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AKTU · B.TECH 1ST YEAR · ENGINEERING CHEMISTRY

Engineering Chemistry – Smart Prep Doc

Curated for AKTU B.Tech 1st year using last 4–5 years question patterns and important-questions lists.

UNIT-WISE FOCUS PYQ DRIVEN HIGH-WEIGHTAGE FIRST

Focus pehle Water, Electrochemistry, Fuels/Lubricants, Polymers & Nanomaterials par rakho – yahi se maximum long answers aur numericals repeat hote hain.

This Doc Helps You

- ◆ Identify most repeated Chemistry units in AKTU exams.
- ◆ See unit-wise “must-do” topics in clean bullets.
- ◆ Use it as a Canva-style one-pager + PDF for last-day revision.

Contents

Quick map of Engineering Chemistry units and their exam priority based on recent AKTU patterns.

Unit 1 – Water Technology & Environmental

Hardness, treatment, boiler problems, pollution.

Unit 2 – Fuels & Lubricants

Calorific value, bomb calorimeter, lube properties.

Unit 3 – Electrochemistry & Corrosion ★★★

Nernst, cells, batteries, corrosion & prevention.

Unit 4 – Polymers & Engineering Materials ★★

Polymer types, cement, alloys, nanomaterials.

Unit 5 – Spectroscopy & Green Chemistry ★★

Beer–Lambert, UV/IR, MO theory, green chem.

Unit 1 – Water Technology & Environmental Chemistry

WEIGHTAGE: ★★★ (NUMERICALS + LONG ANSWERS)

MUST-KNOW CONCEPTS

- Hardness of water: temporary vs permanent; units (ppm, mg/L, degree Clarke). [Use in numericals]
- Methods of hardness removal: Lime-soda process, Zeolite process, Ion-exchange, Reverse osmosis.
- Boiler problems: scale, sludge, caustic embrittlement, priming, foaming, carry-over.
- Basic environmental chemistry: air pollution (SO_x, NO_x, CO, particulate), acid rain, ozone depletion (short notes).

TYPICAL EXAM QUESTIONS

- Explain hardness of water. Distinguish between temporary and permanent hardness. Describe methods to remove each type and solve a hardness numerical.
- Describe the Zeolite / Ion-exchange process of water softening with reactions and neat diagram.
- What are boiler problems? Explain scale and sludge formation, their disadvantages, and prevention.
- Write short notes on acid rain and ozone layer depletion.

Numerical Pattern – Hardness

- Convert all ions to CaCO₃ equivalents using factors.
- Calculate total hardness in mg/L or ppm.
- Break into temporary/permanent if data given for bicarbonates vs sulphates/chlorides.

Answer Writing Hints

- Always start with definition, then types, then neat labeled diagram (if applicable).
- Hardness question me proper units likho and step-wise calculation show karo.
- Boiler problems ke liye: cause → effect → prevention pattern follow karo.

Unit 2 – Fuels & Lubricants

WEIGHTAGE: ★★ (THEORY + CV NUMERICALS)

MUST-KNOW CONCEPTS

- Classification of fuels: solid, liquid, gaseous; characteristics of a good fuel.
- Calorific value: Gross (GCV) and Net (NCV); relation between GCV & NCV.
- Bomb calorimeter: construction, working principle, expression for CV with corrections.
- Lubricants: definition, functions, mechanisms (hydrodynamic, boundary, mixed) and important properties.
- Properties: viscosity, viscosity index, flash & fire point, cloud & pour point, aniline point.

TYPICAL EXAM QUESTIONS

- Define GCV and NCV. Derive a relation between them. Explain the construction and working of bomb calorimeter.
- What is a lubricant? Discuss various mechanisms of lubrication.
- Explain viscosity, flash & fire point and cloud & pour point. Why are these important in selecting lubricants?

Numerical Pattern – Calorific Value

- Formula typically uses: mass of fuel, water equivalent of calorimeter, rise in temp.
- Apply correction for acid formation and cooling if mentioned.
- Convert answer to kJ/kg and compare with expected range.

Writing Hints – Lubricants

- Answer flow: definition → functions → classification → mechanisms → properties.
- For properties, definition + significance (what happens if value is high/low).

Unit 3 – Electrochemistry, Batteries & Corrosion

WEIGHTAGE: ★★★ (MOST ASKED UNIT)

MUST-KNOW CONCEPTS

- Electrochemical cells: galvanic vs electrolytic, cell notation, standard electrode potential.
- Nernst equation for electrode potential and cell EMF; relation with concentration and pH.
- Conductance: specific, equivalent, molar conductance (definitions & simple relations).
- Batteries: construction and working of dry cell, lead–acid battery, Ni–Cd, lithium ion (basic reactions).
- Corrosion: electrochemical theory, types (uniform, pitting, galvanic, stress), and methods of prevention.
- Corrosion control: cathodic protection (sacrificial anode, impressed current), protective coatings (galvanizing, anodizing).

TYPICAL EXAM QUESTIONS

- Derive Nernst equation for a single electrode potential. How is it applied to calculate EMF of a cell? Solve a numerical.
- Describe construction and working of a lead–acid storage battery with reactions during charging and discharging.
- What is corrosion? Explain the electrochemical theory of corrosion and discuss methods of prevention.
- Write short notes on sacrificial anode protection and impressed current method.

Numerical Pattern – Nernst Equation

- Use standard form: $E = E^\ominus - (0.0591/n) \log (\text{products/reactants})$ at 25°C.
- Always balance the redox reaction to find n (no. of electrons).

- For cells: $E_{\text{cell}} = E_{\text{cathode}} - E_{\text{anode}}$; check sign convention.

Answer Hints – Corrosion

- Diagram of corroding metal piece with anodic and cathodic areas is very scoring.
- State cause → electrochemical reaction → product → effect → prevention.
- For prevention methods, give at least one real-life example (e.g., Mg sacrificial anode for pipelines).

Unit 4 – Polymers, Cement, Alloys & Nanomaterials

WEIGHTAGE: ★★ (THEORY, HIGH SCORING)

MUST-KNOW CONCEPTS

- Basic polymer terms: monomer, polymer, degree of polymerization, average molecular weights (basic idea).
- Classification: addition vs condensation polymers; thermoplastic vs thermosetting (with examples).
- Important polymers: PVC, Bakelite, Teflon, Nylon-6,6, polyesters – preparation (brief), properties, uses.
- Cement: composition of Portland cement, manufacturing process (simple flow), setting and hardening.
- Alloys: definition, reasons for alloying, examples (stainless steel, brass, bronze) with uses.
- Nanomaterials: definition, nano-scale, size-dependent properties, carbon nanotubes and fullerenes (C60) – structure & applications.

TYPICAL EXAM QUESTIONS

- Classify polymers. Explain thermoplastics and thermosetting polymers with examples.
- Describe preparation, properties and uses of PVC / Bakelite / Nylon-6,6.
- Explain composition and manufacturing of Portland cement. Discuss setting and hardening.
- What are nanomaterials? Explain properties and applications of carbon nanotubes.

Answer Pattern – Polymers

- Always start with definition → classification → short mechanism / reaction (if needed) → properties → uses.
- For named polymers, 2–3 uses from engineering / daily life likho.

Short Notes – Nano & Cement

- Nano: definition, size range (1–100 nm), high surface-area, quantum effects, at least 2 applications (drug delivery, sensors, coatings).
- Cement: remember 2–3 main oxide components (CaO, SiO₂, Al₂O₃) and simple point-wise manufacturing steps.

Unit 5 – Spectroscopy, Atomic/MO Theory & Green Chemistry

WEIGHTAGE: ★★ (SHORT + 7-MARK QUESTIONS)

MUST-KNOW CONCEPTS

- Beer–Lambert law: statement, mathematical form, significance and simple numericals.
- Basics of UV, IR, and NMR spectroscopy: principle, what transition occurs, and applications.
- Molecular Orbital (MO) theory for diatomic molecules: energy level diagram for H_2 , N_2 , O_2 , F_2 .
- Bond order calculation and magnetic behavior prediction (para/diamagnetic) using MO diagram.
- Green chemistry: definition, need, 12 principles (short form), and advantages.

TYPICAL EXAM QUESTIONS

- State and explain Beer–Lambert law. Derive the relation and give its applications. Solve a simple numerical.
- Draw MO energy level diagram for O_2 / N_2 and calculate bond order. Comment on its magnetic nature.
- What is green chemistry? Write down its principles and discuss its importance.
- Write short notes on UV and IR spectroscopy.

Numerical Pattern – Beer–Lambert

- Formula type: $A = \epsilon c l$; use given ϵ , path length, and concentration to find absorbance or vice-versa.
- Mention units clearly and round off to reasonable significant figures.

MO Diagram Hints

- Order the orbitals correctly (for lighter vs heavier diatomics if syllabus mentions).
- Fill electrons with Pauli + Hund rules, then use bond order = $(n_b - n_a)/2$.
- Odd electron systems (like O_2) → paramagnetic, even & complete pairing → diamagnetic.

How to Use This Doc

Treat it like a Canva-style one-pager: tick what you've covered, star tricky topics, and use it for last-day recall.

SMART STUDY FLOW

1. Day 1–2: Finish Unit 1 (Water) and Unit 3 (Electrochemistry + Corrosion) with numericals.
2. Day 3: Cover Fuels/Lubricants and Batteries (from Unit 2 & 3).
3. Day 4: Do Polymers, Cement, Alloys, Nanomaterials (Unit 4).
4. Day 5: Do Spectroscopy, MO theory, Green chemistry (Unit 5).
5. Last 1–2 days: Only PYQs and top-25 important questions revise karo (writing practice).

MYCOLLEGEVERSE RESOURCES

- [MyCollegeVerse Notes](#) – exam-oriented notes & resources.
- [MyCollegeVerse.in](#) – explore tools, notes and academic utilities.
- [Resume Builder](#) – after 1st year, polish your resume quickly.

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