(Total Marks: 60)

N.B.: **1) Question No. 1 is compulsory.**
2) Answer any three questions from Q.2 to Q.6.
3) Figures to the right indicate full marks.

1. Attempt any **Five**

(a) If $z = \frac{1}{\sqrt{2}} + \frac{i}{\sqrt{2}}$ and $\bar{z}$ is the conjugate of z, prove that $(z)^{10} + (\bar{z})^{10} = 0$. 3

(b) Prove that $\log\left(\frac{x+iy}{x-iy}\right) = 2i\tan^{-1}\left(\frac{y}{x}\right)$ 3

(c) Show that the matrix $A = \begin{bmatrix} \alpha + i\gamma & -\beta + i\delta \\ \beta + i\delta & \alpha - i\gamma \end{bmatrix}$ is unitary if $\alpha^2 + \beta^2 + \gamma^2 + \delta^2 = 1$ 3

(d) Find the n^{th} derivative of $\frac{x}{(x+1)^4}$. 3

(e) If $u = \sin^{-1}\left(\frac{x}{y}\right) + \cos^{-1}\left(\frac{y}{x}\right)$ then find $\frac{\partial u/\partial x}{\partial u/\partial y}$. 3

(f) Using the Newton-Raphson Method, find a positive root of $3x - cosx - 1 = 0$, correct to three decimal places. 3

2. (a) If α, β are the roots of the equation $z^2 sin^2\theta - z sin2\theta + 1 = 0$, Then prove that **4**

$$\alpha^2 - \beta^2 = 2\, cosn\theta cosec^n\theta.$$

(b) If $z = f(x,y), x = e^u + e^{-v}, y = e^{-u} - e^v$, Then prove that $\frac{\partial z}{\partial u} - \frac{\partial z}{\partial v} = x\frac{\partial z}{\partial x} - y\frac{\partial z}{\partial y}$. 5

(c) Apply the Gauss-Seidel method to solve the equations up to three iterations. 6

$$10x + y + z = 12,\ \ 2x + 10y + z = 13,\ \ 2x + 2y + 10z = 14$$

3. (a) Separate into real and imaginary parts $\tan^{-1}(x + iy)$. **4**

(b) Find the value p, for which matrix $A = \begin{bmatrix} p & p & 2 \\ 2 & p & p \\ p & 2 & p \end{bmatrix}$ will have (i) rank 1, (ii) rank 2, (iii) rank 3. 5

(c) Discuss the maxima and minima of $f(x,y) = x^3 + y^3 - 3x - 12y + 40$. 6

4. (a) If $y = x^n \log x$, prove that $y_{n+1} = \frac{n!}{x}$. **4**

(b) If $u + iv = \text{cosec}\left(\frac{\pi}{4} + ix\right)$, prove that $(u^2 + v^2)^2 = 2(u^2 - v^2)$. 5

(c) Find the root lying between 2 and 3 of the equation $x^3 - 4x - 9 = 0$ by the Regula Falsi method. 6

5. (a) Show that $z = f(x + at) + g(x - at)$ is solution of $a^2\frac{\partial^2 z}{\partial x^2} = \frac{\partial^2 z}{\partial t^2}$ for all f and g.. **4**

(b) If $x = \tan\log y$, prove that $(1 + x^2)y_{n+1} - (2nx - 1)y_n + n(n-1)y_{n-1} = 0$. 5

(c) Test for consistency the following equations and solve them if consistent 6

$$x - 2y + 3t = 2, \qquad 2x + y + z + t = 4, \qquad 4x - 3y + z + 7t = 8$$

6. (a) Find the n^{th} derivative of $y = \cos x \cos 2x \cos 3x$. **4**

(b) Solve $x^5 = 1 + i$ and find the continued product of the roots. 5

(c) Prove that $\text{Log}\left[\frac{(a-b) + i(a+b)}{(a+b) + i(a-b)}\right] = i\left(2n\pi + \tan^{-1}\frac{2ab}{a^2 - b^2}\right)$ 6

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Duration: 1.5 hrs **Marks:45**

N.B. : (1) Question No 1 is Compulsory.
(2) Attempt any two questions out of the remaining four.
(3) Assume suitable data, if required and state it clearly.

1 Attempt any FIVE [15]

(a) What is the difference between spontaneous and stimulated Emission.
(b) The N.A.of an optical fiber is 0. 5 & core R.I.is 1.54.find R.I.of cladding.
(c) What is antireflection coating? What should be the refractive index and minimum thickness of the coating?
(d) Show that the divergence of a curl of a vector is zero.
(e) Calculate the wavelength of de-Broglie waves associated with mass 1 kg moving with a speed of 10^3 m/sec.
(f) An electron is confined in a box of length10^{-8}m.calculate minimum uncertainty in its velocity.
(g) Define drift velocity and Mobility. Write its unit.

2 (a) What is resonant cavity? Explain its use in the generation of laser beams [05]
(b) Derive an expression for numerical aperture of a step index optical fiber. [05]
(c) The diameter of 5th dark ring in Newton's ring experiment was found to be 0.42cm.Determine the diameter of 10th dark ring. [05]

3 (a) What is gradient? If $\Phi = 3(x^2y - y^2x)$, find $\nabla\Phi$ at the point (1, -2, -1). [05]

(b) Derive Schrodinger's Time Independent wave equation for matter waves. [05]
(c) Explain mobility of electrons. The resistivity of Cu is 1.72×10^{-8} ohm-m. Calculate the mobility of electrons in Cu given that number of electrons per unit volume is 10.41×10^{28} m^{-3} [05]

4 (a) Show that for an intrinsic semiconductor, Fermi level lies midway of conduction band and valence band. [05]
(b) Obtain the condition for maxima and minima for the interference in thin film of uniform thickness in a reflected light. [05]
(c) Calculate velocity and de-Broglie wavelength of alpha particle of energy 1 keV. Given: mass of alpha particle as 6.68×10^{-27} kg [05]

5 (a) Explain the following terms in optical fiber: (a) Total internal reflection (b) Critical angle (c) Acceptance angle (d) Attenuation (e) Numerical aperture [05]
(b) State and explain Maxwell's fourth equation.
(c) Explain applications of LASER in industry and medical field. Discuss any one of them in details

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08-06-2026 FE (SEM-I) NEP-2020 AC QP CODE: 20012402

Time: 1.30 hour **Maximum marks: 45**

NB:
1) Question No.1 is Compulsory
2) Attempt any two questions from Question No.2 to Question No.5
3) Draw neat diagrams and write chemical equations wherever necessary.
4) Figures to the right indicate full marks.

Q. 1 Attempt **any five** of the following: **15**

a) Define fuels. How are they classified? Give examples.

b) Explain why zinc gives better protection for iron than tin.

c) What are the merits of phase rule?

d) Write significance of glass transition temperature of polymer.

e) Define composite materials. Write four important characteristic properties of composite materials?

f) What are the main advantages of biodiesel?

g) A sample of coal contains C=80%, H=7%, O=3%, S=3.5%, N=2.1% and Ash= 4.4%. Calculate gross calorific value of coal.

Q.2 What is corrosion? Explain the mechanism of electrochemical corrosion by **a)** evolution of hydrogen with suitable example and reactions. **6**

b) How proximate analysis conducted and what is its significance in determining the utility of a coal for particular purpose? **5**

c) Explain conventional and greener route of synthesis of carbaryl. Also write the principle of green chemistry involved in this reaction. **4**

Q.3 In a sample of polymer has following molar mass: **6**
a)

Number of Molecules	Molar mass(g/mole)
20	20000
30	30000
50	60000

Calculate the number average, weight average and polydispersity index of above sample polymer.

b) Define the following terms involved in phase rule with suitable examples: i) Phase ii) Components iii) Degree of freedom. **5**

c) What is matrix phase of composites? Write functions of matrix phase with examples. **4**

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Q.4	Give the definitions and significance of following properties of polymer.	**6**
a)	Tensile strength, insulation resistance and refractive index.	
b)	What is green fuel? Explain the manufacture of power alcohol from molasses with reactions and write its advantages.	**5**
c)	Calculate the weight and volume of air required for complete combustion of 1 kg of coal containing C = 75%, H = 12%, O = 6%, S = 4% and remaining ash. (Mol. Wt. of air = 28.949 kg)	**4**
Q.5	How material selection and proper design of equipment's can prevent	**6**
a)	corrosion. Explain with the help of diagram and designing principles.	
b)	What are laminates? Explain it with the help of diagram and functions.	**5**
c)	1000 kg of a sample of argentiferous lead containing 0.1% silver is melted and then allowed to cool. If eutectic contains 2.6% silver, what mass of: i) Eutectic will formed and ii) Mass of lead will separate out?	**4**

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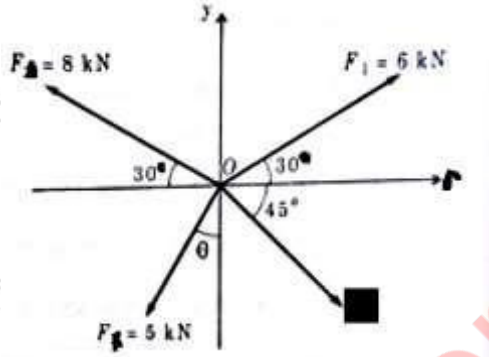
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Time: 2 Hrs **Marks: 60**

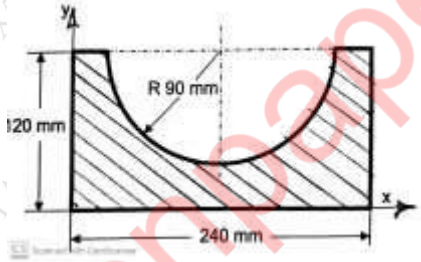
N. B. (1). Question no. 1 is compulsory.
(2) Attempt any three question from remaining five question.
(3) assume suitable date if necessary and mention the same clearly.
(4) Take g = 9.81 m/s^2.

Q.1 Attempt any five.

a) Find out the magnitude of the force F4 and the direction of the force F3 so that the resultant of the four forces is zero. 3



b) Find the centroid of shaded area with respect to given axis. 3



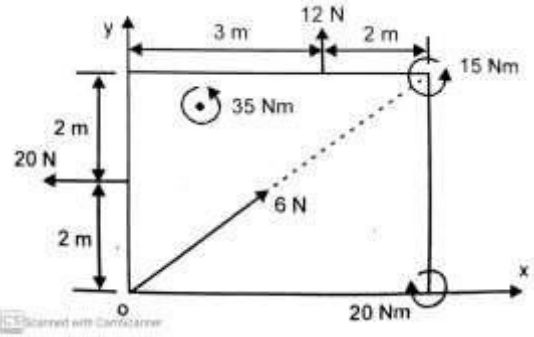
c) Write note on D H parameters. 3

d) A car at 72 kmph applies brakes and comes to rest in 8 sec. Find the minimum coefficient of friction between wheel and road. 3

e) Explain robot kinematics. 3

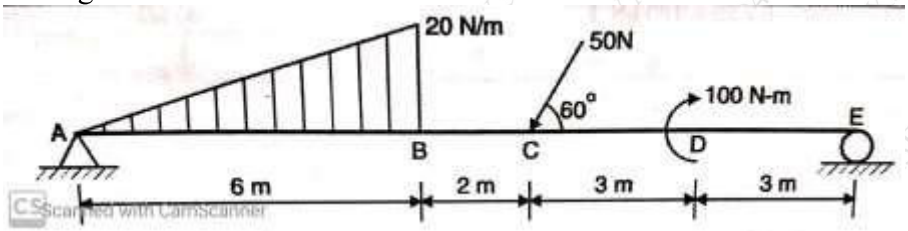
f) During a test, a car, moves in a straight line such that it velocity is defined by $v = 0.3(9t^2 + 2t)$ m / s where 't' is in seconds. Determine its position and acceleration when t = 3 sec. Take at t = 0 x = 0 3

Q.2 a) Replace the system of forces and couples by a single force and locate the point on the x-axis through which the line of action of the resultant passes. 8



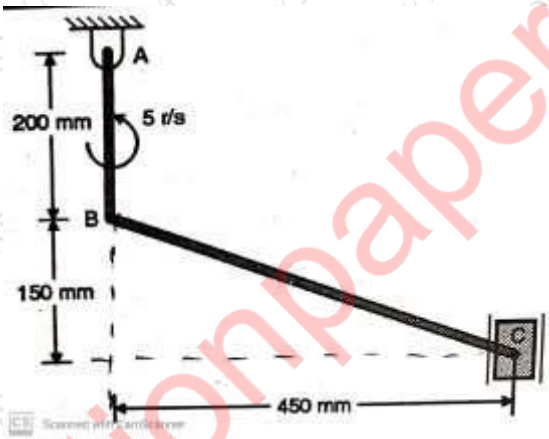
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b) Find the reactions at supports A and E for the beam loaded as shown in the Fig. 7

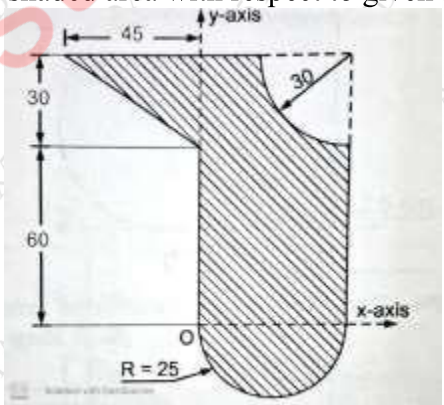


Q.3 a) The lines of actions of three forces concurrent at origin O pass respectively through point A (-1, 2, 4), B (3, 0-3), C (2,2, 4). Force F_1 = 40 N passes through A, F_2= 10 N passes through B, F_3 = 30 N passes through C. Find the magnitude and direction of their resultant. 7

b) In the mechanism shown the angular velocity of link AB is 5 rad/sec anticlockwise. At the instant shown, determine the angular velocity of link BC and velocity of piston C. 8



Q.4 a) Find the centroid of shaded area with respect to given axis. 7

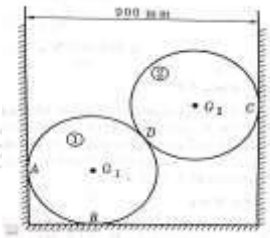


b) The motion of a particle is defined by the position vector r = 6t i +4 t^2 j where r is in metres and t is in seconds. At the instant when t = 3 sec, find (i) Tangential and Normal components of accelerations (ii) Radius of curvature. 8

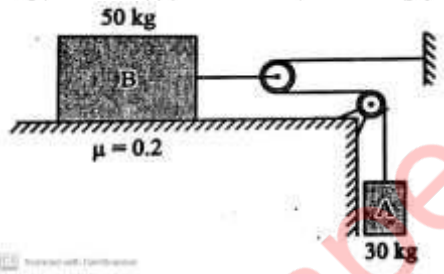
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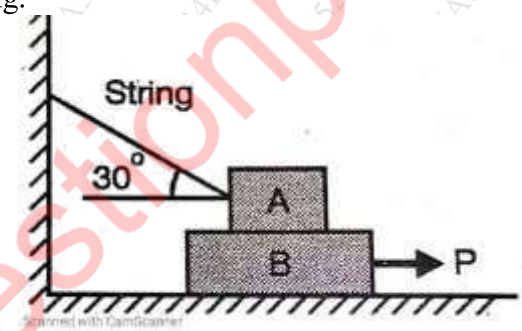
Q.5 a) Two smooth spheres of weight 100 N and of radius 250 mm each are in equilibrium in a horizontal channel of width 900 mm as shown. Find the reaction at the surface of contact A, B, C, D assuming all the surfaces to be smooth. 7



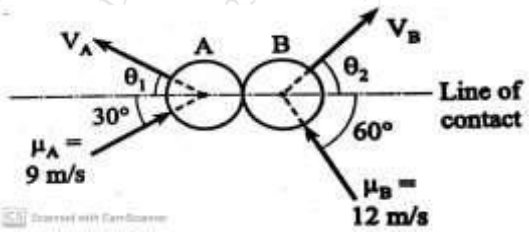
b) If the system is released from rest, find the acceleration of the blocks and the tension in the cable. Refer Fig. 8



Q.6 a) Find force requires to pull block B as shown in Fig. Coefficient of friction between A and B is 0.3 and between B and floor is 0.25. Mass of A = 40 kg and B = 60 kg. 7



b) The magnitude and direction of velocity of two identical smooth balls before central oblique impact are as shown in figure. Assuming, e = 0.9, determine the magnitude and direction of the velocity of each ball after impact. 8



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Time: 2 Hours **Marks: 60**

N.B:

1) Question **no.1** is compulsory
2) Attempt any **THREE** Questions from remaining **FIVE** Questions.
3) Assume suitable data if necessary and mention the same clearly.
4) Figure on right indicate the marks.

Q1. Answer any **FIVE** questions

A State and Explain Superposition Theorem [3]

B Find RMS and Average value of an alternating current varying sinusoidal takes 1.67 msec to obtain 14.14 A for the first time after becoming instantaneously zero. Time taken by an alternating current to complete it's one cycle is 20 msec. [3]

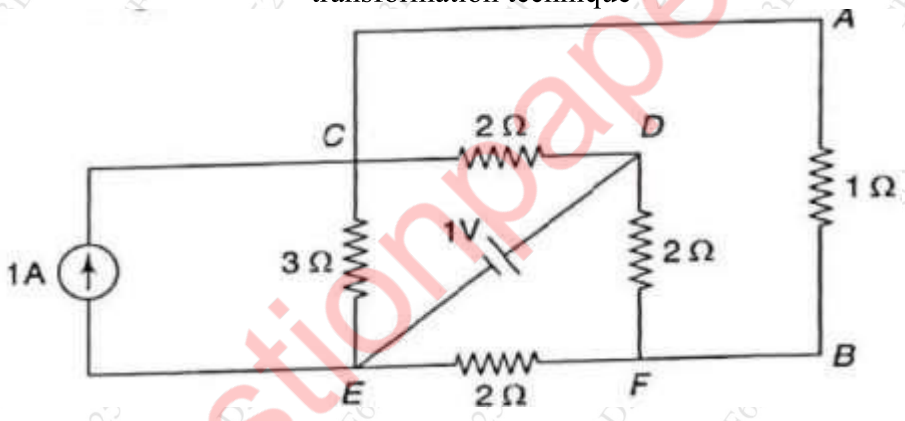
C Compare Ideal and Practical transformer. [3]

D Why single-phase induction motor is not self-starting? [3]

E Draw & Explain VI characteristics of Zener diode. [3]

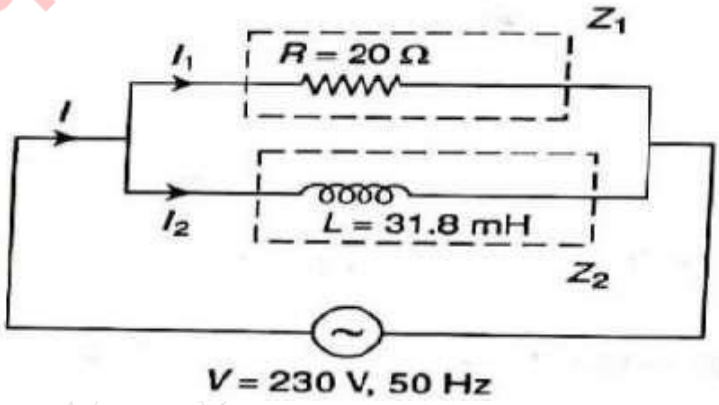
F Write applications of LED. [3]

Q2. A State Superposition theorem. Find 1 Ω using Superposition theorem without using source transformation technique [10]



B Explain the working principle of three phase induction motor.\ [5]

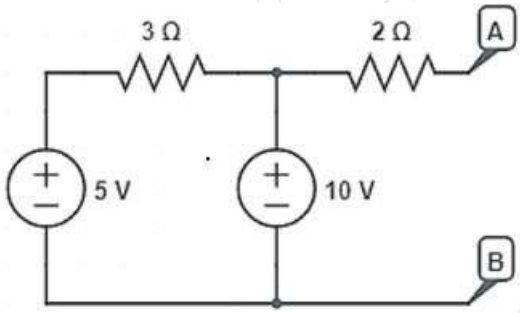
Q3 A A resistance of 20 Ω and a pure coil of inductance 31.8mH are connected in parallel across a 230V,50Hz, 1-ϕsupply. Find i) The line current ii) Power Factor, iii) Power consumed by circuit. [10]



B Explain the application of Zener diode as a voltage regulator. [5]

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Q4. A Find Thevenin's and Norton's equivalent circuit across A & B. [5]



B Write a short note on FET. [5]

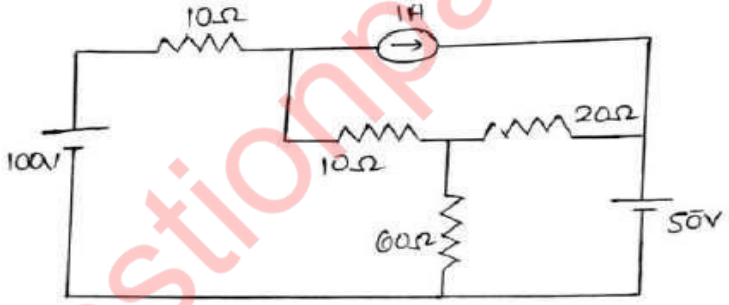
C Derive relation between line & phase voltage and line & phase current in three phase STAR connected balanced circuit. [5]

Q5. A Explain the working principle and transformation ratio of a single-phase transformer. [5]

B Write short notes on BLDC motor [5]

C A resistor of 20 Ω, an inductor of 0.05H and a capacitor of 50 μF are connected in series combination. Calculate the following1) Impedance 2) current of the circuit 3) phase difference angle 4) power factor 5) Active power [5]

Q6. A Obtain current through 60Ω resistance by Mesh analysis. [6]



B State the necessary condition for resonance in a series circuit. Compare series and parallel resonance. [5]

C Explain the application of BJT as a switch. [4]

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Time: 1 ½ Hours **Marks: 45**

N.B.

1. Q.1. is compulsory.
2. Attempt any two out of the remaining four questions.
3. Figures to the right indicate full marks.
4. Answers to the sub questions should be grouped together.
5. Assume suitable data wherever necessary.

Q1 Answer the following questions **(15)**

a Define methods of communication. Describe the Verbal method of communication. **5**

b Explain the concept and importance of active listening. **5**

c Write a letter to the Principal/Director requesting permission and necessary facilities to organize a Career Guidance Seminar in your institution (Use Complete Block Style). **5**

Q.2. Answer any three of the following questions **(15)**

a Write one sentence summary of each of the following extracts: **5**

1. A mind map is a visual tool used to organize ideas, concepts, and information around a central topic. It helps learners connect related ideas, improve understanding, and remember information more effectively. Mind maps encourage creative thinking, brainstorming, and better planning. They are useful for studying, problem-solving, note-making, and summarizing information in a clear and structured way. **2**
2. Content creation for digital media and e-commerce platforms involves developing engaging text, images, videos, and other digital materials to inform, attract, and persuade audiences. Effective content helps businesses promote products, build brand awareness, and connect with customers. On e-commerce platforms, quality content such as product descriptions, reviews, and advertisements influences purchasing decisions. It plays a vital role in enhancing user experience and increasing online sales. **2**
3. Coherence and cohesion are essential qualities of effective writing. Coherence ensures that ideas are logically organized and easy to understand, while cohesion connects sentences and paragraphs through linking words and references. Together, they improve the flow and clarity of a text. Good coherence and cohesion help readers follow the writer's message without confusion. **1**

b Write a dialogue between a teacher and a student in which the student seeks advice on improving communication skills for better personal and professional success. **5**

c Read the following situations and identify the communication barrier in each case. Suggest one suitable measure to improve each communication situation. **5**

1. During an online team meeting, poor internet connectivity causes frequent interruptions, making it difficult for participants to understand the discussion. **2**
2. A manager uses highly technical jargon while explaining a task to new employees, leaving them confused about their responsibilities. **2**
3. A student is upset after receiving low grades and fails to pay attention to the teacher's feedback during a counselling session. **1**

d Write an email to the librarian requesting an extension of the book return deadline. **5**
Writers email ID: sumexampce26@nomail.com
Librarian's email ID: elib26@autofmit.ac.in

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Q.3 Answer any three of the following questions **(15)**

a Rewrite the following sentences by correcting errors in punctuation, grammar, spelling, and style. **(one mark each)** **5**

1. the principle announsed that the seminar have been postpone till next weak however all students must attend it
2. I have seen a movie last night
3. every employee are expected to submit there reports by monday otherwise the management wont review them
4. my freind dont likes reading books because its boring
5. she were absent yesterday but she dont informed the teacher

b Define the SQ5R method and explain its role in improving reading comprehension. **5**

c Write a paragraph on "Ethical use of AI Tools" **5**

d Read the following situations. Identify the principle of the 7 Cs of Communication that is not followed and suggest how the communication can be improved. **(one mark each)** **5**

1. A manager writes a long email containing unnecessary details, making the main message difficult to understand.
2. A teacher tells students, "Submit the assignment soon," without mentioning the deadline.
3. A project leader says, "The project was successful," without providing any specific results or data.
4. A company notice contains spelling and grammatical errors.
5. A customer receives a reply stating, "Your complaint has been noted," but no information about further action is provided.

Q.4 Answer any three of the following questions **(15)**

a Give Diagrammatic representation of the following: **5**

1. The Complete Block Style **2**
2. The Upward Communication Network **2**
3. The Horizontal/Lateral Communication Network **1**

b You recently purchased a desktop computer from *TechZone Computers*, 125 M.G. Road, Duniya –000000. After installation, you discovered that the monitor screen was damaged and the system frequently shuts down unexpectedly. Write a complaint letter to the Manager of the shop requesting repair or replacement of the defective computer under warranty. (Use Complete Block Style). **5**

c A team of students is assigned a semester-long project. Explain the activities likely to occur at each stage of team development during the execution of the project (Organize project activities as per the five stages of team). **5**

d Construct one meaningful sentence each using the following idiomatic expressions: **5**
(one mark each)

1. Leave no stone unturned
2. Bark up the wrong tree
3. Weather the storm
4. Turn a blind eye
5. Pull strings

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Q.5. Answer any three of the following Questions **(15)**

a During a campus placement interview, Rahul enters the room and greets the interview panel. While answering questions, he avoids eye contact, sits with crossed arms, and speaks in a very low and hesitant voice. Although his answers are technically correct, the interviewers are not impressed. Identify the non-verbal communication factors affecting Rahul's performance and explain how he can improve them to create a positive impression during the interview. **5**

b Describe a Mini Drafter. **5**

c 1. You buy lunch from the college canteen and find that the food is stale. Your friend advises you not to complain because it may create trouble for the canteen staff. What ethical dilemma do you face, and what would you do? **5**

2. While preparing a project assignment, one of your teammates copies materials from the internet and asks the group to submit it without mentioning the source. What ethical issue is involved, and how would you respond? **2**

3. During an examination, you notice that your close friend is copying answers from another student. You are unsure whether to report the incident or remain silent. What ethical dilemma do you face, and what action would you take? **2**

d Read the following passage carefully and answer the questions that follow: **5**
(one mark each) **1**

In today's rapidly changing job market, continuous skill development is essential for students to remain employable and competitive. Recent global trends, including frequent job layoffs in the IT sector and other industries, show that companies are increasingly valuing employees who can quickly adapt to new technologies and work environments. This makes both hard skills (such as technical knowledge, coding, data analysis, and domain expertise) and soft skills (such as communication, teamwork, problem-solving, adaptability, and emotional intelligence) equally important. Hard skills help individuals perform specific job tasks, while soft skills enable them to work effectively with others and handle workplace challenges. With automation and artificial intelligence transforming many traditional roles, continuous upskilling and reskilling have become necessary for career stability. Therefore, students must actively develop and upgrade their skills throughout their education to improve employability and secure better career opportunities.

1. Why is continuous skill development important in today's job market?
a) To reduce study time b) To remain employable and competitive
c) To avoid exams d) To increase package

2. Which of the following is an example of a hard skill?
a) Communication b) Teamwork
c) Coding d) Leadership

3. Which of the following is a soft skill?
a) Data analysis b) Programming
c) Emotional intelligence d) Machine learning

4. Recent job layoffs highlight the need for employees who are:
a) Less educated b) Highly adaptable and skilled
c) Less experienced d) Dependent on others

5. Continuous upskilling helps students to:
a) Avoid learning new things b) Secure better career opportunities
c) Reduce employability d) Stop working

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