



S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Use Vernier calliper 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
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	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	V	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Daniel Cell.		
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*
	<b>Total</b>		<b>54</b>

**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 judicious 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
	<b>Total</b>	<b>100</b>

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.



according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1<sup>st</sup> year
- 'Organising Level' in 2<sup>nd</sup> year and
- 'Characterising Level' in 3<sup>rd</sup> 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,	2
3	Accuracy: $\pm 0.02\text{mm}$ or better	
4	Spherometer: range:-10 to +10 mm, LC = 0.01 mm	3
5	Digital multimeter: 3½ digit display, 9999 counts, digital multimeter measures: V <sub>ac</sub> , V <sub>dc</sub> ( 1000V max), A <sub>dc</sub> , A <sub>ac</sub> (10 amp max), Hz, Resistance (0-100 MΩ), Capacitance and Temperature	4, 5, 6, 7, 21, 22, 23
6	Resistance Box: 4 decade ranges from 1 ohm to 1KΩ, accuracy 0.1 % - 1 %	4, 5, 6, 7
7	Battery eliminator: 0- 12V, 2A	6, 7, 25, 26
8	Boyle's apparatus: U tube manometer, digital barometer Joule's calorimeter: well insulated 'mechanical/Electrical equivalent of heat	12
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	13
10	Forbiddan energy band gap set up: Oven : temperature range up to 100°C, thermometer, micro ammeter, Ge diode	14
11	pH meter reading up to pH14; ambient temp. -40 to 70°C ; pH/mV resolution: [3 bit	24
12	Electronic balance, with the scale range of 0.001 g to 500 g pm size 100 mm: response time 3-5 sec; power requirement 90-250 V, 10 watt	13, 17, 19,
13	Electric oven inner size 18" x 18" x 18"; temperature range 100 to 250°C, with the capacity of 40 lt.	25, 26, 31
14	Ammeter 0-2 amp	31
15	Redwood viscometer-I	25, 26
16	Cleveland open cup apparatus	27
17	Abel's close cup apparatus	29
		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, physical quantities: fundamental and derived quantities and their units
- Systems of unit: CGS, MKS, FPS and SI
- Dimensions, dimensional formula
- Errors, types of errors: instrumental, systematic and random error, estimation of errors: absolute, relative and percentage error, significant figures

- Describe the given measurement device and its application.
- Describe with justification the device required to measure the radius of curvature of the given object.
- State with justification the error in the given measurement quantity.
- Describe the procedure to determine the dimensions of the given physical quantities.

- Calculate electric field, potential and potential difference of the given static charge.
- Describe the concept of given magnetic intensity and flux with relevant units.
- Explain the heating effect of the given electric current.
- Apply laws of series and parallel combination in the given electric circuits.

- Distinguish the given conductors, semiconductors and insulators on the basis of energy bands.
- Explain the I-V characteristics and applications of the given p-n junction diodes.

- Convert the given temperature in different temperature scales.
- Describe the properties of the given good and bad conductors of heat.
- Relate the characteristics of the three gas laws.
- Determine the relation between specific heats for the given materials.

- Distinguish the phenomena of total internal reflection for
- 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.
<b>Unit-IV Chemical bonding and Catalysis</b>	<p>4a. Explain the properties of given material based on the bond formation.</p> <p>4b. Describe the molecular structure of given solid, liquid and gases.</p> <p>4c. Describe the crystal structure of the given solids.</p> <p>4d. Select the relevant catalyst for given application.</p>	<p>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.</p> <p>4.2 Molecular arrangement in solid, liquid and gases.</p> <p>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</p> <p>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</p>

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
		Daniel cell Ionisation and dissociation Faraday's first and second law Primary cell and secondary cell! Electrolysis- Mechanism, Electroplating and electro-refining of copper.
<b>Unit-V Metal Corrosion, its prevention and Electrochemistry</b>	<p>5a. Describe the phenomenon of the given type of corrosion and its prevention.</p> <p>5b. Identify the different factors affecting rate of corrosion for the given type of material.</p> <p>5c. Select the protective measures to prevent the corrosion in the given corrosive medium.</p> <p>5d. Differentiate the salient features of the given electrolytic cell and electrochemical cell.</p> <p>5e. Distinguish the given</p>	<p>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) Concentration cell corrosion -oxygen absorption mechanism in neutral or alkaline medium, Pitting corrosion, Waterline corrosion, Crevice corrosion.</p> <p>5.2 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</p> <p>5.4 Electrolyte- strong and weak, Non-Electrolyte, Electrolytic cell, Electrochemical cell, Cathode, Anode, Electrode potential- oxidation and reduction, Construction and working of</p>

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

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

