CHEMISTRY I
(CHEM 1001)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) Which statement is not correct regarding reversible process?
(a) it is imaginary process (b) it takes infinite time
(c) work obtained is maximum (d) it is spontaneous.

(ii) Entropy of the universe is
(a) increasing (b) decreasing
(c) remaining same (d) dependent on conditions

(iii) Schottky defect is found in
(a) NaCl (b) ZnO
(c) AgCl (d) FeO

(iv) Which of the following has zero dipole moment?
(a) PCl_3 (b) NH_3
(c) SF_6 (d) ClF_3

(v) The following equilibrium exists in aqueous solution $CH_3COOH \leftrightarrows H^+ + CH_3COO^-$. When dil.NaOH is added
(a) the equilibrium shifts toward left
(b) acetate ion concentration decreases
(c) the equilibrium shifts toward right
(d) acetic acid concentration increases

(vi) The function of electrochemical cell is to
(a) To convert chemical energy into electrical energy
(b) To convert electrical energy into chemical energy
(c) To convert chemical energy into heat energy
(c) To convert heat energy into chemical energy

(vii) Octane number of n-hexane is
(a) 0 (b) 25 (c) 50 (d) 100

(viii) Leakage of LPG cylinder can be detected by adding
(a) oxane (b) 1,2-dibromoethane
(c) mercaptan (d) n-heptane

(ix) The half-life period of a reaction is found to be directly proportional to the initial concentration. The order of the reaction is
(a) zero (b) one (c) two (d) three

(x) Which of the following polymers is used for non-stick coating?
(a) polythene (b) Teflon (c) Bakelite (d) polyaniline

Group – B

2. (a) Show that the work done in a reversible process is greater than that in irreversible process. CO 2, IOCQ
(b) Calculate the values of q, w and ΔU for the expansion of 5 moles of an ideal gas reversibly and isothermally at 27ºC from an initial volume of 50L to 100L. CO 2, HOCQ
(c) What do you mean by extensive and intensive properties of a system? CO 2, LOCQ
(d) State and explain Hess's law of constant heat summation. CO 2, LOCQ
(e) Depict the stretching modes of vibration of water molecule and from then select the IR active stretching mode. CO 6, LOCQ

3 + 3 + 2 + 2 + 2 = 12

3. (a) What are the limitations of first law of thermodynamics? CO 2, LOCQ
(b) What do you mean by entropy? Derive the expression for entropy change of an ideal gas undergoing reversible isothermal expansion from initial volume V_1 to final volume V_2. CO 2, HOCQ
(c) At NTP, 11.2 litre of oxygen were mixed with 36 gm of Helium. Calculate the entropy change due to mixing of these gases.[M.W. of dioxygen and helium are 32 and 4, respectively] CO 2, HOCQ
(d) Explain briefly the terms Joule-Thomson effect and inversion temperature. CO 2, IOCQ
(e) Mention the range of electromagnetic radiation used in UV-vis spectroscopy. CO 6, LOCQ

2 + 5 + 2 + 2 + 1 = 12

Group – C

4. (a) Arrange H_2S, PH_3 and SiH_4 according to their increasing boiling point and justify your answer. CO 2, IOCQ
(b) Differentiate between E1 and E2 mechanism. CO 2, LOCQ

(c) What is a buffer solution? An aqueous solution at 25˚C is 0.01 molar in propionic acid and 0.02 molar in sodium propionate. Find out the pH, H^+ concentration and degree of dissociation. [Given $K_a = 1.34 \times 10^{-5}$]. CO 2, HOCQ

(d) What is an intrinsic semi-conductor? Give example. CO 4, LOCQ

(e) Ethanol is miscible in water while its isomer dimethyl ether is immiscible with water- explain. CO 2, IOCQ

2 + 2 + 4 + 2 + 2 = 12

5. (a) Explain why an aqueous solution of $CuSO_4$ is acidic and that of NaCl is neutral. CO 2, IOCQ

(b) Does Be_2 molecule exist? Justify using molecular orbital theory. CO 2, IOCQ

(c) Identify the major product(s) showing the reaction involved when ethylbromide is separately reacted with (i) aqueous alcoholic KCN (ii)aqueous alcoholic AgCN. CO 2, IOCQ

(d) Why does KCl turn violet when heated in presence of potassium vapour? CO 4, LOCQ

2 + 4 + 4 + 2 = 12

Group – D

6. (a) Deduce the expression for the rate constant of a first order reaction and its half-life. What is the nature of the plot if concentration of the reactant is plotted against time for a first order reaction? CO 2, IOCQ

(b) Explain the effect of dilution on equivalent conductance for a strong and weak electrolyte. CO 2, LOCQ

(c) Construct galvanic cells and calculate their emfs at 25°C from the following pair of half-cells.

Pb | $PbCl_2$ (1M) $E^0_{Pb2+/Pb} = -0.13$ V

Fe | $FeSO_4$ (1M) $E^0_{Fe2+/Fe} = -0.44$ V. CO 1, HOCQ

5 + 4 + 3 = 12

7. (a) Give a brief account of homogeneous catalysis using suitable example. CO 2, LOCQ

(b) Differentiate between order and molecularity of a reaction. CO 2, LOCQ

(c) Explain the working principle of standard hydrogen electrode.. CO 1, LOCQ

(d) The specific conductance of a 0.5(N) acid solution is 0.15 mho cm^{-1}. Calculate the degree of dissociation of the acid. Given the equivalent conductance of this acid at infinite dilution is 380 mho cm^2eqv^{-1} CO 1, HOCQ

(e) Write down the postulates of collision theory of reaction rate. CO 2, LOCQ

2 + 2+ 3 + 2+ 3 = 12

Group – E

8. (a) What do you mean by carbonisation of coal? Give differences between HTC an LTC? CO 5, LOCQ

(b) What are the main constituents of aviation gasoline and jet gasoline? CO 5, LOCQ

(c) What do mean by cetane scale for diesel fuel? CO 5, LOCQ

(d) Write the structue of the monomeric units and uses of (i) natural rubber (ii) teflon. CO 3, LOCQ

4 + 2 + 2 + 4 = 12

9. (a) Give a brief idea about: linear, branched and crosslinked polymers. CO 3, LOCQ

(b) Distinguish between thermoplastic and thermosetting polymers. CO 3, LOCQ

(c) Give one example of condensation polymerization reaction. CO 3, LOCQ

(d) What do you mean by knocking? How TEL can be used to reduce knocking in an internal combustion petrol engine? CO 5, LOCQ

3 + 3 + 2 + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	60.4%	25.0%	14.6%

The course outcomes of the subject are

1. Knowledge of understanding the operating principles and reaction involved in batteries and fuel cells and their application in automobiles as well as other sectors to reduce environmental pollution.
2. An ability to design and conduct experiments, as well as to organize, analyzes, and interprets data.
3. An ability to identify and formulate polymers and have a knowledge of various polymers like polyethene, PVC, PS, Teflon, Bakelite, Nylon which have engineering applications
4. Have knowledge of synthesizing Nanomaterials and their applications in industry, carbon nano tube technology is used in every industry now-a-days.
5. An ability of synthesizing bio fuels as a renewable and environment friendly alternative source for natural fuel.
6. Elementary knowledge of IR and UV spectroscopy is usable in structure elucidation and characterisation of various molecules.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question

Department & Section	Submission Link
AEIE/CSE/ECE/IT Google Classroom:	https://classroom.google.com/c/NDc1MTU5OTA4NDQ1?cjc=qlmekz4
AEIE/CSE/ECE/IT Paper Submission:	https://classroom.google.com/c/NDc1MTU5OTA4NDQ1/a/NDc1MTU5OTA5OTA0/details