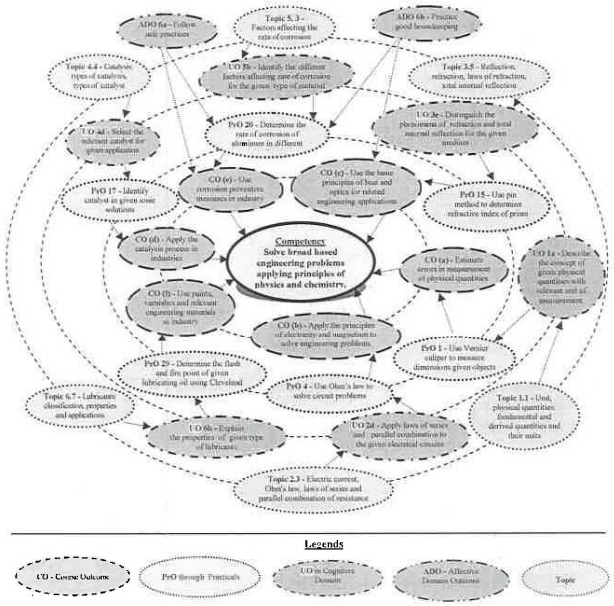

Figure 1 - Course Map

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
	Physics		

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Use Vernier caliper to : (i) Measure dimensions of given objects. (ii) Measure the dimensions of objects of known dimensions. (iii) Estimate the errors in measurement.	I	02*
2	Use Screw gauge to: (i) Measure dimensions of given objects. (ii) Measure the dimensions of objects of known dimensions. (iii) Estimate the errors in measurement.	I	02*
3	Use Spherometer to measure radius of curvature of any curved surface.	I	02
4	Use Ohm's law to solve circuit problems.	II	02*
5	Determine the specific resistance of given wire.	II	02*
6	Use the principle of series resistance in solving electrical engineering problems.	II	02
7	Use the principle of parallel resistance in solving electrical engineering problems.	II	02
8	Use magnetic compass to draw the magnetic lines of forces of magnet of different shapes.	II	02*
9	Use magnetic compass to determine the neutral points when (i) North pole of bar magnets points towards the north pole of earth. (ii) South pole of bar magnets points towards the north pole of earth.	II	02
10	Use p-n junction diode to draw forward bias and reverse bias I-V characteristics.	II	02*
11	Determine forbidden energy band gap in semiconductors.	II	02
12	Determine the pressure-volume relation using Boyle's law.	III	02
13	Use Joule's calorimeter to determine Joule's mechanical/electrical equivalent of heat.	III	02*
14	Use Searle's thermal conductivity apparatus to find co-efficient of thermal conductivity of a given material.	III	02*
15	Use pin method to determine refractive index of prism.	III	02*
16	Determine the refractive index of glass slab using TIR phenomenon.	III	02
	Chemistry		
17	Identify cation in given ionic solutions.	IV	02*
18	Identify anion in given ionic solutions.	IV	02
19	Determine the percentage of iron in the given sample using redox titration.	IV, V	02*
20	Prepare the corrosive medium for Aluminium at different temperature.	V	02
21	Determine the rate of corrosion on different temperatures for Aluminium.	V	02*
22	Determine the electrode potential of Copper metal.	V	02
23	Determine the electrode potential of Iron metal.	V	02*
24	Determine the voltage generated from chemical reaction using Daniel Cell.	V	02
25	Determine the pH value of given solution using pH meter and universal indicator.	V	02*
26	Determine electrochemical equivalent of Cu metal using Faraday's first law.	V	02
27	Determine equivalent weight of metal using Faraday's second law.	V	02
28	Determine the effect of temperature on viscosity for given lubricating oil using Redwood viscometer-I.	VI	02*
29	Determine the steam emulsification number of given lubricating oil.	VI	02
30	Determine the flash and fire point of given lubricating oil using Cleveland open cup apparatus.	VI	02*
31	Determine the flash point of given lubricating oil using Abel's closed cup apparatus.	VI	02*
32	Determine thinner content in oil paint.	VI	02*
	Total		64

Note

*i. A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 (each in Physics and Chemistry) 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. 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 PrOs. as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	Exp. S.No.
1	Vernier Calipers: Range: 0-150mm, Resolution: 0.1mm	1
2	Micrometer screw gauge: Range: 0-25mm, Resolution:0.01mm, Accuracy: ±0.02mm or better	2
3	Spherometer: range:-10 to +10 mm, LC = 0.01mm	3
4	Digital multimeter: 3½ digit display, 9999 counts, digital multimeter measures: V_{ac}, V_{dc} (1000V max), A_{dc}, A_{ac} (10 amp max), Hz, Resistance (0-100 MΩ), Capacitance and Temperature	4, 5, 6, 7, 21, 22, 23
5	Resistance Box: 4 decade ranges from 1 ohm to 1KΩ ,accuracy 0.1 % - 1 %	4,5,6,7
6	Battery eliminator: 0- 12V, 2A	6,7, 25, 26
7	Boyle's apparatus: U tube manometer, digital barometer	12
8	Joule's calorimeter: well insulated 'mechanical/Electrical equivalent of heat apparatus' in wooden box, digital/analog thermometer	13
9	Searle's thermal conductivity apparatus : Cylindrical copper, aluminum, brass, glass and iron rod, steam chamber, digital / analogue thermometer, arrangement for fitting tubes and thermometer	14
10	Forbidden energy band gap set up: Oven : temperature range up to 100°C, thermometer, micro ammeter, Ge diode	11
11	pH meter reading up to pH14; ambient temp. -40 to 70° C.; pH/mV resolution:13 bit	24
12	Electronic balance, with the scale range of 0.001g to 500gm pan size 100 mm; response time 3-5 sec.; power requirement 90-250 V, 10 watt	13,17, 19, 25, 26, 31
13	Electric oven inner size 18"x18"x18"; temperature range 100 to 250° C. with the capacity of 40 lt.	31
14	Ammeter 0-2 amp	25,26
15	Redwood viscometer-I	27
16	Cleveland open cup apparatus	29
17	Abel's close cup apparatus	30

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Physics		

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Units and Measurements	1a. Describe the given measurement device and its application. 1b. Describe with justification the device required to measure the radius of curvature of the given object. 1c. State with justification the error in the given measurement quantity. 1d. Describe the procedure to determine the dimensions of the given physical quantities.	1.1 Unit, physical quantities: fundamental and derived quantities and their units 1.2 Systems of unit: CGS, MKS, FPS and SI 1.3 Dimensions, dimensional formula 1.4 Errors, types of errors: instrumental, systematic and random error, estimation of errors: absolute, relative and percentage error, significant figures
Unit– II Electricity, Magnetism and Semiconductors	2a. Calculate electric field, potential and potential difference of the given static charge. 2b. Describe the concept of given magnetic intensity and flux with relevant units. 2c. Explain the heating effect of the given electric current. 2d. Apply laws of series and parallel combination in the given electric circuits.	2.1 Concept of charge, Coulomb's inverse square law, Electric field, Electric field intensity, potential and potential difference 2.2 Magnetic field and magnetic field intensity and its units, magnetic lines of force, magnetic flux 2.3 Electric current, Ohm's law, specific resistance, laws of series and parallel combination of resistance, heating effect of electric current
	2e. Distinguish the given conductors, semiconductors and insulators on the basis of energy bands. 2f. Explain the I-V characteristics and applications of the given p-n junction diodes.	2.4 Conductors, Insulators and Semiconductors, Energy bands, intrinsic and extrinsic semiconductors 2.5 p-n junction diode, I-V characteristics of p-n junction, applications of p-n junction diode
Unit– III Heat and Optics	3a. Convert the given temperature in different temperature scales. 3b. Describe the properties of the given good and bad conductors of heat. 3c. Relate the characteristics of the three gas laws. 3d. Determine the relation between specific heats for the given materials.	3.1 Heat, temperature, temperature scales 3.2 Modes of transfer of heat, good and bad conductors of heat, law of thermal conductivity 3.3 Boyle's law, Charle's law, Gay Lussac's law, perfect gas equation 3.4 Specific heat of gas at constant pressure and volume (C_p and C_V), ratio of specific heats
	3e. Distinguish the phenomena of total internal reflection for	3.5 Reflection , refraction, laws of refraction, total internal reflection

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	the given mediums. 3f. Describe light propagation in the given type of optical fiber.	3.6 Optical fiber: Principle, construction and path of light through optical fiber, applications of optical fibers.
	Chemistry	
Unit-IV Chemical bonding and Catalysis	4a. Explain the properties of given material based on the bond formation. 4b. Describe the molecular structure of given solid, liquid and gases. 4c. Describe the crystal structure of the given solids. 4d. Select the relevant catalyst for given application.	4.1 Electronic theory of valency, chemical bonds: types and characteristics, electrovalent bond, covalent bond, coordinate bond, hydrogen bond, metallic bond, metallic properties, intermolecular force of attraction. 4.2 Molecular arrangement in solid, liquid and gases. 4.3 Structure of solids: crystalline and amorphous solid, properties of metallic solids-, unit cell- of simple cubic, body centre cubic, face centre cubic, hexagonal close pack crystals. 4.4 Catalysis: Types of catalysis, Catalyst, Types of Catalyst, Positive Catalyst, Negative Catalyst, Auto-catalyst, Catalytic Promoter and Catalytic inhibitor, Industrial Application of Catalyst
Unit –V Metal Corrosion, its prevention and Electroche mistry	5a. Describe the phenomenon of the given type of corrosion and its prevention. 5b. Identify the different factors affecting rate of corrosion for the given type of material. 5c. Select the protective measures to prevent the corrosion in the given corrosive medium.	5.1 Corrosion: Types of corrosion- Dry corrosion, Wet corrosion. Oxidation corrosion (Atmospheric corrosion due to oxygen gas), mechanism, Types of oxide film, Wet corrosion mechanism (Hydrogen evolution in acidic medium) 5.2 Concentration cell corrosion -oxygen absorption mechanism in neutral or alkaline medium, Pitting corrosion, Waterline corrosion, Crevice corrosion. 5.3 Factors affecting the rate of corrosion control: Modification of environment, Use of protective coatings- coating of less active metal like Tin (Tinning), coating of more active metal like Zinc (Galvanizing), Anodic and cathodic protection, Choice of material-using pure metal and using metal alloys
	5d. Differentiate the salient features of the given electrolytic cell and electrochemical cell. 5e. Distinguish the given	5.4 Electrolyte- strong and weak, Non-Electrolyte, Electrolytic cell, Electrochemical cell. Cathode, Anode, Electrode potential- oxidation and reduction, Construction and working of

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	primary and secondary electrolytic cells. 5f. Describe the process of electrolysis for the given electrolyte. 5g. Describe the process of electroplating of the given material.	Daniel cell Ionisation and dissociation 5.5 Faradays first and second law 5.6 Primary cell and secondary cell Electrolysis- Mechanism, Electroplating and electro-refining of copper.
Unit-VI Paints, Varnishes, Insulators, Polymer, Adhesives and Lubricants	6a. Identify the ingredients of the given paints. 6b. Differentiate salient properties of the given paint and varnish. 6c. Describe the properties of insulating materials for the given application.	6.1 Paints: Purpose of applying paint, Characteristics of paints, Ingredients of paints, Function and Examples of each ingredients 6.2 Varnish: Types, Difference between paints and varnishes 6.3 Insulators: Characteristics, Classification, Properties and Application of Glass wool, Thermo Cole
	6d. Differentiate the given types of structural polymers. 6e. Describe the polymerization process of the given polymer. 6f. Explain the properties and uses of the given polymer, elastomer and adhesive. 6g. Describe the application of relevant adhesives required for the given material. 6h. Explain the properties of given type of lubricants.	6.4 Polymer and Monomer, Classification: on the basis of Molecular structure, on the basis of monomers (homo polymer andcopolymer), on the basis of Thermal behavior(Thermoplastics and Thermosetting) 6.5 Types Polymerization Reaction, Addition Polymerization, Condensation Polymerization, Synthesis, properties and application of Polyethylene, Polyvinyl chloride, Teflon, Polystyrene, Phenol formaldehyde, Epoxy Resin 6.6 Adhesives: Characteristics, Classification and their uses 6.7 Lubricants: Classification, properties and applications

***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
	Physics					
I	Units and Measurements	06	02	03	-	05
II	Electricity, Magnetism and Semiconductors	14	03	05	08	16

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
III	Heat and Optics	12	03	05	06	14
	Chemistry					
IV	Chemical bonding and Catalysis	08	02	03	04	09
V	Metal Corrosion, prevention and Electrochemistry	12	03	04	05	12
VI	Paints, Varnishes, Insulators, Polymer Adhesives and Lubricants	12	03	05	06	14
	Total	**64**	**16**	**25**	**29**	**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. Market survey of different resins and compare the following points.
   i. Structure
   ii. Properties
   iii. Applications.
b. Library survey regarding engineering material used in different industries.
c. Power point presentation or animation for showing different types of bonds or molecules.
d. Seminar on any relevant topic.

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 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 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. **Optical Fiber and TIR**: Prepare models by using water and diode laser to demonstrate total internal reflection and the working of optical fiber.
b. **Conductivity**: Collect different materials such as metal, plastics, glass etc. and prepare models to differentiate between good and bad conductor within collected materials.
c. **Gas laws:** Prepare models to demonstrate Boyle's laws, Charle's Law and Gay Lussac's law using house hold materials.
d. **Battery and Cell:** Collect wastage material from lab and household and prepare working model of cell.
e. **Adhesives:** Prepare model to demonstrate the applications of various adhesives.
f. **Polymer:** Collect the samples of different polymers and list their uses.
g. **Series and parallel resistances:** Prepare models for combination of series and parallel resistances using bulbs/ LED.
h. **Systems and units:** Prepare chart on comparison of systems of units for different physical quantities.
i. **Magnetic flux:** Prepare models to demonstrate magnetic lines of lines of forces of different types of magnets.
j. **Dimensional analysis:** Prepare chart on dimensions of fundamental and derived physical quantities and highlights the applications of dimensional analysis.
k. **Types of bonds:** Prepare chart and models displaying different types of bonds with examples.
l. **Ionization:** Prepare chart displaying ionization phenomenon.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Physics Textbook Part I - Class XI	Narlikar, J. V.; Joshi, A. W.; Mathur, Anuradha; *et al*	National Council of Education Research and Training, New Delhi, 2010, ISBN : 8174505083
2	Physics Textbook Part II - Class XI	Narlikar, J. V.; Joshi, A. W.; Mathur, Anuradha; *et al*	National Council of Education Research and Training, New Delhi, 2015, ISBN : 8174505660
3	Physics Textbook Part I - Class XII	Narlikar, J.V.; Joshi, A. W.; Ghatak A.K. *et al*	National Council of Education Research and Training, New Delhi, 2013, ISBN : 8174506314
4	Physics Textbook Part II - Class XII	Narlikar, J.V.; Joshi, A. W.; Ghatak A.K. *et al*	National Council of Education Research and Training, New Delhi, 2013, ISBN : 8174506713
5	Fundamentals of	Haliday, David;	John Wiley and sons, Hoboken,

S. No.	Title of Book	Author	Publication
	Physics	Resnik, Robert and Walker, Jearl	USA, 2014 ISBN : 812650823X
6	Engineering Chemistry	Jain and Jain	Dhanpat Rai and sons; New Delhi, 2015, ISBN : 9352160002
7	Engineering Chemistry	Dara, S. S.	S.Chand. Publication, New Delhi, 2013, ISBN: 8121997658
8	Fundamental of electrochemistry	Bagotsky,V.S.	Wiley International N. J.,2005, ISBN: 9780471700586

14. SOFTWARE/LEARNING WEBSITES

a. http://nptel.ac.in/course.php?disciplineId=115
b. http://nptel.ac.in/course.php?disciplineId=104
c. http://hperphysics.phy-astr.gsu.edu/hbase/hph.html
d. www.physicsclassroom.com
e. www.physics.org
f. www.fearofphysics.com
g. www.sciencejoywagon.com/physicszone
h. www.science.howstuffworks.com
i. https://phet.colorado.edu
j. www.chemistryteaching.com
k. www.visionlearning.com
l. www.chem1.com
m. www.onlinelibrary.wiley com
n. www.rsc.org
o. www.chemcollective.org