

JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
[A GOVERNMENT AUTONOMOUS COLLEGE]
JGEC/B.TECH/ CSE/ECE/IT/ BS-CH101/ 2022-23
2022
CHEMISTRY

Full Marks: 70

Times: 3 Hours

The figures in the margin indicate full marks.
Candidates are instructed to write the answers in their own words as far as practicable.

GROUP-A
[OBJECTIVE TYPE QUESTIONS]

Answer **all** questions

5x2=10

1. Define the term electronegativity.
2. Acetic acid is weak in water but strong in ammonia -comment on the statement.
3. Write down the limitations of First law of thermodynamics.
4. What do you mean by the term 'racemic mixture'?
5. What is the simplest alkane that is optically active?

2
2
2
2
2

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any **four** questions

4x15 = 60

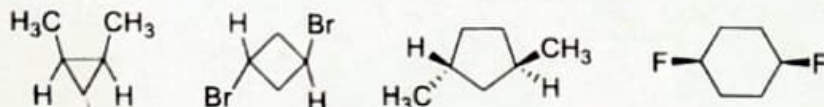
6. i) What are the minimum but sufficient conditions for the wave function to be a solution of Schrodinger equation. The normalized eigen functions for the particle in one dimensional box are automatically orthogonalized - Justify the statement. 2+3
- ii) Discuss the characteristic features of Ψ_n , Ψ_n^2 and E_n of a particle in one dimensional box. 3
- iii) Calculate the probability of existence of a particle in one dimensional box of length 'a' in the region $0 \leq x \leq a$ for the states $n = 1, 2$ and 3 . 4
- iv) Explain why after ionization, the atoms or molecules show the continuous spectrum? 3
7. i) What do you mean by effective nuclear charge? What would be the value of screening constant according to Slater's rule for the valence electron of $_{31}\text{Ga}$. Calculate the electronegativity of $_{33}\text{As}$ (III). Given $r_{\text{cov}} = 120 \text{ pm}$. 1+2+3
- ii) State the basic postulates of CFT. Draw the splitting of d- orbitals under octahedral ligand field. 2+2
- iii) Compare the magnetic property and colour intensity of the complexes $[\text{Fe}(\text{CN})_6]^{4-}$ and $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$ in terms of CFT. 3
- iv) Vitamin A has five conjugated double bonds and it shows the first absorption peak at 332 nm. Find the length of the molecule. 2
8. i) Draw the molecular orbitals of 1,3- butadiene and calculate the energies of corresponding energy levels. 3
- ii) Give reasons for the fact that electron affinity of noble gases is zero. 2
- iii) The efficiency of Carnot heat engine can be increased by decreasing temperature of sink or by increasing temperature of source. Prove which one is better process and why? 3
- iv) Derive the thermodynamic relation $\Delta S = C_v \ln T_2/T_1 + RT \ln V_2/V_1$ for one mole of an ideal gas. (the thermodynamics functions have their own significance) 3
- v) AgCl is less soluble in water than NaCl -why? Compare the stability of the complexes $[\text{CoF}_6]^{3-}$ and $[\text{CoI}_6]^{3-}$ on the basis of HSAB principle. 2+2
9. i) Define entropy. Derive the relation $\Delta H = n F [T(dE/dT)_P - E]$ (the thermodynamics functions have their own significance) 1+3
- ii) Explain why C_p is always greater than C_v . Why is the enthalpy considered more useful than internal energy in chemical reactions? 2+2
- iii) The emf of the cell: $\text{Cd} | \text{CdCl}_2 \text{ 2.5 H}_2\text{O (saturated)} || \text{AgCl(s)} | \text{Ag}$ is 0.6753 and 0.6915 at 25°C and 0°C respectively. Calculate the heat of the reaction (ΔH), free energy change (ΔG) and entropy change (ΔS) at 25°C . 3

iv) What are the limitations of Lambert Beer Law? 2.5×10^{-4} M solution of a substance in a 1 cm length cell at λ_{max} 245 nm has absorbance 1.17. Calculate ϵ_{max} for this transition.

2+2

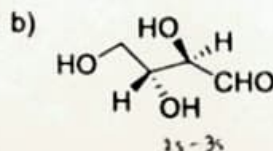
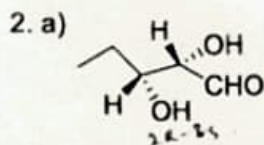
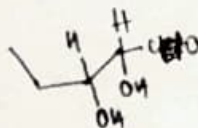
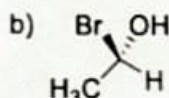
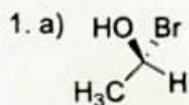
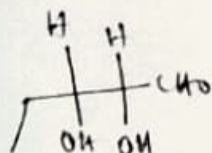
10. i) Identify the optically active molecule of the following:

4



ii) Designate the chiral center as a (R) or (S) of the following and also identify the relationship (enantiomer, diastereomer or identical)

4



iii) When 0.30 g of natural cholesterol is dissolved in 15 ml of chloroform and placed in a 10 cm polarimeter tube, the observed rotation at 20°C (using the D-line of sodium) is -0.630° . Calculate the specific rotation of cholesterol.

4

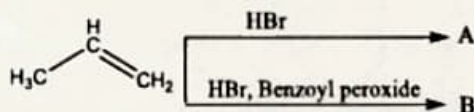
iv) Among *cis*-2-Butene and *trans*-2-Butene on bromination, one gives meso product while other one gives an enantiomer. Write down the proper mechanism.

3

11. i) Distinguish between S_N1 and S_N2 mechanism with suitable examples.

ii) Identify the product (A and B) of the following reactions:

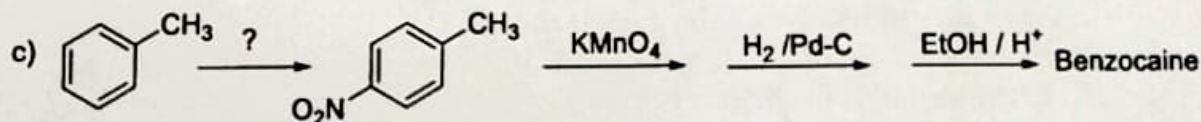
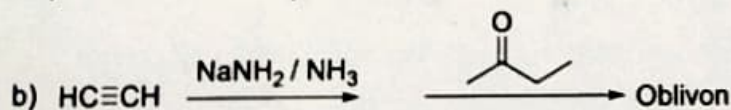
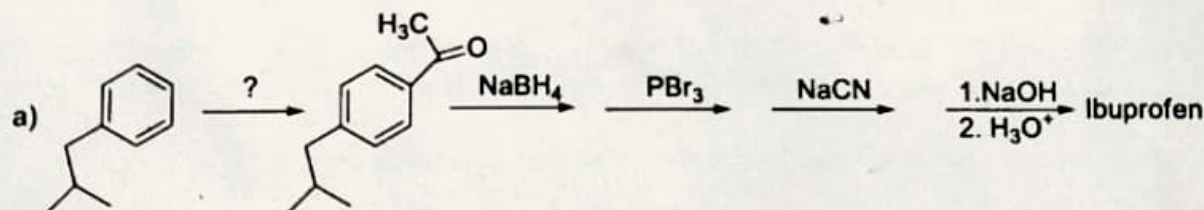
4



3

iii) Complete the following reactions and write the name of reagents where require:

3+2+3



12. Write short notes on **any three** of the following:

3x5

(i) Resonance and Hyperconjugation (ii) Nernst equation (iii) Carbocation and Carbanion (iv) Aromatic electrophilic substitution reaction (v) n-type and p-type semiconductors (vi) Fajan's rule



JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
[A GOVERNMENT AUTONOMOUS COLLEGE]
JGEC/B.TECH/CE/EE/ME/ECE/BS-M101B/2022-23
2022
MATHEMATICS IB

Times: 3 Hours

Full Marks: 70

The figures in the margin indicate full marks.
Candidates are instructed to write the answers in their own words as far as practicable.

$$\sqrt{4+1+4} = \sqrt{9}$$

GROUP-A
[OBJECTIVE TYPE QUESTIONS]

5 × 2 = 10

Answer **all** questions

1. Examine the function $f(x) = x^3 - 6x^2 + 24x + 4$ for maxima or minima. 2
2. Find $\Gamma(1)$. 2
3. Find the directional derivative of $f(x, y, z) = x^2yz + 4xz^2$ at the point $(1, 2, -1)$ in the direction of the vector $2\hat{i} - \hat{j} - 2\hat{k}$. 2
4. Find the radius of convergence of the series $\frac{1}{2}x + \frac{13}{25}x^2 + \frac{135}{258}x^3 + \dots$. 2
5. If $y = 2 \cos x (\sin x - \cos x)$, show that $(y_{10})_0 = 2^{10}$. 2

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

5 × 12 = 60

Answer any **five** questions

- (a) Reduce the matrix $\begin{pmatrix} 1 & 3 & 4 & 3 \\ 3 & 9 & 12 & 3 \\ 1 & 3 & 4 & 1 \end{pmatrix}$ in a row reduced echelon form and hence find its rank. 4
- (b) Determine the value of k for which the system of equations

$$\begin{aligned} x + y + z &= 1 \\ 2x + y + 3z &= -2 \\ x + y + kz &= k + 4 \end{aligned}$$
 has (i) no solution, (ii) a unique solution, (iii) has infinitely many solution. 4
- (c) $A = \begin{pmatrix} 0 & -1 & 2 \\ 1 & 0 & 3 \\ 2 & 3 & 0 \end{pmatrix}$. Find A^{-1} using Cayley-Hamilton theorem. 4
- (7.) (a) For the matrix $A = \begin{pmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{pmatrix}$, find a matrix P such that $P^{-1}AP$ is a diagonal matrix. 7
- (b) Prove that $\int_0^1 \frac{dx}{(1-x^6)^{\frac{1}{6}}} = \frac{\pi}{3}$. 5
8. (a) Given the function $f(x, y) = \begin{cases} \frac{xy(x^2-y^2)}{x^2+y^2}, & (x, y) \neq (0, 0) \\ 0, & (x, y) = (0, 0) \end{cases}$ 4
 Show that $f_{xy}(0, 0) \neq f_{yx}(0, 0)$. 3
- (b) If $z = (1 - 2xy + y^2)^{-\frac{1}{2}}$, show that $\frac{\partial}{\partial x} \left\{ (1 - x^2) \frac{\partial z}{\partial x} \right\} + \frac{\partial}{\partial y} \left\{ y^2 \frac{\partial z}{\partial y} \right\} = 0$. 3
- (c) Find the maximum and minimum values and saddle points of the following function $f(x, y) = x^3 + y^3 - 3axy$, ($a \neq 0$). 5

9. (a) Find the equation of the tangent plane and normal line to the surface $2x^2 + y^2 + 2z = 3$ at the point $(2, 1, -3)$. 5
 (b) For any scalar point function $f(x, y, z)$, show that $\text{grad} f$ is irrotational. 3

- (c) If $f(x, y) = \begin{cases} \frac{x^2 y^2}{x^2 y^2 + (x-y)^2}, & \text{for } (x, y) \neq (0, 0) \\ 0, & \text{for } (x, y) = (0, 0) \end{cases}$, 4
 then show that $\lim_{(x,y) \rightarrow (0,0)} f(x, y)$ does not exist.

10. (a) Verify Rolle's theorem for the function $f(x) = x\sqrt{a^2 - x^2}$ in $0 \leq x \leq a$. 3
 (b) State and prove Lagrange's mean-value theorem and give its geometric interpretation. 1+3+2
 (c) Use mean-value theorem to prove that

$$0 < \frac{1}{\log(1+x)} - \frac{1}{x} < 1 \quad \forall x > 0$$

11. (a) State Taylor's theorem with Lagrange's form of remainder. Expand the function $f(x) = \cos x$ in powers of x in infinite series satisfying the conditions under which the expansion is valid. 1+(2+1)
 (b) Find the values of a and b such that $\lim_{x \rightarrow 0} \frac{x(1-a \cos x) + b \sin x}{x^3} = \frac{1}{3}$, assuming that L'Hospital rule is applicable. 4

- (c) Check the convergence of the sequence $\{a_n\}$ where

$$a_n = 1 + \frac{1}{2!} + \frac{1}{3!} + \dots + \frac{1}{n!}$$

12. (a) Test the convergence of the series 6
 $\frac{x}{1} + \frac{1}{2} \cdot \frac{x^3}{3} + \frac{1.3}{2.4} \cdot \frac{x^5}{5} + \frac{1.3.5}{2.4.6} \cdot \frac{x^7}{7} + \dots \dots \dots (x > 0).$
 (b) Prove that the series $x - \frac{x^2}{2} + \frac{x^3}{3} - \dots \dots \dots$ is absolutely convergent when $|x| < 1$ and 6
 conditionally convergent when $x = 1$.

13. (a) Find the Fourier series of the function $f(x)$ defined by 6
 $f(x) = \begin{cases} 0, & -\pi < x \leq 0 \\ x, & 0 < x \leq \pi \end{cases}$ with $f(x + 2\pi) = f(x)$.
 (b) Obtain the cosine series for the function $f(x) = x$ in $0 < x < \pi$. Use Parseval's theorem 4+2
 to show that $\sum_{n=1}^{\infty} \frac{1}{(2n-1)^4} = \frac{\pi^4}{96}$.

JALPAIGURI GOVERNMENT ENGINEERING COLLEGE

[A GOVERNMENT AUTONOMOUS COLLEGE]

COE/B.TECH/ES-EE101/2022-23

(New syllabus Regular & Back for CSE/IT/ECE + Old syllabus Back for all departments)

2023

Basic Electrical Engineering

Full Marks: 70

Times: 3 Hours

The figures in the margin indicate full marks.

Candidates are requested to write their answers in their own words as far as practicable.

GROUP-A

[OBJECTIVE TYPE QUESTIONS]

Answer **all** questions

5×2=10

1. Define form factor and peak factor. 1+1
2. Why the rating of transformer is given in KVA and not in kW? 2
3. What is the necessity of short-circuited rotor conductors in squirrel cage induction motor? 2
4. What is co-efficient of coupling between two coils? 2
5. What is buck-boost converter? Mention its application. 1+1

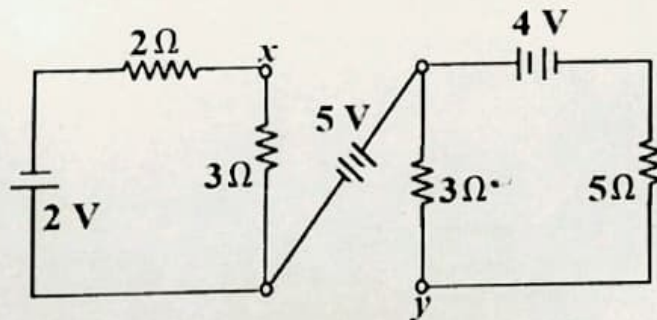
GROUP-B

[LONG ANSWER TYPE QUESTIONS]

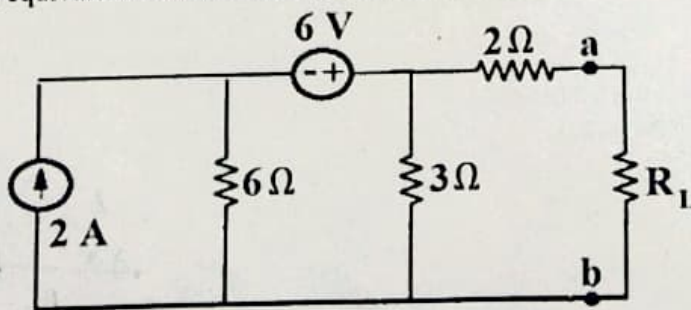
Answer any **four** questions

4×15=60

6. i) What is the potential difference between x and y in the network shown in the figure? 3



- ii) Find the Thevenin's equivalent circuit to the left of terminal 'ab'.



- iii) Distinguish between- (a) active and passive elements. (b) linear and non-linear elements. (c) lumped and distributed elements. 3×2

7. i) Explain with proper diagram, the working principle of a three-phase induction motor. 5

- ii) A three-phase induction motor is wound for 4 poles and is supplied from a 60 Hz system. Calculate (a) synchronous speed (b) speed of the motor when slip is 3% (c) the rotor current frequency when the motor speed is 750 r.p.m. 3

iii) The power input to a three-phase induction motor is 60 kW. The stator loss is 1 kW. Find out the rotor copper loss per phase if the motor has a slip of 4%. 3

iv) Draw the torque-slip characteristics of three-phase induction motor showing operating regions. 4

8. i) Derive the emf equation of transformer. Why cooling of a transformer is essential? 4+2

ii) A sinusoidal flux 0.02 wb (maximum) links with 55 turns of a transformer secondary coil. Calculate the rms value of the induced emf in the secondary. The supply frequency is 50 Hz. $\Phi = 0.02$, $N_2 = 55$, $f = 50$ Hz 3

iii) In a 50 KVA transformer, the iron loss is 500 watt and full load copper loss is 800 watts. Calculate the efficiency of the transformer at half full load and 0.8 p.f. (lagging). 4

iv) What happens if dc supply is given to a transformer? 2

9. i) What is rms value of an ac quantity? Obtain expression for the rms value of a sinusoidal current in terms of its maximum value. 2+3

ii) An alternating current is represented by $i = 70.7 \sin 520 t$. Determine (a) the frequency (b) the current 0.0015 second after passing through zero, increasing positively (c) rms value and (d) average value 4

iii) A coil having a resistance of 10 ohms and inductive reactance of 25 ohms is connected across a 220-volt, 50 Hz supply. Find (a) inductance of the coil (b) impedance (c) current (d) angle of phase difference (e) power factor and (f) true power 0.0741 , 26.92 , 64.14 , 0.3714 , 667.48 6

10. i) Why single-phase induction motor is not self-starting? $R_a = 0.1$ 4

ii) A separately excited dc generator having armature resistance of 0.1Ω supplies 4 kW at a terminal voltage of 200 V. If the machine is now operated as a motor at the same terminal voltage and same armature current with flux per pole being increased by 10%, what will be the ratio of the generator speed to the motor speed? 5

iii) Write down the function of commutator in a dc machine. Draw the typical speed-torque curve of a separately excited dc motor. 2+4

11. i) What are the advantages of three phase system over single-phase system? 5

ii) A star connected 3-phase load has a resistance of 6Ω and inductive reactance of 8Ω in each branch. A line-to-line voltage of 220 V is impressed through a 3-phase auto transformer. Find the voltage across each branch, line voltages and line currents and total active power. 6

iii) In a two-wattmeter method of measurement of three phase power, the readings of the two wattmeters are 3kW and 1 kW respectively. Calculate the power and power factor for a balanced circuit. 4

12. Write short note on any **three** of the followings-

(a) Auto transformer and its applications

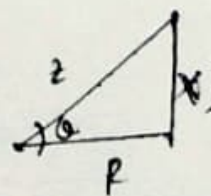
(b) Miniature circuit breaker

(c) Norton's theorem

(d) Lead acid battery

(e) Speed control of three phase induction motor

(f) Construction and application of synchronous generator



$$I = \frac{E_2}{Z} \quad 5 \times 3$$