GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN EE/ET**
PROGRAMME CODE	**02/03**
COURSE TITLE	**APPLIED CHEMISTRY**
COURSE CODE	**SC11202**
PREREQUISITE COURSE CODE & TITLE	**--**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration Hrs.	Theory				Based on LL &TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
SC11202	APPLIED CHEMISTRY	DSC	3	0	2	1	6	3	2	30	70*#	100	40	25	10	25@	10	25	10	175

Total IKS Hrs for Term: 02 Hrs

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

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

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as '**Detained**' in that semester.
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as '**fail**' and will have to repeat and resubmit SLA work.
3. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
4. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.

6.*Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

Applications of Material Science and Chemical Principles have resulted in the development of new materials used in modern medicines and automobiles, synthetic fibers, polymers, alloys, new energy sources and many other important products and processes. Material Science is an important and expanding branch in the scientific engineering and economic field of our society.

The topic of atomic structure includes the basic structure of matter, which governs the Mechanical, Electrical and Magnetic properties of matter. Corrosion and methods of prevention will make students realize the importance of care and maintenance of machines and equipment. The study of different polymers, insulators, and adhesives and their chemical behaviour will be useful in their applications in electrical appliances and electronics industries. The study of impurities and hardness in water and methods for water softening will help the students make proper use of water.

Nanomaterials are widely used in the engineering field. It will help to understand the need for nanomaterials in different engineering fields.

III. COURSE-LEVEL LEARNING OUTCOMES (CO'S)

Students will be able to achieve and demonstrate the following CO's on completion of course-based learning

CO1: Distinguish materials based on atomic structure.
CO2: Apply the concepts of electrochemistry to solve engineering problems
CO3: Select metals and non-metals for given applications.
CO4: Select the relevant insulating material for various engineering problems.
CO5: Use corrosion preventive measures in the industry.
CO6: Use the appropriate engineering material in various engineering applications.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT:

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT-I ATOMIC STRUCTURE (CL Hrs-6, Marks-12)				
1.	**TLO 1.1** Explain the Characteristics of fundamental particles of an atom. **TLO 1.2** Distinguish between atomic number and atomic mass number **TLO1.3** Distinguish between orbit and orbital. **TLO 1.4** Explain the significance of quantum numbers. **TLO 1.5** Explain the formation of a given molecule **TLO 1.6** State Aufbau's principle and Hund's rule. **TLO 1.7** Define Electrovalent and covalent bonds with examples. .	1.1.**Indian Chemistry:** -Philosophy of atom by Acharya Kanad. 1.2.Definition of an atom, structure of atom, Characteristics of fundamental particles of an atom, definition of atomic number, atomic mass number and their difference 1.3.Orbits**:** Bohr's energy levels, sub-energy levels, s, p, d, f orbital, shapes and description of s and p orbital. Definition and significance of quantum numbers 1.4.Aufbau's principle, Hund's rule, orbital electronic configurations (s, p, d, f) of elements having atomic numbers 1 to 30. 1.5.Definitions of valence electrons, valency, types of valencies, Definition of electrovalency, positive and negative electrovalency 1.6. Formation of Electrovalent compounds-Nacl Alcl3 Definition of covalency, single, double and triple covalent bonds, formation of Covalent compounds H2O, CO2, N2	Chalk and board Improved lecture, Tutorial Assignment Demonstration	CO1
UNIT-II ELECTROCHEMISTRY (CL Hrs -8, Marks-14)				
2	**TLO 2.1** Explain the assumptions of Arrhenius's theory of electrolytic dissociation. **TLO 2.2.** Describe the process of electroplating taking a suitable example **TLO 2.3** Explain the mechanism of electrolysis for the given electrolyte. **TLO 2.4** Calculate CE, ECE, the	2.1. Definition of electrolyte, electrolysis, ionization, Arrhenius theory, Difference between atom and ion 2.2. Activity series, mechanism of electrolysis of CuSO4 using Pt electrode and Cu electrode 2.3. Applications of electrolysis: electroplating, electro-refining, 2.4. Faraday's laws of electrolysis and numerical. 2.5. Types of conductors: metallic conductors, electrolytic Conductors (definition and	Chalk and board Improved lecture, Tutorial Assignment Demonstration	CO2

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
	weight of substance deposited or liberated, and time in the given numerical. **TLO 2.5** Distinguish between metallic conductor and electrolytic conductor.**TLO 2.6** Describe the construction and working of cells. **TLO 2.7** Explain applications of Cells **TLO 2.8** Explain the care and maintenance of a battery	difference)2.6. Conductance in metals, conductance in electrolytes, Factors affecting conductance: nature of solute, nature of the solvent, temperature, concentration of solution. 2.7. Primary and secondary cell: Difference between primary cell and secondary cell, Construction, working and applications of Daniel cell (porous vessel and salt bridge), Dry cell, lead acid cell, Ni-Cd cell, Lithium-ion battery Maintenance of battery		
UNIT-III METALS AND ALLOYS (CL Hrs-08, Marks-10)				
3	**TLO 3.1** Draw the flow chart showing different processes in metallurgy. **TLO 3.2** Classify carbon steel giving properties and application of each **TLO 3.3**. Explain the purposes of heat treatment methods. **TLO 3.4** Explain the purposes of making alloys. **TLO 3.5** Classify alloys with suitable examples of each. **TLO 3.6** Write the composition, properties and uses of alloys. .	3.1. Occurrence of metals, definitions of mineral, ore, flux, matrix, slag and metallurgy, mechanical properties of metal. 3.2. Flow chart showing different processes in metallurgy, classification, properties and application of carbon steel, heat treatment (definition, purposes and methods) 3.3. Definition of alloy, purposes of making alloys with examples, classification of alloys(ferrous and non-ferrous), 3.4 Composition properties application of copper-zinc alloy, cadmium copper alloy, chromium copper alloy, brass, bronze, duralumin, wood's metal, and babbit metal.	Chalk and board Improved lecture, Tutorial Assignment Demonstration	CO3
UNIT- IV INSULATING MATERIALS (CL Hrs-8, Marks-12)				
4	**TLO 4.1** Describe the formation of a given polymer **TLO4.2**.Distinguish between thermo-softening and thermosetting plastics. **TLO 4.3.** Explain the applications of Plastic based on its properties **TLO 4.4** Explain the vulcanization process of natural rubber. **TLO 4.5** Distinguish between synthetic and natural rubber. **TLO 4.6** Explain the preparation, properties and applications of given synthetic rubber **TLO 4.7** Explain the properties andapplication of thermal insulators **TLO 4.8** Explain the properties and application of electrical insulators	**Plastic** 4.1. Definition of monomer and polymer, polymerization, classification of plastic based on monomer, based on thermal behaviour, on basis of monomer structure, 4.2. Types of polymerization (Addition, and Condensation) applications of Plastic based on its properties. 4.3. Synthesis, properties and applications of-polythene,PVC,Teflon, Bakelite, and polystyrene. **Rubber:** 4.4. Types of rubber, processing of natural rubber, properties of rubber, drawbacks of natural rubber, vulcanization of rubber. **4.5.** Synthetic rubber – preparation, properties and application of BUNA-S, BUNA-N, neoprene, Thiokol. **Thermal insulators :** 4.6. Properties and application of thermocol and glass wool. **Electrical insulators:** 4.7. Properties and applications of Ceramics, silicon fluid, nitrogen gas.	Chalk and board Improved lecture, Tutorial Assignment Demonstration	CO4

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT –V CORROSION (CL Hrs-7, Marks-10)				
5	**TLO 5.1** Explain different types of oxide films. **TLO 5.2** Explain the mechanism of electrochemical corrosion **TLO 5.3** Explain the factors affecting the rate of atmospheric corrosion and electrochemical corrosion. **TLO 5.4** Describe the galvanization process of protection of metal from corrosion**.** **TLO 5.5** Distinguish between galvanizing and tinning **TLO 5.6** Describe the given process of protection of metal from corrosion.	5.1. Definition, causes of corrosion types of corrosion definition (atmospheric and electrochemical) Types of oxide films 5.2. Mechanism of atmospheric and electrochemical corrosion (evolution of hydrogen, absorption of oxygen). 5.3. Factors affecting the rate of atmospheric corrosion and electrochemical corrosion. 5.4. Protection Methods-anodic and cathodic protection, galvanizing and tinning process, sherardizing process.	Chalk and board Improved lecture, Tutorial Assignment Demonstration	CO5
UNIT - VI ENGINEERING MATERIALS (CL Hrs-8, Marks-12)				
	TLO 6.1 Explain the properties and applications of nanomaterials. **TLO6.2** Explain the properties and applications of Magnetic Material. **TLO 6.3** Distinguish between diamagnetic and paramagnetic materials. **TLO 6.4** Explain the properties and applications of semiconducting materials. **TLO 6.5** Differentiate between N-type and P-type semiconductors. **TLO 6.6** Describe the properties of three groups of resistor materials. **TLO 6.7** Describe the properties and applications of Resistor material	6.1. **Nanomaterials**- properties and application of fullerene, graphene. 6.2. **Magnetic Material:** properties and applications of diamagnetic materials, paramagnetic materials and ferromagnetic materials. 6.3. **Semiconducting materials:** Definition, Applications of Semiconducting materials, Examples of Semiconductors commonly used, Intrinsic and extrinsic semiconductors, N-type and P-type semiconductors, Difference between N-type and P-type semiconductors, **6.4 Resistor material**: Definition, Properties of three groups of resistor materials, Properties and applications of resistor materials: Tungsten, Carbon, Nichrome, Manganin, Eureka, and Platinum.	Chalk and board Improved lecture, Tutorial Assignment Demonstration	CO6

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

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1	LLO 1 Write the electronic configuration of atoms from Z=1 to Z=30	Write the electronic configuration of atoms from Z=1 to Z=30	**2**	**CO1**
2	LLO 2 Write the formation of compounds NaCl, $AlCl_3$, H_2O, CO_2, N_2	Write the formation of compounds NaCl, AlCl3, H2O, CO2, N2	**2**	**CO 1**
3	LLO 3 Determine basic radicals from given ionic solutions by performing a selective test	Determination of basic radical from given ionic solution	**2**	**CO 1**
4	LLO 4 Determine acidic radicals given ionicsolutions by performing a selective test	Determination of acidic radical from given ionic solution.	**2**	**CO 1**
5	LLO 5 Determine the electrochemical equivalent of copper metal using Faraday's first law and Faraday's second law. .	Determination of electrochemical equivalent of copper metal using Faraday's first law and Faraday's second law.	**2**	**CO 2**
6	LLO 6 Use a Hydrometer for testing the Battery	Use a Hydrometer for testing Battery	**2**	**CO 2**
7	LLO 7 Measure the voltage developed due to chemical reactions by setting up of Daniel cell	Measurement of the voltage developed due to chemical reactions by setting up of Daniel cell	**2**	**CO 2**
8	LLO 8 Determine the percentage of iron in a given steel sample by redox titration.	Determination of the percentage of iron in a given steel sample by redox titration.	**2**	**CO3**
9	LLO 9 Prepare phenol formaldehyde resin.	Preparation of phenol formaldehyde resin.	**2**	**CO 4**
10	LLO 10 Determine the acid value of the given resin	Determination of acid value of given resin	**2**	**CO4**
11	LLO 11 Determine the electrode potential of various metals to study their tendency to corrosion.	Determination of electrode potential of various metals to study their tendency to corrosion.	**2**	**CO 5**
12	LLO 12 Determine the rate of corrosion of Aluminium in acidic and basic medium.	Determination of the rate of corrosion of Aluminium in acidic and basic medium.	**2**	**CO 5**

Note: A suggestive list of practical LLOs is given in the table, more such practical LLOs can be added to attain the COs and competency. A Compulsory 12 experiments or more for chemistry practicals for LLOs needs to be performed so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as

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

generally required by the industry. ii. Hence, the 'Process' and 'Product' related skills associated with each LLOs of the laboratory work are to be assessed according to a suggested sample of Performance Indicators (Weightage in %) as follows:

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 the report in time 10%.

VI. SUGGESTED MICROPROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT(SELF-LEARNING)

Micro Project /Assignment/Activity is planned to be undertaken by a student assigned to him/her at the beginning of the semester. She/He ought to submit it by the end of the semester to develop industry-oriented COs. Each micro-project should encompass two or more COs. The Micro-Project could be industry application-based, internet-based, workshop-based, laboratory-based or field-based. The assessment of the micro-project is to be done under Practical (FA-PR) Assessment. The Micro Project is preferably assigned to a group of (4-6) students or an individual taking into consideration the capabilities and circumstances at the time.

A suggested list is given here. A similar micro-project/ Assignment could be added by the concerned faculty.

Micro project:

- Types of bonds: Prepare a chart and models displaying different types of bonds with examples.
- Metals and Alloys: Prepare a chart showing the composition, properties application of Ferrous Alloys & non ferrous alloys.
- Insulating materials: Prepare a chart including different synthetic materials Plastic and Rubber and list their uses.
- Cells & batteries: Prepare a chart including the mechanism of different cells & batteries.
- Batteries: Collect and analyse different types of batteries.
- Corrosion: Prepare a Chart displaying images of observed corrosion processes in the surrounding
- Materials: Collect information by library survey regarding engineering materials used in various industries.
- Engineering material: Collect information by library survey regarding engineering materials used in various industries.

Assignment:

1. Explain covalent bonds and ionic bonds with examples
2. Distinguish between plastic and rubber.
3. Write the electronic configuration of atoms
4. Write the formation of compounds NaCl, $AlCl_3$, H_2O, CO_2, N_2
5. Compare between Thermoplastics and Thermosetting
6. State properties and applications of thermocol and glass wool.
7 Explain types of alloys with examples.
8. Demonstrate the Mechanism of the Hydrogen Evolution process.
9. Write properties and applications of engineering materials.
10. Write properties and applications of insulating materials.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr. No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Hydrometer	6
2	Electronic balance with the scale range of 0.001 gm to 500 gm	All

VIII. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS AND ASSESSMENT PURPOSE (Specification Table)

Sr. No	Unit	Unit Title	Aligned COs	Learning Hours	R - Level	U - Level	A - Level	Total Marks
1	I	Atomic structure	CO 1	06	04	06	02	12
2	II	Electrochemistry	CO 2	08	04	04	06	14
3	III	Metals and alloys	CO 3	08	02	02	06	10
4	IV	Insulating materials	CO 4	08	04	02	06	12
5	V	Corrosion	CO 5	07	04	02	04	10
6	VI	Engineering Materials	CO 6	08	02	04	06	12
Grand Total				**45**	**20**	**20**	**30**	**70**

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Two Unit Tests of 30 marks and the average of two unit tests. For Laboratory Learning 25 Marks. SLA assessment of 25 marks.	End Semester assessment of 25 marks for laboratory learning. End Semester assessment of 70 marks (Online)

X. SUGGESTED COs- POsMATRIXFORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes * (PSOs)		
	PO-1 Basic and Discipline - Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	**PSO-1**	**PSO-2**	**PSO-3**
CO1	3	-	-	-	1	-	2			
CO2	3	2	-	-	1	1	2			
CO3	3	-	-	2	-	-	1			
CO4	3	2	-	2	1	1	1			
CO5	3	-	-	1	1	1	1			
CO6	3	2	-	3	1	1	1			

Legends:-High:03,**Medium:**02,**Low:**01,**NoMapping:**-
*PSOs are to be formulated at the institute level

XI.SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No.	Author	Title	Publisher with ISBN Number
1	Dara S.S. Umare S.S.	Engineering Chemistry	S. Chand and Co publication, New Delhi, 201, ISBN: 8121997658
2	Jain and Jain	Engineering Chemistry	Dhanpat Rai and Sons, New Delhi,2015, ISBN: 9352160002
3	Vairam. S	Engineering Chemistry	Wiley Indian Pvt. Ltd, New Delhi, 2013 ISBN: 9788126543342
4	Agnihotri, Rajesh	Chemistry for Engineers	Wiley Indian Ptd. Ltd, New Delhi, 2014, ISBN: 9788126550784
5	Agrawal Shikha	Engineering Chemistry	Cambridge University Press, New Delhi, 2015 ISBN: 97811074764
6	V. P. Mehta	Polytechnic Chemistry	Jain brothers, New Delhi.2012818360093X

XII. LEARNING WEBSITES & PORTALS

Sr.No	Link/Portal	Description
1	www.chemistryteaching.com	Physical, inorganic and organic chemistry.
2	www.chemcollective.org	Virtual Labs, simulation
3	www.chem1.com	Chemistry instruction and education
4	www.onlinelibrary.wiley.com	Materials and corrosion
Sr.No	**Link/Portal**	**Description**
5	www.chemcollective.org	Collection of virtual labs, scenario-based learning activities
6	https://www.ancient-origins.net/history-famous-people/indian- sage-acharya-Kanad-001399	IKS Philosophy of atom by AacharyaKanad.

Name & Signature:

Smt. Rupali S. Patil
Lecturer in Chemistry
(Course Experts)

Name & Signature:	Name & Signature:
Shri.S.S.Prabhune (Programme Head)	**Shri.S.B.Kulkarni** (CDC In-charge)