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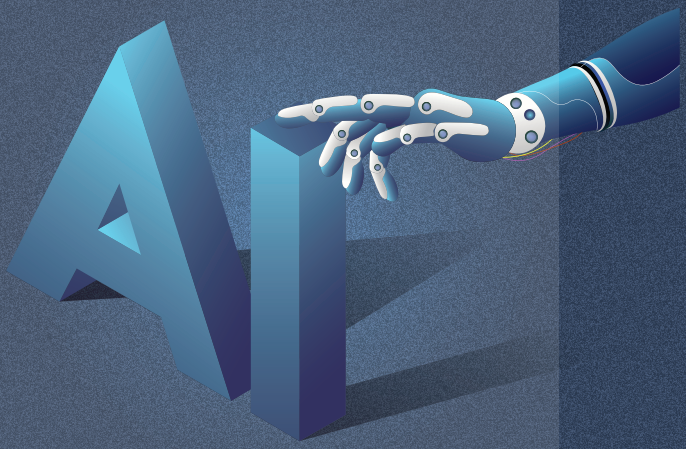
Class IX

DECODING ARTIFICIAL INTELLIGENCE

Teacher's Manual



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Book IX

EMPLOYABILITY SKILLS

CHAPTER 1: Communication Skills–I

Unsolved Questions

Ans 1. The basic components of a communication cycle are as follows:

(*i*) *Sender:* This is the individual or entity who initiates the communication, intending to convey information or express their thoughts, emotions or ideas.

(*ii*) *Encoding:* The sender's role is to transform his thoughts or ideas into a format suitable for transmission and comprehension. This transformation may involve converting the message into spoken words, written text or non-verbal signals.

(*iii*) *Message:* The message is the actual content that the sender wishes to communicate. This content can take various forms, including spoken words, written text or non-verbal cues.

(*iv*) *Channel:* The channel is the medium through which the message is transmitted. It could be through speaking, writing or using gestures, among other methods.

(*v*) *Receiver:* The receiver is the individual or entity at the other end of the communication. Their task is to receive the message and decode it, making sense of its meaning and context.

(*vi*) *Feedback:* Feedback refers to the response given by the receiver to the sender. It can take the form of verbal or non-verbal signals. This feedback is vital because it enables the sender to evaluate the effectiveness of the communication and make adjustments, if necessary.

Ans 2. Communication is the most important factor in various aspects of our lives, whether it involves relationships, work, education or personal development. Some key advantages of effective communication include the following:

(*i*) *Building and Sustaining Relationships:* Communication is the fundamental basis of all kinds of human relationships—personal or professional. Effective communication helps in building and sustaining these relationships.

(*ii*) *Sharing Information:* The ability to communicate is the primary means for exchanging information and knowledge. It is only through communication that we can share our thoughts, experiences and insights while learning from others in return.

(*iii*) *Problem-solving and Decision-making:* Effective communication is essential for collaboration and teamwork. It aids in problem identification, exploring solutions and collectively making decisions through discussions and exchanging ideas.

(*iv*) *Conflict Resolution:* Communication is an essential tool for resolving conflicts and disagreements. While it allows us to express our needs and viewpoints clearly, it also helps us to understand others' perspectives. By actively listening to others, we can discover common ground and reach mutually acceptable solutions.

(*v*) *Personal Growth and Development:* Communication also serves as a foundation for personal growth and self-expression. Through self-expression and meaningful conversations, we can nurture our own ideas, gain a deeper sense of self-awareness and evolve as individuals.

Ans 3.

Verbal Communication	Non-verbal Communication
This mode of communication relies on spoken words to transmit information. It is used for a wide range of interactions, including face-to-face conversations, telephone calls and public speaking. Some advantages of verbal communication are immediate feedback, non-verbal cues, personal connection and clarity.	Non-verbal communication doesn't rely on spoken words. Instead, it involves the use of body language, gestures, facial expressions and other non-verbal hints to convey information. Non-verbal hints play a significant role in adding meaning and context to non-verbal communication. Examples include crossed arms, smiling, fidgeting, etc.

Ans 4. Some advantages of verbal communication are as follows:

(*i*) *Immediate Feedback:* Verbal communication allows for instant feedback and response. This enables real-time conversations and allows for clarification of misunderstandings as they occur during the conversation.

(*ii*) *Non-verbal Cues:* Verbal communication usually incorporates tone, manner and other non-verbal hints to complement the information being conveyed. These elements make it possible to additionally convey emotions and nuanced details that may not be expressed verbally.

(*iii*) *Personal Connection:* Verbal communication plays a vital role in building personal relationships and developing a sense of connection between people. It allows for a more personal and human connection, as voice and presence add depth to interaction.

(*iv*) *Clarity:* Verbal communication can be an effective way to ensure that everyone has a clear understanding of the information being conveyed. It allows for immediate clarification and questions, reducing the likelihood of misinterpretation.

While verbal communication has its share of advantages, it is also accompanied by the following challenges:

(*i*) *Misunderstandings:* Verbal communication can result in misunderstandings, especially when language/accents are involved. Differences in pronunciation, vocabulary or interpretation can lead to confusion between those conversing.

(*ii*) *Emotional Influence:* Emotions can impact verbal communication, making it challenging to express oneself clearly and effectively. Emotions like anger, nervousness or excitement can interfere with the delivery of the intended message.

(*iii*) *Lack of Record:* Unlike written communication, verbal exchanges are usually not recorded. This can be a drawback when it is necessary to have a documented record of what was discussed. Verbal agreements or important details might be forgotten or disputed.

(*iv*) *Distance Limitation:* Verbal communication is limited by physical distance. It is generally only possible to communicate with individuals who are within hearing range, which can be a constraint in certain situations. However, this constraint has been overcome using technology where telecommunication and the internet have brought the world closer together.

Ans 5. Here are some common forms of non-verbal communication:

(*i*) *Facial Expressions:* Our face is highly expressive during any communication and can convey a wide range of emotions, such as happiness, sadness, anger and fear.

(*ii*) *Eye Contact:* Eye contact or the lack of it adds a lot of value in a conversation. The way a person looks at someone can communicate interest, attentiveness, confidence or even anger.

(*iii*) *Posture:* How one holds oneself can convey various qualities, including confidence, dominance or submissiveness, as observed in body stance and gestures.

Non-verbal communication, at times, complements verbal communication, especially when the information can be conveyed with a nod, tone of voice, eye contact or touch.

Ans 6. Visual communication has the potential to have a significant impact on individuals across all levels of literacy. As visual communication makes use of visual aids, including images, graphics and videos, to transmit information and ideas, those who are not educated enough to gather information from the written text, can easily grasp what is being conveyed. It offers distinct advantages, including:

(*i*) *Accessibility:* Visual communication can enhance accessibility, making information more comprehensible, especially for individuals with limited education.

(*ii*) *Engagement:* Visual communication tends to be more engaging than other forms of communication since it appeals to people's visual senses and can capture and sustain their attention more effectively.

(*iii*) *Memory:* Visual communication has the advantage of being more memorable compared to other communication forms, as images and graphics are easy to remember and recall.

(*iv*) *Clarity:* Visual communication serves as an effective method to clarify complex information and ideas by simplifying and breaking down the content into more manageable components.

Ans 7. In communication, there are four primary types of sentences, each with its own purpose, as outlined below with examples. We may use these to express ourselves.

(*i*) *Declarative Sentences:* Declarative sentences make statements or express ideas. Example: "The cat sleeps peacefully on the windowsill."

(*ii*) *Imperative Sentences:* Imperative sentences give commands or make requests. Example: "Please close the door quietly."

(*iii*) *Interrogative Sentences:* Interrogative sentences ask questions. Example: "Where are you going this evening?"

(*iv*) *Exclamatory Sentences:* Exclamatory sentences express strong emotions or convey surprise. Example: "How incredible the fireworks display was!"

Ans 8. *Simple Sentence:* A simple sentence consists of a single independent clause and is typically punctuated with a period (.) at the end.

Example: "The sun sets in the west."

Compound Sentence: A compound sentence includes two or more independent clauses, joined by a coordinating conjunction (and, but, or, nor, for, yet, so). It is often punctuated with a comma (,) followed by a conjunction. Example: "The sun sets in the west, and the moon rises in the east."

Ans 9. A paragraph is a structured and meaningful unit of writing. It is correctly defined as "a logically cohesive group of sentences or text that centres around one main idea or topic and comprises one or more sentences that support or elaborate on that central concept."

The essential components and purpose of a paragraph are:

(*i*) Typically, a paragraph begins with a topic sentence that states the main idea and is followed by supporting sentences that provide details or examples.

(*ii*) Paragraphs serve to organize written content and facilitate the comprehension of the logical flow of ideas within a written work.

Ans 10. Some key guidelines for writing effective paragraphs are presented below:

(*i*) *Clear Topic:* Always start the paragraph with a clear topic that introduces the primary idea and conveys the focus of the writing.

(*ii*) *Supporting Sentences:* Subsequent sentences should offer details, examples and explanations that add value to the topic.

(*iii*) *Specific Details:* It is always useful to provide specific details as they are more impactful than abstract or general information.

(*iv*) *Maintain Focus:* Throughout the writing, it is important to sustain concentration on the main idea of the paragraph, ensuring that each sentence pertains to the topic.

(*v*) *Transitional Words and Phrases:* Use transitional words and phrases to connect sentences and ideas within the paragraph, guiding the reader through the content.

(*vi*) *Sentence Length:* To make the paragraph interesting to read and to enhance reader engagement, we may try writing sentences with a variety of length.

(*vii*) *Concluding Sentence:* It is also worthwhile to conclude the paragraph with a sentence that provides closure and either summarizes the main idea or smoothly transitions to the next paragraph.

Ans 11. The following table provides examples of how perspectives can affect communication. Recognizing and respecting these diverse perspectives is key to fostering effective communication and avoiding potential misinterpretations.

Perspective	Effect on Communication
(*i*) Cultural differences	Different cultural norms and values may lead to misinterpretations.
(*ii*) Emotional state	Emotional states like happiness or sadness can affect how a message is received.
(*iii*) Beliefs and values	Differing personal beliefs can lead to contrasting interpretations.
(*iv*) Biases	Biases can influence how a message is perceived, potentially causing misunderstandings.
(*v*) Status and authority	Variations in status or authority can impact the perceived importance of the message.
(*vi*) Expertise	Differences in expertise may lead to variations in how the message is valued and understood.

Perspectives can have a significant impact on communication as they influence how people perceive, interpret and respond to information. Diverse perspectives can lead to varying interpretations of the same message, potentially resulting in misunderstandings and miscommunication. It is important to understand and appreciate these perspectives because they are influenced by an individual's life experiences, faith, culture, environment and numerous other factors. For instance, people may possess different norms, values and beliefs. They may also be influenced by biases or emotions, which can impact how they perceive and interpret a message.

Ans 12. The following are the 7Cs of effective communication:

(*i*) *Clarity:* The message should be clear, concise and easily understood.

(*ii*) *Completeness:* The message should contain all the necessary information, leaving out no crucial details.

(*iii*) *Conciseness:* Keep the message brief and to the point, avoiding unnecessary details that may clutter the information.

(*iv*) *Correctness:* Ensure that the message is accurate and free from errors or mistakes.

(*v*) *Concreteness:* Make the message specific and concrete, supporting it with examples and details to reinforce its meaning.

(*vi*) *Consideration:* Take into account the needs, interests and values of the audience when crafting the message.

(*vii*) *Courtesy:* Communicate in a polite, respectful and considerate manner towards the audience.

The following examples explain how the 7Cs of communication contribute to effective communication:

Perspective	Effect on Communication
(*i*) Clarity	"I need you to submit the homework by 1 pm on Friday."
(*ii*) Completeness	"Here's the report you requested. It includes the data you asked for and my analysis of the results."
(*iii*) Conciseness	"Can we meet at 2 pm to discuss the assignments?"
(*iv*) Correctness	"The budget for the project is 50,000, not 500,000."
(*v*) Concreteness	"The students' performance increased by 10% in the last semester and we expect them to continue growing at the same rate next semester."
(*vi*) Consideration	"I know you're busy with other assignments but I would really appreciate it if you could review this report and give me your feedback by Monday."
(*vii*) Courtesy	"I appreciate your hard work on this project. I have a few suggestions that I think could help us improve the final submission.

Ans 13. A sentence consists of various essential components known as the parts of a sentence. The components which may be included in a sentence are presented below with examples:

- *Subject:* The subject is the element of the sentence that focuses on a person, place, thing or idea.
  Example: 'Hiral' in "Hiral is painting a picture."
- *Verb:* The verb signifies the action or the state being carried out by the subject.
  Example: 'is painting' in "Hiral is painting a picture."
- *Object:* The object relates to the person, place, thing or concept upon which the action of the verb is performed or to which it pertains.
  Example: 'a picture' in "Hiral is painting a picture."

Ans 14. Phrases are used to enhance the meaning and clarity of sentences but are unable to function as complete sentences independently. They play a crucial role in providing context and details within a sentence structure. For example, the phrase "with a smile" describes someone's manner but needs more context to make sense.

There are various types of phrases, including:

- *Noun Phrases:* These phrases revolve around a noun and its associated words, providing more information about the noun.
- *Verb Phrases:* Verb phrases encompass the verb and its related words, such as auxiliary verbs or adverbs, to convey the action in greater detail.
- *Adjective Phrases:* Adjective phrases modify nouns or pronouns, offering descriptions or details about them.
- *Adverb Phrases:* Adverb phrases modify verbs, adjectives or other adverbs, enhancing the meaning of the sentence.

Ans 15. Here are some types of non-verbal communication and their significance in conveying information:

(*i*) *Facial Expressions:* Our face is highly expressive during any communication and can convey a wide range of emotions, such as happiness, sadness, anger and fear.

(*ii*) *Eye Contact:* Eye contact or the lack of it adds a lot of value in a conversation. The way a person looks at someone can communicate interest, attentiveness, confidence or even anger.

(*iii*) *Posture:* How one holds oneself can convey various qualities, including confidence, dominance or submissiveness, as observed in body stance and gestures.

(*iv*) *Gestures:* Hand movements, like pointing, waving or using thumbs-up or thumbs-down, convey different meanings based on context and cultural norms.

(*v*) *Touch:* Physical contact, such as a handshake, hug or a pat on the back, can convey affection, respect or even aggression, depending on the context and the relationship between individuals.

(*vi*) *Physical Distance:* The physical distance between people can communicate intimacy, comfort or hostility. Standing close to someone or maintaining a safe distance sends different signals.

(*vii*) *Tone of Voice:* The way a person speaks, including volume, pitch and rhythm, can convey various emotions and attitudes, such as confidence, nervousness or anger.

Ans 16. A compound-complex sentence features two or more independent clauses and one or more dependent clauses and is often punctuated with a combination of commas (,) and conjunctions (and, but, or, nor, for, yet, so). Example: "She sang beautifully, but her voice wavered when she reached the high note."

CHAPTER 2: Self-Management Skills–I

Unsolved Questions

Ans 1. Self-management means being in charge of your thoughts, feelings and actions to reach your goals. It also involves handling yourself in relation to others and the resources around you. This skill allows you to take charge of your life, set your priorities and make good choices. Some self-management skills are:

(*i*) *Time Management:* Time management means using your time wisely to reach your goals. This includes deciding what is most important, making a schedule and saying a firm 'NO' to activities that waste time. A great way to manage your time is to make a list of things you need to do each day and then prioritize them based on their importance and when they are due.

(*ii*) *Goal-Setting:* Goal-setting is about figuring out what you want to achieve and making a plan to get there. It keeps you on track and motivated by giving you a clear path and purpose. To set effective goals, use the SMART criteria, which means they should be Specific, Measurable, Achievable, Realistic and Time-bound.

(*iii*) *Decision-Making:* Decision making involves evaluating options and choosing the best course of action. It is an essential skill for self-management because it helps you make good decisions that align with your values and goals.

(*iv*) *Problem-Solving:* Problem-solving is about identifying problems, coming up with probable solutions and picking the best one. It is an important skill for self-management because it helps you tackle difficulties and roadblocks.

Ans 2. Self-management is important because it keeps a person on track, organized and motivated. Without self-management, one might struggle to finish tasks on time. However, by developing self-management skills, anyone can increase their productivity, reduce stress levels and improve their overall well-being.

Self-management can help achieve long-term goals if practised in everyday life, for example, by using their time and resources well, students can finish assignments on time and get better grades, which may help them in getting admission to good colleges/institutes, paving the way for a remarkable career for them. Similarly, self-managed professionals can set clear goals and make good choices that match their long-term plans.

Besides, self-management lets people work on projects by themselves, without constant supervision. Self-management also helps you to understand what you are good at, where you need improvement and how you can grow.

Ans 3. By encouraging students to follow the given guidelines, teachers and parents can help students to develop good self-management habits:

(*i*) *Time Management:* Time management means using your time wisely to reach your goals. This includes deciding what is most important, making a schedule and saying a firm 'NO' to activities that waste time. A great way to manage your time is to make a list of things you need to do each day and then prioritize them based on their importance and when they are due.

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Ans 4. Self-awareness is the ability to recognize and understand one's thoughts, emotions and behaviours and how they impact oneself and others. It involves being aware of one's strengths, weaknesses and limitations, as well as one's values and beliefs. Self-awareness is important because knowing yourself is a skill that can help you grow, get better and have better relationships with people. To be self-aware, you need to be open to thinking about yourself honestly and without being too critical. You also have to think about how others see you. It can involve practices such as writing a journal, being mindful and asking people you trust for their thoughts and feedback.

"Your vision will become clear only when you can look into your own heart. Who looks outside, dreams; who looks inside, awakes." —C.G. Jung

Ans 5. Self-awareness comes in two forms: internal and external.

- Internal self-awareness is about knowing your values, beliefs, emotions and why you do things.
- External self-awareness is about knowing how others see you and how your actions affect them.

Ans 6. Self-awareness is the ability to recognize and understand one's thoughts, emotions and behaviours and how they impact oneself and others. It involves being aware of one's strengths, weaknesses and limitations, as well as one's values and beliefs. Being self-aware is a skill that can help you grow and have better relationships with people. For a self-aware student, it will help them have better relationships with other students as well as family members, friends and acquaintances.

Ans 7. Stress is a natural reaction to challenging or threatening situations. While a bit of stress can be helpful, too much stress can harm students' physical and mental health.

Negative Stress (Distress): Long-lasting or severe stress that feels like it is too much to handle and can harm your physical and mental health.

- Higher chance of heart problems
  - A weaker immune system
  - Issues with your stomach and digestion
- Feelings of anxiety, depression, helplessness and hopelessness
  - Increased irritability and anger
  - Decreased self-esteem

Ans 8. Stress management refers to the ability to cope with stress and reduce its negative impact. Stress management is another crucial part of self-management.

Some common stress management techniques and their impact on us are presented in the table below:

Stress Management Techniques	**Their impact**
(*i*) Deep Breathing	Inhaling and exhaling slowly and deeply to calm the mind and reduce physical tension • Lowers heart rate • Reduces muscle tension • Improves focus and concentration

(*ii*) Exercise	Engaging in physical activities such as yoga, walking, playing favourite sports, swimming, dancing, etc. • Improves overall physical health and well-being • Reduces tension • Promotes better sleep
(*iii*) Mindfulness & Meditation	Focusing on the present moment and acknowledging thoughts and emotions without judgment • Reduces anxiety and depression • Improves sleep quality • Increases self-awareness
(*iv*) Social Support	Connecting with others and seeking emotional support from friends, family or mental health professionals • Reduces feelings of loneliness and isolation • Provides a sense of community • Promotes healthy coping mechanisms
(*v*) Time Management	Organizing and prioritizing tasks, setting realistic goals and managing time effectively • Increases productivity • Promotes a sense of accomplishment • Increases a sense of control
(*vi*) Journaling/Diary	Writing down thoughts and emotions to increase self-awareness and release negative feelings • Improves self-awareness • Reduces anxiety and depression • Promotes emotional regulation
(*vii*) Relaxation Techniques	Engaging in activities such as listening to music or spending time in nature to promote relaxation and reduce stress • Reduces physical tension • Promotes relaxation • Improves mood and overall well-being
(*viii*) Sleep Routine	Developing healthy sleep habits such as sticking to a regular sleep schedule in a relaxing sleep environment • Improves sleep quality • Reduces anxiety and depression • Promotes overall physical and mental health

Ans 9. Stress is a natural reaction to challenging or threatening situations. While a bit of stress can be helpful, too much stress can harm one's physical and mental health affecting performance at work or in school.

Self-management techniques, such as exercise, time management, journaling/writing diary, relaxation techniques, sleep routine, go a long way in overcoming the impact of stress.

Ans 10. Positive thinking is a way of thinking in which you concentrate on the good parts of situations and experiences and don't give much attention to the negative parts. It is about having a mindset that sees opportunities and chances in each situation, rather than getting stuck on failures, problems or things that didn't work out.

Positive thinking brings many benefits, including greater self-confidence, less stress, improved physical health and better relationships. It is a key part of your journey to self-improvement.

Ans 11. Self-confidence is your own belief in your abilities and skills. It is a big part of self-management because it keeps you feeling motivated and focused on your goals. Self-confidence can also help you deal with tough situations and challenges by giving you a sense of determination.

Positive thinking is a way of thinking in which you concentrate on the good parts of situations and experiences and don't give much attention to the negative parts. It is about having a mindset that sees opportunities and chances in each situation, rather than getting stuck on failures, problems or things that didn't work out.

Positive thinking helps in challenging negative thoughts, paying attention to negative self-talk and countering it with positive and empowering thoughts. Positive thinking brings many benefits, including greater self-confidence, less stress, improved physical health and better relationships. It is a key part of your journey to self-improvement.

Ans 12. Personal hygiene refers to the practices that we undertake to maintain cleanliness and promote good health. Personal hygiene is a crucial aspect of our lives and it is important to learn the basics of hygiene from an early age. Maintaining personal hygiene is an important part of taking care of your health and well-being.

Ans 13. Personal hygiene refers to the practices that we undertake to maintain cleanliness and promote good health. Personal hygiene is a crucial aspect of our lives and it is important to learn the basics of hygiene from an early age. Maintaining personal hygiene is an important part of taking care of your health and well-being.

The following are some good personal hygiene practices:

(*i*) Taking a shower or bathing each day removes dirt, sweat and bacteria from your skin, preventing body odour.

(*ii*) Brushing your teeth twice daily and flossing once a day removes food bits and plaque, which can cause tooth decay, bad breath and gum issues.

(*iii*) Daily washing your face helps get rid of dirt, oil and makeup that can block pores and cause acne or other skin troubles.

(*iv*) Regularly washing your hands with soap and water stops germs from spreading and lowers the risk of getting sick.

(*v*) Keeping your nails short helps prevent dirt and bacteria from gathering underneath, which can lead to infections.

Ans 14. Teachers and parents can go a long way in inculcating in students the habit of maintaining personal hygiene. Some examples are:

At home, parents can ensure that their child brushing his teeth, taking a bath daily and washing his hands after playing and before having their meal and keep their surroundings clean.

In school, teachers can discuss the benefits of keeping oneself clean, washing hands to prevent diseases, citing communicable diseases like COVID-19 as an example, to stay healthy. Another step that teachers can take to ensure that the students are conscious about personal hygiene is checking their nails randomly.

CHAPTER 3: ICT Skills–I

Unsolved Questions

Ans 1.

Input Device	Output Device	Storage Device
Microphone	Plotter	Flash Drive
Touch screen	Speaker	Hard disk
Bar Code reader	Printer	
Light Pen	Projector	

Ans 2. (*a*) *RAM (Random-Access Memory):* RAM is volatile in nature and hence holds the data till the computer is switched on.
The data to be worked upon is brought into primary memory or RAM.
ROM (Read-Only Memory): ROM is permanent in nature as its contents are retained even after the system gets switched off.
Some preliminary steps for booting process, *i.e.*, startup or warm-up session, resides in ROM and are read from the ROM.

(*ii*) *Plotter:* Plotters are the output devices that are used for producing vector graphics, good-quality images and drawings like architectural designs, maps, computer-aided designing (CAD), etc., by plotting lines using a pen. Unlike printers, they support printing of large-sized papers. The pens in plotters use different-colored ink to draw in different colors.
Printer: A printer is an output device which is used to generate hard copies (printout) of the output generated by the computer system. The printer can generate both text and images on paper.

(*iii*) *Web Page:* A web page is an electronic document/page designed using HTML. It displays information in textual or graphical form. Traversal from one web page to another is possible through hyperlinks. The first page of a website is called home page. It generally contains information and links of all the related web pages. Each web page has a unique address that is visible on the address bar.
Website: A website is a collection of various web pages, images, video, audio and other kinds of digital assets that are hosted on one or several web servers. The first page of a website is known as home page where all the links related to other documents are displayed. The web pages of a website are written using HTML and the information is transferred over the internet through the HTTP protocol. HTML documents consist of several hyperlinks that are accessed through the HTTP protocol. Examples of various websites are *cbse.nic.in*, *google.com*, *amazon.in*, etc.

Ans 3. ICT stands for Information and Communication Technology. The world around us revolves around computers and it has become an indispensable part of our life. ICT skills have made our lives better and easier as it helps us in doing our day-to-day tasks flawlessly, efficiently and quickly. The best examples are smartphones that have become the most important and indispensable hand-held devices.
The following are the areas where ICT is being used:
Role of ICT in Personal Life:

(*a*) Online Financial Services
(*b*) Communication
(*c*) Healthcare
(*d*) Education
(*e*) Entertainment
(*f*) Social Networking Platforms

Role of ICT in Industries and Businesses:

(*a*) Banking Industry
(*b*) E-commerce
(*c*) Accounting Tools
(*d*) Training and Education
(*e*) Travel and Ticketing
(*f*) Research
(*g*) Defence

Ans 4. A light pen is a pointing device that can be used to select anything on the computer screen by simply pointing at it or for drawing figures directly on the screen. The tip of the light pen, termed as stylus, contains a light-sensitive element which, when placed on the screen, detects light from the screen, enabling the computer to identify the location of the pen on the screen. Clicking is performed by pressing the pen on the screen. A light pen is mostly used by engineers, architects or designers.

Ans 5. Laser printers use laser technology to produce printed documents. They work just like a photocopy machine and print good-quality images at high speed.

Laser printers are used both in offices and homes. Color laser printers too produce very good result.

Ans 6. (*a*) ALU: Arithmetic Logic Unit
(*b*) CU: Control Unit
(*c*) CPU: Central Processing Unit

Ans 7. *Central Processing Unit (CPU):* A computer receives data and instructions through input devices which get processed by the CPU and the result is shown through the output devices. The main/primary memory and secondary/auxiliary memory are used to store data inside the computer.

The CPU is the control centre/brain of a computer. It guides, directs, controls and governs all the processing that takes place inside the computer.

Ans 8. *Email (Electronic mail):* Short for electronic mail, e-mail or email is the information stored on a computer that is exchanged between people over a network. It is a fast and efficient way to communicate with multiple users at the same time and is the cheapest and fastest method to send files that may contain text, images and other information across the network.

Postal mail, as we all know, is slow as compared to electronic mail. Thus, matters of urgency cannot be left to postal mail. However, sending parcels, etc, is not possible through electronic mail, where postal mail comes in handy.

Ans 9. Web browser is a software that helps in accessing web pages and thus, is also called web client. It helps the user to navigate through the world wide web and displays web pages. Some popular web browsers are Google Chrome, Mozilla Firefox, Opera, AOL, WebKit, etc.

The site to be searched is done by typing the address of the web page (URL) in the address bar. Clicking on Go or pressing Enter from the keyboard shall take you to the destined website and the home page will be loaded on your browser window.

Ans 10. The role of ICT at home:

(*a*) *Online Financial Services:* One of the most sought-after services provided by ICT is online financial transactions. You can pay your bills online from the comfort of your home, without standing and waiting in long queues. Banking transactions are all done online using smartphones and computers. In addition to this, loan services, insurance and social welfare schemes can be accessed online.

(*b*) *Communication:* Sending and receiving messages with the click of a mouse has become easy and instant whether it is about updating meeting timings, communicating via email in offices, looking for information online, doing research work or seeking help and consultation. Sharing and collaborating information with each other through online mode has become faster and easier with time.

Ans 11. ICT plays a significant role in industrial set-ups and businesses as described below:

(*i*) *Banking Industry:* With e-banking, it is no longer required to wait in queues. You can do all banking transactions online now. Even new accounts can be opened online.

(*ii*) *E-commerce:* With e-commerce, all types of business transactions are carried out very easily, accurately and by ensuring proper sales and services. Buying and selling of products through online mode has become very convenient.

(*iii*) *Accounting Tools:* Handling of accounts is easily done through customized accounting tools that run on computers, which are required for business and personal purposes.

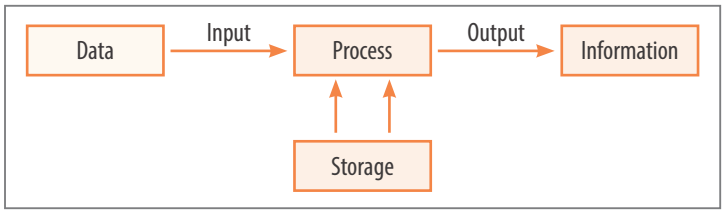
(*iv*) *Training and Education:* Computers play significant roles in providing professional trainings, skill development, capacity-building programs, organizing workshops and online training sessions at school and college levels. Online tutorials, digitized content, e-libraries, multimedia tablets and user-friendly learning platforms have changed the face of education.

(*v*) *Travel and Ticketing:* The IRCTC/Indian Railways portal is one of the most popular applications for booking online tickets, thanks to easy access through the internet, secured payments and instant services. Besides booking air tickets, hotel reservations and cab booking are just a click away.

Ans 12. A computer is an electronic device that takes input in the form of data and generates output in the form of information. This process of converting data into some meaningful information is called Information Processing Output cycle or IPO cycle. This is performed by the fundamental units or the basic components of a computer system.

Basic Operations of a Computer

Every task given to a computer follows an Input → Process → Output Cycle (IPO cycle).



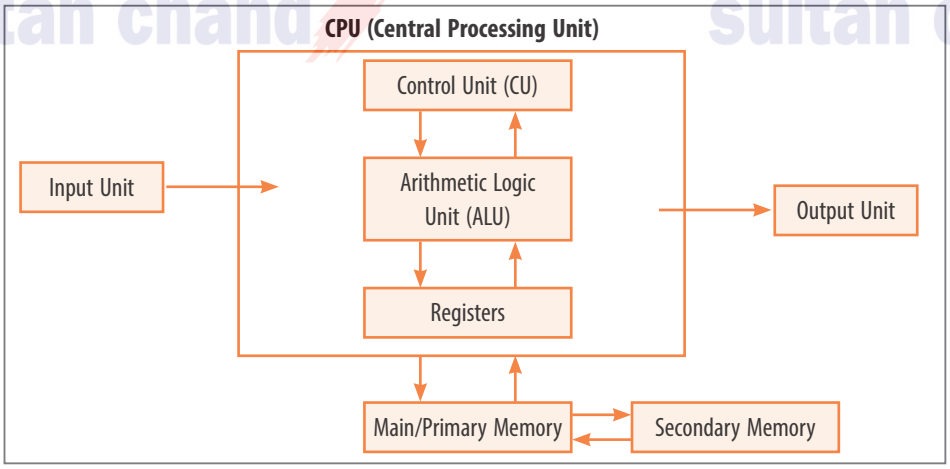
IPO Cycle

It accepts certain input (raw data), processes that input and produces the desired output (processed data or information).

The input unit takes the input, the Central Processing Unit (CPU) processes the data and the output unit produces the output. The memory unit holds the data and instructions during the processing.

A computer receives data and instructions through input devices which get processed by the CPU and the result is shown through the output devices. The main/primary memory and secondary/auxiliary memory are used to store data inside the computer, as shown in the given figure.

The main memory holds the input and intermediate output during the processing.



Functional Components of a Computer System

Ans 13. *Output Devices:* Output devices are the physical components that produce the output or processed data generated by the computer system in human readable form. Some of the most commonly used output devices are speakers, monitor, printer, etc.

Input Device: The input unit comprises devices attached to the computer. These devices help to provide instructions to the computer. Thus, it accepts input from the user and converts it into a form that can be understood by the computer (*i.e.*, binary code/form). The term "Binary" means two states—ON/OFF or HIGH/LOW—voltage and, in turn, two bits or symbols, 1 for ON and 0 for OFF. Examples include keyboard, light pen, etc.

Ans 14. To turn off the computer completely, follow the given steps:

(*i*) Click the **Start** button.

(*ii*) Then, from the pop-up menu, click on **Shut Down** option. The computer desktop will fade away and the computer will gradually shut down.

Ans 15. An email address is a unique identifier for an email account. It is used for both sending and receiving email messages. Every email address has two main parts—a username and a domain name. The username comes before '@' and the domain name comes after it. In the example given below, 'abc' is the username and 'gmail.com' is the domain name: abc@gmail.com

CHAPTER 4: Entrepreneurial Skills-I

Unsolved Questions

Ans 1. The different types of businesses are:

(*i*) *Manufacturing Business:* A manufacturing business is a kind of business that deals with the production of goods (make things/products) in a step-by-step approach using raw materials, labour, technology, capital and production overheads. The entire process leads to finished goods which are then sold to the consumers directly or indirectly through wholesalers and retailers.

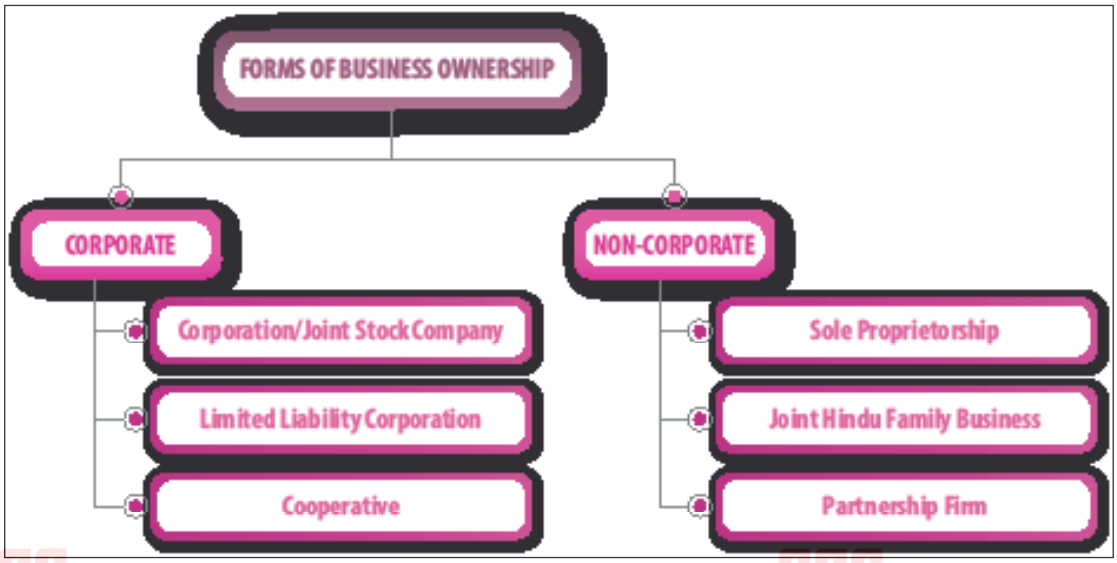
(*ii*) *Service Industry:* Service industry serves consumers with intangible products (products without physical form) or benefits. These business establishments offer consultation, accounting, professional expertise, skills, hospitality and more.

(*iii*) *Merchandising Business:* Merchandising is the most common form of business where products are purchased and sold in bulk which is beneficial to all—wholesalers, retailers, shopkeepers and customers. In merchandising, finished products are purchased at wholesale price and sold to consumers at retail price.

(*iv*) *Hybrid Business:* Hybrid business is a combination of the above business types, like service, manufacturing, merchandising or a combination of all three. It deals in both goods and services. The best example of a hybrid business is 'Patanjali Yogram'.

Ans 2. Entrepreneurship Development is the process of improving and enhancing the required skillset and knowledge of an entrepreneur with respect to starting and running an enterprise and generating maximum profit while taking into account the risks involved. This can be structured in-house trainings, classroom training programs and sessions which will help budding entrepreneurs to become successful. Entrepreneurship development becomes necessary to tackle the problem of unemployment, to overcome stagnation in the economy and to give a boost to business and industries. It is a tool for industrialization.

Ans 3. On a broader perspective, a business can be divided into **corporate** or **non-corporate** form.



Ans 4. To become a successful entrepreneur, the following characteristics should be imbibed:

(*i*) *Risk-bearing Capacity:* Every business, whether small or big, involves risks to a certain extent. Thus, an entrepreneur should have enough courage to take risks while setting up a new venture and take calculative decisions to capture the market and succeed.

(*ii*) *Innovation:* Entrepreneurship involves coming out with innovative ideas for setting up a new business with a creative blend to changes in the environment and market requirement. It involves introduction of services and products in a new, better and innovative way.

(*iii*) *Purposeful and Goal-oriented:* Entrepreneurship is a purposeful and goal-oriented activity with a strong vision of earning maximum profits through innovative practices and eventually benefiting the society.

(*iv*) *Leadership Qualities:* Entrepreneurship is all about managing a team with an intent to earn good profits. A successful entrepreneur should possess strong leadership qualities so that those working under their guidance strongly believe in them and respect them.

(*v*) *Flexible and Dynamic Process:* Business is a dynamic activity that keeps on changing with respect to circumstances and market environment. Those changes create opportunities for entrepreneurs. So, a successful entrepreneur should be flexible and prepared in all situations and circumstances to work for the benefit of the business and society.

(*vi*) *Gap-filling Activity:* An entrepreneur identifies and fills the gap between the requirement of society and what is available.

(*vii*) *Awareness about Market Trends:* An entrepreneur fills the gap between what are the customers' needs and what is available to them. The entrepreneur should be aware of a product's market value and demand so that they can take better decisions and constantly improve their products based on customer feedback.

(*viii*) *Multi-dimensional:* A multi-dimensional approach helps to improve the performance of an enterprise by taking care of all the important aspects related to it, *viz*. economic, psychological, social, cultural, etc. All these dimensions impact each other and eventually the growth of the business.

Ans 5. The following are the roles of entrepreneurship:

(*i*) *Economic Development:* An entrepreneur acts as one of the pillars of economic development through efficient use of resources and arranging capital for fruitful long-term investments.

(*ii*) *Generating Employment Opportunities:* An entrepreneur efficiently utilizes human resources as they are job creators and not job seekers.

(*iii*) *Contribution towards Industrial Development:* An entrepreneur contributes significantly towards industrial development by setting up new business ventures and industrial units in backward and rural areas to bring balanced regional development.

(*iv*) *Mobilizing Revenue:* Entrepreneurs significantly help in increasing national wealth by mobilizing the revenue of a country.

(*v*) *Enhancing Standard of Living:* As more businesses are set up, the problem of unemployment gets resolved to a great extent.

The following are the rewards of entrepreneurship:

(*i*) *Independence:* An entrepreneur is their own boss and takes independent decisions in terms of hours of work, team members, etc.

(*ii*) *Passion:* Entrepreneurs are passionate about their dreams. As a job is performed with utmost sincerity and efforts, the results are also fruitful.

(*iii*) Adventure and Excitement: There are numerous people who have given up their good jobs to nurture their dreams. They live up to their dreams and become successful entrepreneurs.

(*iv*) *Freedom:* Entrepreneurship allows the freedom to implement one's ideas as per their area of interest and perspective.

(*v*) *Profit-making and Financial Stability:* Successful entrepreneurs create and maintain a good bank balance for themselves and benefit their employees and staff.

(*vi*) *Good Status:* Success in entrepreneurship brings considerable fame and prestige.

Ans 6. The abilities of a successful entrepreneur are:

(*i*) *Risk-bearing Capacity:* Every business, whether small or big, involves risks to a certain extent. Thus, an entrepreneur should have enough courage to take risks while setting up a new venture and take calculative decisions to capture the market and succeed.

(*ii*) *Innovation:* Entrepreneurship involves coming out with innovative ideas for setting up a new business with a creative blend to changes in the environment and market requirement. It involves the introduction of services and products in a new, better and innovative way.

(*iii*) *Purposeful and Goal-oriented:* Entrepreneurship is a purposeful and goal-oriented activity with a strong vision of earning maximum profits through innovative practices and eventually benefiting the society.

(*iv*) *Leadership Qualities:* Entrepreneurship is all about managing a team with an intent to earn good profits. A successful entrepreneur should possess strong leadership qualities so that those working under their guidance strongly believe in them and respect them.

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(*viii*) *Multi-dimensional:* A multi-dimensional approach helps to improve the performance of an enterprise by taking care of all the important aspects related to it, *viz.* economic, psychological, social, cultural, etc. All these dimensions impact each other and eventually the growth of the business.

Ans 7. Business consists of several activities which are broadly classified into following major categories:

(*i*) *Manufacturing Business:* A manufacturing business is a kind of business that deals with the production of goods (make things/products) in a step-by-step approach using raw materials, labour, technology, capital and production overheads. The entire process leads to finished goods which are then sold to the consumers directly or indirectly through wholesalers and retailers.

(*ii*) *Service Industry:* Service industry serves consumers with intangible products (products without physical form) or benefits. These business establishments offer consultation, accounting, professional expertise, skills, hospitality and more.

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(*iv*) *Hybrid Business:* Hybrid business is a combination of the above business types, like service, manufacturing, merchandising or a combination of all three. It deals in both goods and services. The best example of a hybrid business is 'Patanjali Yogram'.

Ans 8. Atal Innovation Mission, Startup India, Mudra Yojana Scheme and Entrepreneurship-cum-Skill Development Programme (E-SDP) are some of the entrepreneurship development initiatives undertaken by the Government of India.

Ans 9. **Business** includes all those economic activities that comprise exchange, purchase, sale, production/creation of goods and services with the objective of making profits along with customer satisfaction. A factory, a shop, a transport company, an insurance company, a commercial bank, an advertising agency, etc., are all examples of business enterprises. Hence, business may be defined as an economic activity involving the production and sale of goods and services to earn profits after satisfying consumer needs.

On the contrary, **Entrepreneurship** is the process of discovering an opportunity, mobilizing resources and creating an establishment to exploit the opportunity. It is an attempt to create value. Business and entrepreneurship are both inter-related activities and cannot be separated.

Ans 10. The following is the role of an entrepreneur in a country's economic development:

(*i*) *Resources and Capital:* An entrepreneur acts as one of the pillars of economic development through efficient use of resources and arranging capital for fruitful long-term investments.

(*ii*) *Generating Employment Opportunities:* An entrepreneur efficiently utilizes human resources as they are job creators and not job seekers.

(*iii*) *Industrial Development:* An entrepreneur contributes significantly towards industrial development by setting up new business ventures and industrial units in backward and rural areas to bring balanced regional development.

(*iv*) *Mobilizing Revenue:* Entrepreneurs significantly help in increasing national wealth by mobilizing the revenue of a country.

(*v*) *Enhancing Standard of Living:* As more businesses are set up, the problem of unemployment gets resolved to a great extent.

CHAPTER 5: Green Skills–I

Unsolved Questions

Ans 1. In broader terms, 'Environment' means 'surroundings' (environs). The word 'environment' has been derived from the French word 'Environia', which means 'to surround'. Hence, environment refers to our surroundings which consist of biotic (living) and abiotic (non-living) components.

Ans 2. **Biotic:** The living components of an ecosystem are called biotic components. Some of these include plants, animals as well as fungi and bacteria. Plants are autotrophs—they make their own food by absorbing carbon dioxide from the environment and releasing oxygen after the process of photosynthesis. Animals are mainly dependent on plants or on other animals for their food and existence.

Abiotic: Abiotic components constitute all non-living components of an ecosystem. It includes air, water, soil, minerals, sunlight, temperature, nutrients, etc.

Ans 3. Society and environment have always been closer and dependent on each other since time immemorial. A society is best described as a group of people living together to form a community, tribe, village or a city, sharing common interests along with continuous social interactions. As various environmental changes like weather, climate and different terrains affect our lives, in the same manner, our actions and activities also greatly impact the environment. Thus, human beings and environment affect each other alike.

For example, the careless cutting down of forests and trees to clear land to grow crops for ages has led to soil erosion and change in climatic conditions which, in turn, has created an ecological imbalance.

Ans 4. The various factors causing ecological imbalance are:

- *Deforestation:* It is the outcome of population explosion. Due to rising population, forests and related ecosystems are cleared for urbanization and industrialization. This has resulted in land degradation and soil erosion and, in turn, has resulted in the extinction of many bird and animal species.
- *Pollution:* It is defined as the contamination of environment, mainly air, water and soil, with undesirable addition of unwanted harmful substances or toxins that destroy the health of the environment and make it unfit and unhealthy for life sustenance and have long-lasting effects.
- *Global Warming and Greenhouse Effects:* The increase in carbon dioxide content in the atmosphere due to emission of chlorofluorocarbons and other air pollutants, excessive use of fossil fuels like coal, petrol, oil and natural gas produces greenhouse gases like methane, carbon dioxide etc., and results in a sharp increase in greenhouse effect and, in turn, global warming.
- *Mining:* It is the process of extracting minerals from the earth's surface. If we will keep extracting minerals at the current pace, it will lead to their depletion and create an ecological imbalance. Large-scale mining leads to long-term effects such as land erosion, dust contaminating the air and improper mining waste disposal.
- *Radioactive and E-Waste:* The working of nuclear reactors produces a lot of radioactive waste which is highly dangerous for all living beings. It is not decomposed and stays intact for thousands of years. Thus, radioactive waste should be handled properly. Another waste of concern is e-waste. This is due to large scale usage of smartphones, laptops and other digital gadgets which generate a lot of e-waste and need proper management.

Ans 5. An ecosystem is an interdependent community of living and non-living organisms that interact with each other and create a balance in their surrounding environment. For example, gardens, ponds and forests are all ecosystems. Any imbalance created in any of the components shall disturb the entire ecosystem, which may hamper the existence of other living organisms.

An ecosystem comprises two major components:

- *Biotic:* The living components of an ecosystem are called biotic components. Some of these include plants, animals as well as fungi and bacteria.
- *Abiotic:* Abiotic components constitute all non-living components of an ecosystem. It includes air, water, soil, minerals, sunlight, temperature, nutrients, etc.

Ans 6. Human activities have contributed to creating ecological imbalance in the following ways:

(*i*) *Deforestation:* It is the outcome of population explosion. Due to rising population, forests and related ecosystems are cleared for urbanization and industrialization. This has resulted in land degradation and soil erosion and, in turn, has resulted in the extinction of many bird and animal species.

(*ii*) *Pollution:* It is defined as the contamination of environment, mainly air, water and soil, with undesirable addition of unwanted harmful substances or toxins that destroy the health of the environment and make it unfit and unhealthy for life sustenance and have long-lasting effects.

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Ans 7. Green economy is described as an economy with low carbon emissions, less pollution, efficient use of resources and a healthy society. It can be achieved through clean energy to implement green initiatives.

Building green economy can be achieved by inculcating green skills and environment-friendly practices that require technical skills, knowledge, critical thinking and a problem-solving approach.

The important components of Green Economy are:

- *Renewable energy:* Renewable energy is a form of energy which is produced by renewable resources like wind, sunlight, water, geothermal heat, etc. Using these alternative green energy sources contributes to lowering the impact on the environment caused by the depletion of non-renewable sources of energy.

- *Green building and green transportation:* This includes the construction of buildings and developing a well-planned transportation system with minimum damage to the environment and forests. Green transportation ensures the use of fuel that produces minimum greenhouse gases and pooling, promoting alternative sources of energy and fuel like CNG, battery, etc. Green transportation lowers dependency on fossil fuels, is cheaper and helps in keeping the environment clean.
- *Waste management:* It means managing waste by following 4R's—Refuse, Reduce, Reuse and Recycle—and 1U—Upcycle—for minimal environment degradation.
- *Land management:* It relates to using land as a resource judiciously in terms of soil, forests and trees, farms, roads, etc., without causing harm to the environment.
- *Water management:* Water management means to reduce water wastage and replenish groundwater level by adopting rainwater harvesting mechanism for future use. Using rainwater for agriculture and wastewater for washing and cleaning purposes proves to be an effective mechanism for reducing water wastage which is responsible for the scarcity of water.

Ans 8. The need to develop green economy arises from the fact that it will help in conserving resources for future generations with improved social well-being and reduced environmental risks that will promote economic growth of a country, eradicate poverty and reduce carbon emissions and ecosystem degradation; In a green economy, growth in employment and income are driven by public and private investment into such economic activities, infrastructure and assets that allow reduced carbon emissions and pollution.

Ans 9. Green buildings refer to the construction of buildings and developing a well-planned transportation system with minimum damage to the environment and forests.
Green buildings support green economy by contributing effectively in the following areas:

- Wastewater treatment
- Using renewable energy (solar power and wind energy)
- Rainwater harvesting
- Use of clean energy and focusing on conserving energy
- Reducing all types of pollution, mainly air, water and soil

Ans 10. Air pollution is one of the most pressing environmental issues of our time. It not only affects the environment but also has a significant impact on human health. In recent years, there has been a growing awareness of the role of technology in reducing air pollution, which include:

- *Renewable energy sources like solar, wind and hydro power*—they can significantly help to reduce the amount of pollution generated by traditional power plants.
- *Electric vehicles*—they produce significantly less air pollution than traditional cars running on gasoline or diesel.
- *Air quality sensors*—these devices measure the levels of pollutants in the air and can help identify areas with high levels of pollution, allowing authorities to take action to reduce pollution levels.
- *Air quality maps*—they provide a visual representation of the levels of pollution in different areas and allow people to make informed decisions about their outdoor activity and take action to reduce pollution levels.

Ans 11. Upcycle means that a safe and eco-friendly alternative should be used in place of a non-biodegradable substance. Also, any product that is not usable can be upcycled with creativity and innovation. For example, using a cloth bag instead of a polythene bag.

Ans 12. A few green projects taken up in India for building a green economy include:

(*i*) Digital Green aims at rural education, promoting education in rural areas through smart classrooms and video-based learning.

(*ii*) Waste management and vermicomposting. Vermicomposting is a faster method for reducing organic waste than traditional composting. This approach utilizes the action of earthworms as well as bacteria to break down organic waste. The resultant material (vermicompost) can be a highly effective fertilizer or soil conditioner.

(*iii*) Making solar energy accessible by providing customized solutions to industry clients.

(*iv*) Banyan Nation is an initiative to work towards a pollution-free environment by collecting plastic waste from industries and recycling it for further use.

(*v*) Bio toilet by Green Solution Foundation is an eco-friendly toilet. Its working is based on using aerobic bacteria. Its tank converts human waste into standard compatible water, which is used for flushing and even for irrigation.

Ans 13. Green skills aim at developing a framework for building and managing a sustainable green economy. Learning green skills is an important and indispensable method to enhance knowledge, abilities, values and attributes to develop and support organizations that focus on saving the environment and improving it to support life systems.

Some prominent areas in which green skills contribute to building a sustainable economy and improving environmental conditions are as follows:

- Wastewater treatment
- Using renewable energy (solar power and wind energy)
- Rainwater harvesting
- Green buildings and transportation
- Use of clean energy and focusing on conserving energy
- Reducing all types of pollution, mainly air, water and soil

Building green economy can be achieved by inculcating green skills and environment-friendly practices that require technical skills, knowledge, critical thinking and a problem-solving approach.

Decoding Artificial Intelligence
Teacher's Manual
Book IX

SUBJECT-SPECIFIC SKILLS

CHAPTER 1: AI Reflection, Project Cycle and Ethics

Unsolved Questions

Ans 1. Artificial Intelligence (AI) refers to machines simulating human intelligence to perform tasks like understanding language, recognizing patterns and solving problems. AI is used in various daily applications. In healthcare, AI aids in diagnosing diseases and analyzing medical images. In transportation, it powers self-driving cars and optimizes routes. A notable example in agriculture is Plantix, an AI app that helps farmers diagnose plant issues and recommend treatments. AI is also behind virtual assistants like Siri and Alexa, which manage tasks like setting reminders and controlling devices.

Ans 2. AI Access means making Artificial Intelligence (AI) tools and resources available to everyone, regardless of their background, income or location. It includes ensuring that people can afford, understand and use AI, and that it supports different languages and cultures. It helps in boosting growth, reducing inequality, empowering communities and preventing power monopolies.

Ans 3. AI Bias happens when an AI system makes unfair or prejudiced decisions. This bias often comes from the data used to train the AI, which can reflect real-world inequalities. If the data or how it is labelled has certain biases, the AI might make unfair choices. For example:

(*i*) *Facial Recognition:* If an AI is trained mostly on lighter-skinned faces, it may struggle to recognize darker-skinned faces accurately.

(*ii*) *Hiring Tools:* An AI trained on past resumes from a male-dominated industry might prefer men over equally qualified women for new jobs.

Bias in AI is an issue because it can lead to unfair treatment. It can be minimized by using diverse data and carefully checking AI decisions.

Ans 4. Artificial Intelligence (AI) can transform smart cities by improving traffic management, resource efficiency, public safety, healthcare and environmental monitoring. However, it comes with challenges such as high costs, privacy concerns, job losses, technical failures and cybersecurity risks. Despite these, AI has great potential to create smarter and more sustainable cities if challenges are addressed effectively.

Ans 5. AI can support the United Nations Sustainable Development Goals (SDGs) in various ways. It helps reduce poverty (SDG 1) by identifying resource gaps, promote agriculture (SDG 2) by detecting pests, and enhances healthcare (SDG 3) through early disease diagnosis. AI boosts education (SDG 4) with personalized learning, supports clean water (SDG 6), and promotes renewable energy (SDG 7). It aids smart cities (SDG 11), tracks climate change (SDG 13) and protects oceans (SDG 14) and wildlife (SDG 15).

Ans 6. AI presents ethical concerns such as bias, where unfair decisions may arise from biased training data and privacy issues, as AI relies on large amounts of personal data that could be misused or stolen. It may also lead to job losses through automation, causing unemployment and poses cyber security risks, if hacked. Additionally, lack of transparency in AI decision-making can make it hard to understand or challenge its outcomes.

Ans 7. AI is classified into Weak AI and Strong AI.

(*i*) *Weak AI:* Also known as Narrow AI, it is designed for specific tasks, *e.g.*, Siri, Alexa or recommendation systems on Netflix.

(*ii*) *Strong AI:* Also known as General AI, it doesn't yet exist. It would be able to think and reason like humans, capable of solving any task. Some fictional examples of Strong AI include Skynet from *The Terminator* and Ava from *Ex Machina*.

Ans 8. Data privacy is essential in AI to protect personal information and prevent its misuse. Risks include identity theft, financial fraud or misuse of sensitive data. For example, leaked health data could expose private details or social media could exploit personal data without consent. Strong regulations and secure systems are vital to ensure trust and safety in AI applications.

Ans 9. The three domains of AI are as follows:

(*i*) *Data Science:* It analyzes the patterns and trends available in our data using various statistical and mathematical methods. For example, if a company wants to know which flavours of ice cream are most popular, it can use data science to analyze sales data from ice-cream shops.

(*ii*) *Natural Language Processing:* It helps in understanding and generating human language using advanced techniques for tasks like language translation and sentiment analysis. For example, asking your voice assistant, "How is the weather today?" and getting the weather forecast.

(*iii*) *Computer Vision:* It gathers and processes the information available in images or videos. For example, when your phone unlocks itself by scanning your face, it uses computer vision.

Ans 10. The AI project lifecycle consists of key stages to develop and deploy AI solutions effectively. Its structure is as follows:

(*i*) *Problem Scoping:* Defines the problem and goals the AI will address.

(*ii*) *Data Acquisition:* Gathers relevant and quality data for training the AI.

(*iii*) *Data Exploration and Preprocessing:* Cleans, processes and formats the data for analysis.

(*iv*) *Modelling:* Chooses or builds an AI model and trains it using the data.

(*v*) *Evaluation:* Tests the model for accuracy and ensures it meets the objectives.

(*vi*) *Deployment:* Implements the AI system in real-world environment.

Ans 11. During the Problem Scoping stage of an AI project, a problem statement template helps define the issue, context and the desired outcomes. It includes identification of problem, gathering information, defining objectives, analyzing causes and identifying ethical issues. This ensures that all stakeholders have a clear understanding, aligning the project's objectives and constraints effectively.

Ans 12. Data acquisition is the process of collecting and preparing data from various sources to use in an AI project. It is a crucial step because high-quality data forms the foundation of AI models, enabling them to learn and make accurate predictions. Proper data acquisition ensures the data is clean, relevant and free from biases, which is essential for the performance and reliability of the AI system.

Ans 13. Common sources of data for AI projects include sensors, databases, APIs, surveys, IoT devices, cameras and user-generated content like reviews and feedback. Sensors capture real-time data from the physical world, while databases store structured information for training AI models. APIs provide access to external data and surveys collect insights from specific groups. IoT devices offer data from interconnected systems, cameras capture visual data for tasks like image recognition, and user-generated content helps refine AI systems with feedback and opinions.

Ans 14. Data exploration is the process of analyzing and visualizing data to understand its structure, patterns and key characteristics. It helps identify trends, relationships, anomalies and missing values in the dataset. This step is essential in the AI project lifecycle because it ensures the data is suitable for building effective models, helps refine problem understanding and guides the selection of appropriate algorithms and preprocessing techniques.

Ans 15. System maps are visual diagrams that represent the components, relationships and interactions within a system or process. In AI projects, system maps play a crucial role by providing a clear understanding of how data flows between various elements. They help stakeholders visualize the system's structure, identify dependencies and ensure alignment with the project's goals. By mapping out the system, areas for improvement can be identified early, leading to better implementation of AI solutions.

Ans 16. Artificial Narrow Intelligence (ANI) performs specific tasks and is limited to its predefined functions, *e.g.*, voice assistants or recommendation systems.

Artificial General Intelligence (AGI), which hasn't been achieved yet, would be able to think and learn like a human, handling a wide range of tasks.

Artificial Superintelligence (ASI) surpasses human intelligence in all areas, remaining a hypothetical concept with significant potential and risks.

Ans 17. The primary goal of Modelling phase in the AI project lifecycle is to develop and train algorithms that can analyze data, recognize patterns and make accurate predictions or decisions. This phase focuses on selecting and building models to ensure they effectively solve the problem defined in the project.

Rule-based AI relies on a set of predefined rules and logical conditions created by humans. It operates strictly within the boundaries of these rules and doesn't improve or adapt over time. It is ideal for structured and predictable problems.

Learning-based AI uses machine learning algorithms to train on data and improve performance over time. It can adapt, recognize patterns and make predictions without explicit programming. It is more flexible and powerful, especially for complex, data-driven tasks.

Ans 18. Evaluation in AI projects is crucial to ensure that the model meets the desired performance, aligns with objectives and functions reliably in real-world scenarios. It typically occurs after training to validate the model on unseen data and during deployment to monitor performance in real-world conditions.

Ans 19. The main purpose of deploying an AI model is to integrate it into a production environment where it can provide real-world value by automating tasks, making predictions or driving decisions. Deployment typically happens after the model has been trained and evaluated to meet performance requirements, marking the transition from development to operational use.

Ans 20. Data visualization is the graphical representation of data using charts, graphs and other visual tools to make complex information easier to understand. Its purpose is to highlight trends, patterns and insights in the data.

Importance of data visualization in the process of data analysis is as follows:

(*i*) *Simplifies Complex Data:* Makes large datasets easier to interpret.

(*ii*) *Identifies Patterns and Trends:* Helps uncover relationships and outliers quickly.

(*iii*) *Improves Communication:* Presents insights in a clear and impactful way for stakeholders.

(*iv*) *Aids in Decision-Making:* Provides actionable insights to guide strategies and solutions.

Ans 21. Charts used to present parts-of-a-whole relationships include pie charts, donut charts and stacked bar charts.

Advantages of using these charts include the following:

(*i*) Help in quick decision-making.

(*ii*) They are easy to understand for small datasets.

(*iii*) Stacked bar charts allow comparison across multiple groups.

Precautions to be taken while using these charts are as follows:

(*i*) Avoid too many categories to prevent clutter.

(*ii*) Ensure clear labels and distinct values.

(*iii*) Use appropriate chart types for the data to ensure accurate interpretation.

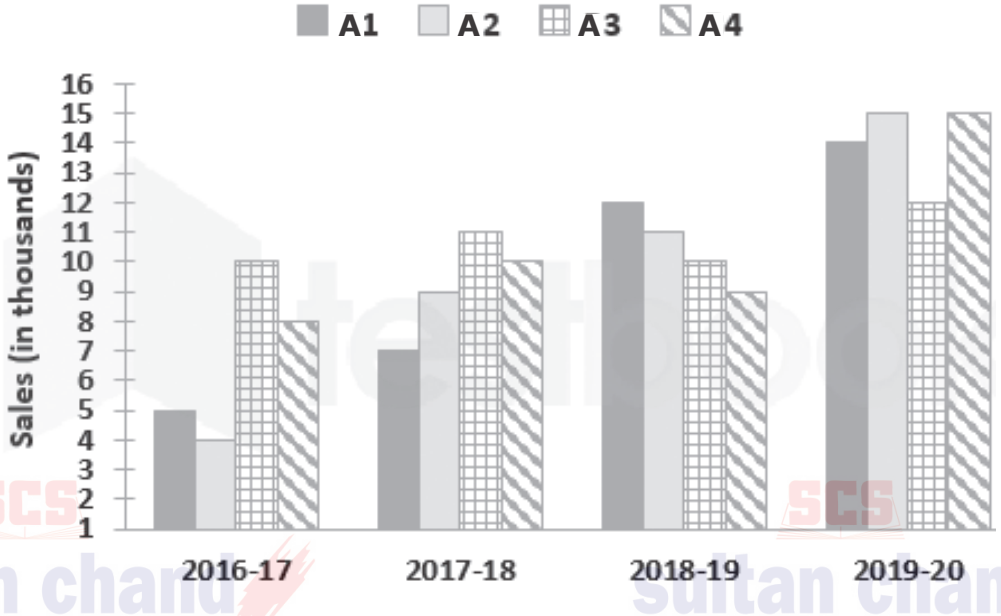
Ans 22. A scatter plot is used to visualize the relationship or correlation between two numerical variables by plotting data points on a two-dimensional graph. It is particularly useful for identifying patterns, trends, clusters and outliers in the data. The main advantage of a scatter plot is its ability to clearly show how variables relate to each other. However, precautions should be taken to ensure the axes are properly scaled and data points are not overcrowded.

Ans 23. Legend in charts is a key that explains the meaning of colors, symbols or patterns used to represent different data categories or series. It enhances clarity and makes the visualization easier to interpret by linking visual elements to their respective data. A well-designed legend ensures the chart is accessible and helps communicate information effectively, especially in multi-category visualizations.

Ans 24. Different types of bar charts are as follows:

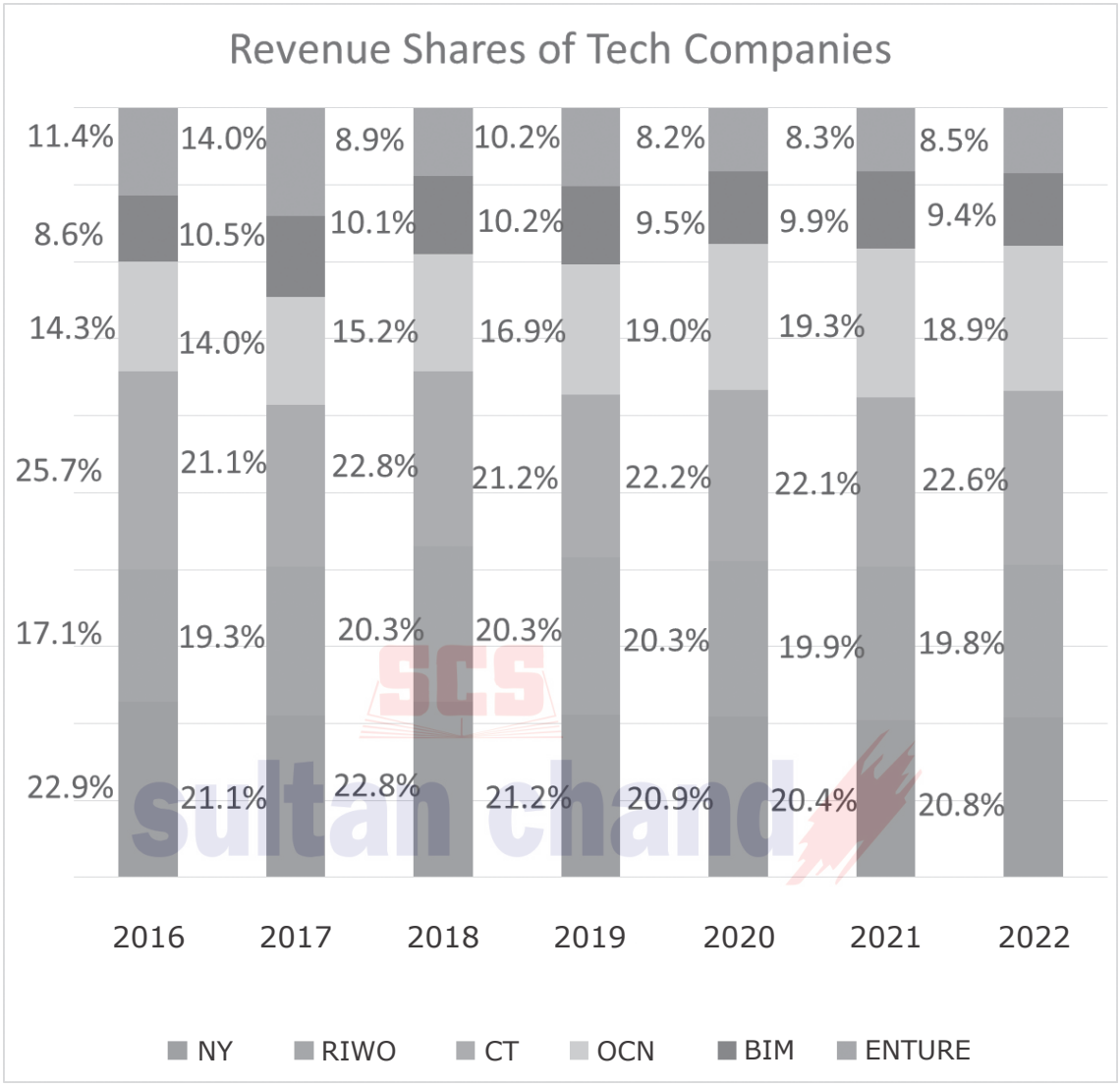
(*i*) *Simple Chart*: It represents a single variable using rectangular bars, where height (or length) indicates the value.

For example, a chart showing sales figures for different products.



(*ii*) *Stacked Bar Chart*: It shows the composition of each category by stacking sub-group bars on top of each other.

For example, see the below-given chart representing the revenue share of some Tech companies.



Ans 25. Single Variable Plots focus on analyzing one variable at a time, showcasing its distribution, central tendency or spread. Examples include histograms, box plots and bar charts. They are ideal for understanding a single dataset's characteristics like frequency or range.

Multivariate Plots, on the other hand, analyze relationships among two or more variables. They are used to identify patterns, trends or correlations. Examples include scatter plots, heatmaps, pair plots and parallel coordinates.

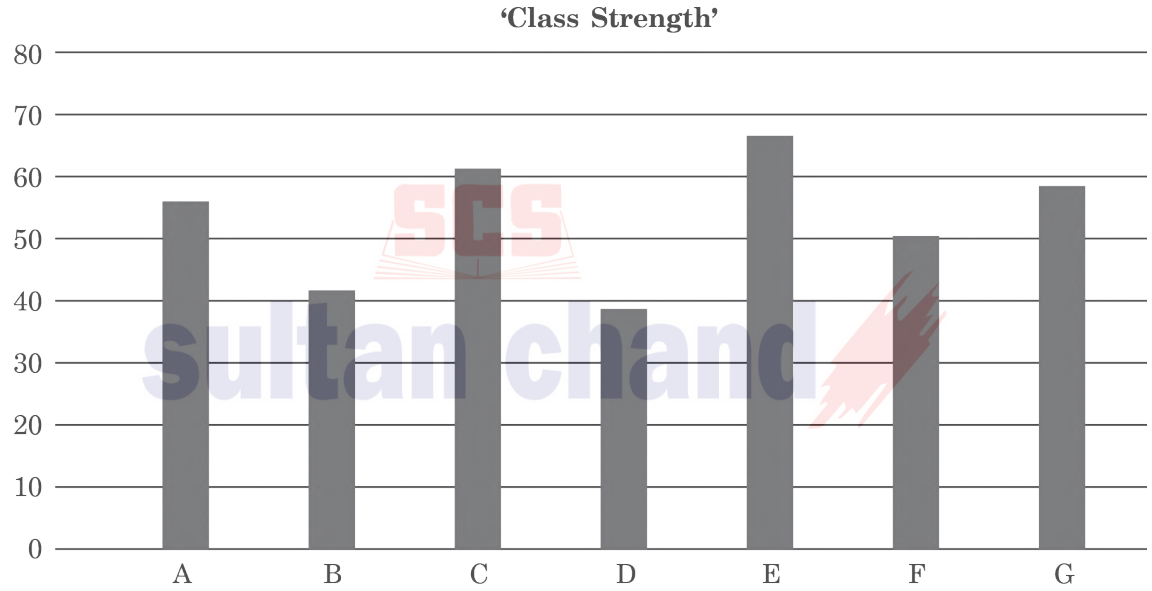
Visualizations like scatter plots, heatmaps and 3D plots are commonly associated with multivariate data as they allow multiple variables to be represented in a single chart for comparative analysis.

Ans 26. Exploratory Data Analysis (EDA) is the process of analyzing and summarizing datasets to uncover patterns, relationships and anomalies. It helps understand the data's structure, clean it and prepare it for modelling, often using visualizations and statistical techniques.

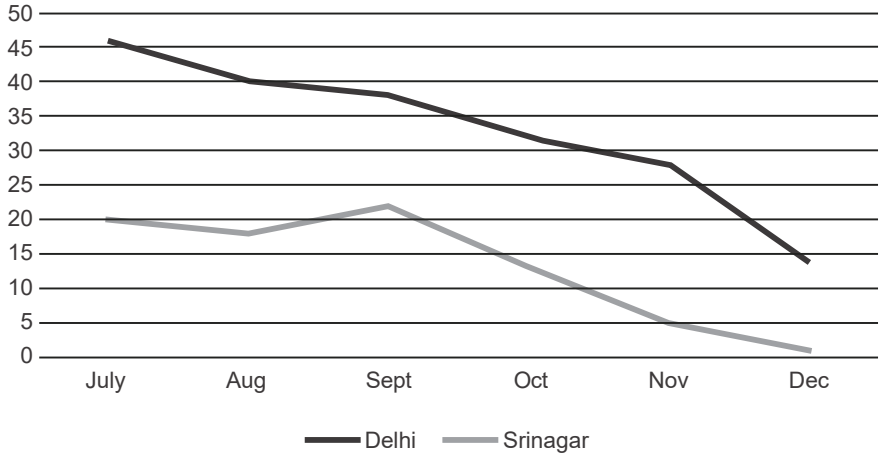
Ans 27. The table for the given data, along with the built-in function to show the section with the minimum strength, is as follows:

Section	Strength
A	56
B	42
C	62
D	39
E	67
F	51
G	59
Minimum Strength:	=min(D4:D10)

The following is the bar chart for the given data:



Ans 28. The following line chart visualizes comparison for the given data:



Ans 29. Data privacy is essential to protect individuals from identity theft, fraud and unauthorized access to sensitive information. It ensures control over personal data, safeguards rights and builds trust between users and organizations. Strong privacy measures are crucial to prevent misuse of data and maintain confidence in technology.

Ans 30. Ethics are crucial in personal and professional life as they provide a moral framework that guides individuals in distinguishing right from wrong. They foster trust, accountability and fairness in interactions. In decision-making, ethics influence choices by encouraging individuals to consider the broader impact of their actions on others and the environment. Ethical behaviour enhances integrity, builds credibility and promotes a positive reputation, ensuring long-term personal and professional success. Without ethics, decisions may prioritize short-term gains over long-term values.

Ans 31. When a company mishandles customer data, leading to a breach of privacy, it violates ethical principles such as confidentiality, trust and accountability. Customers' personal information is exposed, risking identity theft or financial fraud. To rectify the situation, the company should acknowledge the breach, strengthen data security, adopt transparency, train employees and comply with privacy laws.

Ans 32. Spreading misinformation and manipulating public opinion on social media violates ethical principles of honesty and public trust, leading to social unrest and harm to democratic processes. Individuals are responsible for verifying information before sharing and reporting false content while platforms must implement moderation, fact-checking and transparency in algorithms to prevent misinformation.

Ans 33. When AI systems gain too much control, ethical concerns—loss of autonomy, bias, privacy violations and accountability—arise. To ensure AI remains under human control, society must establish ethical guidelines, enforce regulations, ensure human oversight and design systems with fail-safes. Promoting AI literacy empowers individuals to understand and manage AI responsibly, ensuring it serves humanity without compromising rights or values.

Ans 34. Three key ethical principles that guide the development and implementation of AI technologies are:

(*i*) *Fairness and Bias Mitigation:* AI technologies must be designed to minimize biases in data and algorithms to ensure fair treatment of all individuals, regardless of race, gender or background.

(*ii*) *Respect for Human Rights:* AI systems should uphold fundamental human rights, including dignity, freedom and equality. They must not be used for activities that harm individuals or groups.

(*iii*) *Privacy Protection:* AI systems must prioritize user privacy by ensuring that personal data is collected, stored and used responsibly. Strong data encryption, consent-based practices and compliance with regulations are essential to safeguard individuals' privacy.

Ans 35. The process of evaluating and deploying a machine learning model involves testing its performance on unseen data to assess accuracy, robustness and fairness. Evaluation ensures that the model meets the desired metrics and aligns with the problem's goals. Deployment involves integrating the model into real-world environment, monitoring its performance and updating it as needed. These steps are crucial to ensure the model functions effectively, avoids biases and adapts to changing conditions, ultimately delivering reliable and ethical outcomes in real-world applications.

Ans 36. Different ML tasks need different metrics to match their goals. Classification uses metrics like accuracy, precision and recall to evaluate discrete predictions while regression uses MSE, MAE and R^2 to assess continuous value predictions. Proper metrics ensure accurate performance evaluation.

Ans 37. Train-test split method of evaluation divides data into training and testing sets to train the model and evaluate its performance on unseen data. This prevents overfitting, ensures generalization and provides a reliable performance estimate.

Ans 38. Cross-validation splits data into multiple subsets, training and testing the model on different combinations. Unlike train-test split, it uses the entire dataset for evaluation, reducing bias and variability. It provides a more reliable assessment of the model's performance by testing it on multiple data splits, ensuring better generalization.

Ans 39. Confusion matrix is a table showing the performance of a classification model by comparing the actual and predicted values. Its components are:

(*i*) *True Positives (TP):* These are the correctly predicted positive cases.

(*ii*) *True Negatives (TN):* These are the correctly predicted negative cases.

(*iii*) *False Positives (FP):* These are the incorrectly predicted positive cases.

(*iv*) *False Negatives (FN):* These are the incorrectly predicted negative cases.

It helps evaluate model accuracy, precision, recall and F1 score, giving a detailed view of prediction errors.

Ans 40. ROC curve (Receiver Operating Characteristic) plots the True Positive Rate (TPR) against the False Positive Rate (FPR) at different thresholds. It evaluates a classification model's ability to distinguish between classes. A model with a curve closer to the top-left corner performs better and its performance is quantified using the AUC (Area Under Curve) score.

Ans 41. AUC (Area Under Curve) represents the overall ability of a model to distinguish between classes in an ROC curve. A higher AUC value indicates better performance as it shows the model has a higher true positive rate and lower false positive rate across thresholds, making it more reliable.

II. Case-Based/Application-Based Questions

(*a*) The first thing that stands out in the graph is that global average temperatures have been steadily increasing over time. From 1880 to about the mid-20th century, the temperatures were mostly below the average of the 20th century (shown in blue). However, from around 1980 onwards, there is a clear and sharp rise in temperatures, with recent years (especially after 2000) showing temperatures significantly above the 20th century average (shown in orange). This indicates a clear trend of global warming.

(*b*) The Sustainable Development Goal most closely associated with this visualization is **SDG 13: Climate Action**. This goal focuses on taking urgent action to combat climate change and its impact.

The following efforts can help reverse the trend:

- Reducing energy consumption by using energy-efficient appliances and switching off lights and devices when not in use.
- Using public transport, cycle or walk instead of using private vehicles to reduce carbon emissions.
- Supporting and using renewable energy sources such as solar, wind or hydro power.
- Planting more trees and supporting afforestation and reforestation initiatives.
- Reducing, reusing and recycling materials to minimize waste and lowering our carbon footprint.
- Raising awareness about climate change and encouraging others to adopt sustainable practices.
- Supporting policies and leaders who prioritize climate action and environmental protection.

By making these efforts, individuals and communities can contribute to slowing down and eventually reversing the trend of rising global temperatures shown in the graph.

CHAPTER 2: Data Literacy

Unsolved Questions

Ans 1. Data literacy is the ability to read, understand, create and communicate data as information. It is important in the modern world because:

(*i*) It helps us understand that different types of data may have good or poor quality, *i.e.*, the data may be reliable or unreliable.

(*ii*) It helps us understand that different types of data carry different values or significance.

(*iii*) It makes it easier to understand how data is collected and presented.

Ans 2. Data refers to raw facts and figures that are unprocessed and do not possess any meaning, *e.g.*, a list of numbers (1, 2, 3, 4, 5…). On the other hand, information is processed data that has been organized, structured and presented in a meaningful context, *e.g.*, if we add 'Roll Number' as context to the list of numbers, then the data becomes information.

Ans 3. DIKW model is a pyramid-shaped model of knowledge management which represents the relationship between Data, Information, Knowledge and Wisdom.

The significance of each component is as follows:

(*i*) Data is the main component of the DIKW model and consists of raw facts, figures, etc.

(*ii*) Information is processed data and is used to convey meaning within a specific context.

(*iii*) Knowledge provides a deeper understanding that is gained through interpreting the information.

(*iv*) Wisdom is the highest level of the DIKW model and helps in decision-making.

Ans 4. Quantitative data refers to data values that can be measured, counted and compared with each other on the basis of quantity. For example, the age of a person, the number of pages in a book, the mileage of a vehicle, etc. On the other hand, qualitative data refers to data values that can depict the quality, properties or the distinguishing characteristics to be classified into one out of the two or more categories. For example, color of the eyes, name of the author of a book, type of vehicle, etc.

Ans 5. Discrete data consists of discrete values that are whole numbers and cannot be subdivided further. For example, the number of students in a classroom, the number of items sold in a store, etc. Continuous data represents measurements that can take any value within a range and can be infinitely subdivided into small increments. For example, the height and weight of individuals, temperature readings, etc.

Ans 6. Categorical variables are variables that are used to classify data into different categories or types. For example, if we are making a classifier that classifies if the vegetables shown in the images are rotten or not, then categorical variable will have two values, *i.e.*, 'rotten' and 'not rotten'.

Ans 7. Common methods of data collection and acquisition include the following:

(*i*) Surveys, polls and questionnaires to gather direct responses from people

(*ii*) Interviews for in-depth insights

(*iii*) Feedback forms to collect user input

(*iv*) Observations for real-world data collection

(*v*) Existing datasets from public or proprietary sources

(*vi*) Sensors to capture real-time data from physical environments

Proper data collection is essential for ensuring accuracy, reducing bias, improving reliability and meeting legal and ethical standards in AI projects.

Ans 8. Data cleaning and preprocessing is an important step before the process of data analysis. It involves cleaning, transforming and preparing raw data into a usable format for analysis. This step is important for any data analysis project because it ensures that the data is of high quality with low errors and consistency, which help perform accurate analysis.

Ans 9. Two major statistical methods used in data analysis and their purpose are as follows:

(*i*) *Descriptive Statistics:* It is used to describe and summarize data. It provides the measure of central tendency, *i.e.*, mean, median and mode.

(*ii*) *Inferential Statistics:* It is used to make inferences or predictions. It involves methods such as hypothesis testing, regression analysis, etc.

Ans 10. Data visualization is a process in which we visualize data using tools like Power BI, Tableau, etc. It is important because it helps in understanding trends, outliers or pattern formation in the data.

Three types of graphs used in data visualization are:

(*i*) *Bar Graphs*: They represent data using vertical and horizontal bars with the length proportional to the value of data.

(*ii*) *Pie Charts*: They are representations of the parts of a whole. Since these charts are shaped like pies, they are called pie charts. Each slice of the pie represents the portion allocated to a specific category.

(*iii*) *Line Graphs*: They are created by connecting various data points. Line graphs are created to show the change in quantity over time.

Ans 11. Critical thinking helps in effective data literacy because it enables users to analyze data objectively, identify biases and evaluate the validity of sources. It also helps in interpreting data accurately, making informed decisions and solving problems effectively. It further ensures that data is used responsibly and accurately, leading to better outcomes.

Ans 12. Ethical considerations in data handling include privacy, accuracy and transparency. Ensuring privacy refers to protecting the personal information of individuals. Accuracy helps in curbing misinformation and transparency helps in building trust in the AI model.

These considerations are important to maintain public trust and prevent harm that can be caused due to the misuse of data.

Ans 13. Data mindset refers to viewing problems through the point of view of data, emphasizing proof-based decision-making. It influences problem-solving by encouraging a systematic approach to decision-making by first gathering relevant data, then analyzing it and making decisions.

Ans 14. Describing data is the ability to understand and describe data, including understanding concepts such as how data is categorized into data types and the way it is stored using variables, datasets and data structures.

It helps in a better understanding of data by identifying the trends and outliers present in the data. It also simplifies large datasets by summarizing them.

Ans 15. Primary data sources are the sources where the data is collected first-hand by individuals for creating an AI model. For example, data gathered from surveys, questionnaires, experiments, observations, interviews, etc. On the other hand, secondary data sources are the sources where data is collected by someone else—you can buy it if it is closed source or use it for free if it is open source. For example, sources like government datasets, datasets from online databases like Kaggle or UCI repositories, journals, research papers, etc.

Ans 16. Algorithms play a very important role in data processing and analysis by transforming the data into meaningful results.
For example, linear regression algorithm creates a relationship between a dependent variable and one or more independent variables. We can use it for several applications such as house price prediction based on size, location and other important features.

Ans 17. Data accuracy, consistency and completeness are the three main pillars of a good AI model. Accuracy tells whether the decisions being made by the model are accurate, unbiased and informed. Consistency helps to maintain consistent data, *e.g.*, each feature of the same domain, and aids in keeping data free from outliers. Completeness ensures that the data is free from missing values. Together, they provide trustworthy and data-driven conclusions.

Ans 18. Data literacy enhances decision-making across the given fields in the following ways:
(*i*) *Healthcare*: Data literacy helps analyze patient data which aids in accurate diagnosis and personalized treatment.
(*ii*) *Education*: Through data literacy, we can create educational experiences as per the needs of a student and identify the areas for improvement.
(*iii*) *Business*: Data literacy helps in identifying market trends and customer behaviour. It also helps in optimizing business by identifying the areas for improvement.

Ans 19. To protect sensitive information, some common data security measures that can be taken are:
(*i*) Adding two-factor authentication to your accounts.
(*ii*) Using strong passwords with a combination of digits, letters and symbols.
(*iii*) Using an advanced encryption algorithm to encrypt data.
(*iv*) Applying firewalls to the outgoing and incoming network traffic.
(*v*) Ensuring the use of updated software.
(*vi*) Using the latest anti-virus software.

Ans 20. Individuals and governments can both respond to crises such as COVID-19 if they are data literate because:
(*i*) Understanding vaccination efficiency will lead individuals to make personalized decisions to protect themselves from the virus and will lead governments to make policies to control the spread of the virus.
(*ii*) Data literacy can help them know whether the data is obtained from a valid source or an unreliable source, which reduces the spread of misinformation.

Ans 21. Real-time data monitoring means tracking data continuously or automatically. This helps in real-time data analysis as well as in decision-making.
Some benefits of real-time data monitoring are:
(*i*) *Issue Detection and Resolution*: Real-time monitoring can detect and address issues immediately. For example, sensors in a machine can track parameters like temperature and pressure. If these exceed the machine's capacity, the machine can be turned off or adjustments can be made to the environment for optimal operation.
(*ii*) *Traffic Management and Scalability*: Real-time monitoring allows scaling resources up or down based on traffic changes to ensure continuous availability. For instance, AI algorithms can analyze traffic data to predict resource requirements, adding resources during traffic spike and reducing them during low traffic periods.

Ans 22. Government initiatives provide different rules, regulations and frameworks that help in enhancing data privacy and security, thus protecting the personal data of individuals. One such initiative is the Digital Personal Data Protection Act 2023. This Act emphasizes obtaining informed consent from individuals before processing their personal data. Through this, we have the right to know how data is being collected, used and stored. Based on this information, we can choose to give or withhold our consent.

Ans 23. Some challenges in data collection and their possible solutions are given below:

(*i*) *Poor quality of data*: This challenge can be overcome by standardizing the data collection process and ensuring that a knowledgeable person is employed for data collection.

(*ii*) *Missing values or human errors*: This challenge can be overcome by performing exploratory data analysis on the data.

(*iii*) *Privacy issue in data*: This challenge can be overcome by properly anonymizing the data before it is used so that it does not reveal the identity of the person.

(*iv*) *Securing the data*: To secure sensitive data, it must be encrypted and must be protected by a firewall.

Ans 24. The following steps are involved in the process of data interpretation:

(*i*) Understanding the data

(*ii*) Cleaning and pre-processing the data

(*iii*) Exploring the data by applying exploratory data analysis

(*iv*) Visualization

(*v*) Pattern recognition

Data interpretation is important because it helps to transform raw data into meaningful insights, which help in informed decision-making and planning.

Ans 25. To develop data literacy skills, start by learning basic statistics to understand averages, probabilities and distributions, which are crucial for interpreting data accurately. Consider the following steps to develop data literacy skills:

(*i*) Familiarize yourself with data tools like Excel or Tableau to analyze and visualize data effectively.

(*ii*) Regularly practise interpreting different datasets to enhance critical thinking and analytical skills.

(*iii*) It is also important to evaluate data sources to ensure reliability and avoid misinformation.

(*iv*) Finally, taking online courses on data analysis and visualization can provide structured learning and deeper insights.

Ans 26. Tableau Desktop is a full-fledged paid version of Tableau that offers a wide range of functionalities. It allows us to perform complex data analysis and create sophisticated visualizations. On the other hand, Tableau Public is a free version with limited features. We can connect to common data sources like spreadsheets and certain cloud platforms, create basic to moderate visualizations and publish them publicly on Tableau Public platform.

Ans 27. The key features of Tableau that make it a powerful tool for data visualization are as follows:

(*i*) It is easy to use because all the elements can be dragged and dropped from one location to another.

(*ii*) We can connect it with real-time data, which makes it easy to work with.

(*iii*) It provides us with advanced data analysis techniques which make it easy to explore, manipulate and analyze the data.

(*iv*) It offers quick data processing which helps us handle large datasets efficiently.

Ans 28. Dimensions in Tableau are the labels or categories that are used for organizing data. They are qualitative fields, *e.g.*, names, dates, etc. Measures in Tableau are the numbers that can be calculated or the aggregate functions that can be applied. They are quantitative fields, *e.g.*, amounts, profits, etc.

CHAPTER 3: Mathematics for AI (Statistics & Probability)

Unsolved Questions

Ans 1. AI tries to identify patterns in arithmetic and geometric sequences, which helps in predicting the upcoming values in the future.

For example, if we try to feed an AI algorithm with an arithmetic sequence like 2, 4, 6, 8, 10, … and a geometric sequence like 2, 4, 8, 16, 32, …, then the AI algorithm will find a pattern and will be able to predict the upcoming values.

Ans 2. Statistics is a special branch of Mathematics associated with collecting and organizing facts and figures.

Large volumes of unorganized data do not make sense on their own. However, when statistical tools are applied, we may obtain a wealth of information that will be used to make important decisions in problem-solving.

Ans 3. Descriptive statistics is a branch of Statistics that tells us about the properties of data which helps us understand it, *e.g.*, summarizing the test report of a class. On the other hand, inferential statistics deals with the prediction of the future with the help of probability, *e.g.*, estimating the height of all students in a school based on a sample.

Ans 4. Statistics and Probability are considered the foundations of AI. Every AI algorithm depends on statistical methods to identify patterns and relationship within datasets. Probability theory helps AI systems make predictions based on uncertainty. Thus, Mathematics contributes to the development and functioning of AI.

For example,

(*i*) In healthcare, AI models use statistical analysis to predict patient outcomes, which helps to optimize the step-by-step planning of the treatment.

(*ii*) In finance, probabilistic models assess risks and detect fraud activities.

(*iii*) In self-driving vehicles, probabilistic algorithms are in continuous use, thus helping in safe navigation by predicting and responding to the frequently changing environment.

Ans 5. Certain events are events that are going to happen for sure, *e.g.*, day turning into night. Likely events are events that have a high probability of happening, *e.g.*, the possibility of rain in the monsoon season.

Ans 6. (*a*) $5x + 10 = -2$ is a valid equation because it has equal to (=) sign which indicates that the value of the expression '$5x + 10$' is equal to '-2' for some value of 'x'.

Options (*b*), (*c*) and (*d*) are not valid equations because they are valid expressions.

Ans 7. In Statistics, the process of data collection includes defining a clear objective (what information is needed), choosing reliable sources of data, selecting an appropriate method of data collection and gathering data. The process of data organization includes data cleaning, structuring, summarizing and visualizing.

These processes support data analysis by ensuring accurate, reliable and fast data analysis by providing high quality, efficient and insightful view of the data.

Ans 8. Mathematics is the backbone of Artificial Intelligence and is essential for developing the algorithms of AI. The branches of Mathematics like linear algebra, calculus, probability theory and statistics are crucial for the optimization and designing of AI models. AI uses computational power to solve complex mathematical problems, which help to make predictions, classification, etc.

Ans 9. The differences between dot plot, tally chart, frequency and histogram are as follows:

(*i*) *Dot Plot*: A dot plot is a simple visual tool that displays data points on a number line. It is used when we have a small dataset, *e.g.*, plotting the number of students entering the library each hour.

(*ii*) *Tally Chart*: A tally chart uses tally marks to record the frequency of data occurrences. It is suitable during surveys or when we have to quickly organize and collect data. In this, we use tally marks to count the number of occurrences, *e.g.*, making a count of the subject that students like the most.

(*iii*) *Frequency*: Frequency refers to the number of times a particular observation appears in a dataset. It is suitable for surveys and when we have to quickly organize and collect data. In this, we use numbers to count occurrences, *e.g.*, asking students their favourite playground activity and recording the one occurring most frequently.

(*iv*) *Histogram*: Histogram is a graphical representation that shows the distribution of numerical data using bars. Large datasets should visualize the frequency of data points between a particular interval using a bar graph-like representation. For example, showing the distribution of marks in a class with scores grouped into ranges like 0–10, 11–20 and so on.

Ans 10. Probability is a branch of Mathematics that deals with the likelihood of events occurring. In AI, it is crucial for handling uncertainty and making predictions. Probability helps algorithms assess the likelihood of different outcomes, enabling models to make informed decisions even with incomplete or noisy data. Understanding probability allows AI systems to improve predictions over time by updating beliefs based on new information, enhancing their accuracy and effectiveness in tasks like classification, forecasting and decision-making.

Ans 11. Probability Theory in AI calculates the uncertainty which helps in making decisions and predictions. Probability helps you understand the reasons behind the patterns you see in data and use those insights to make an educated guess about what may come next.

For example, if we are making a classification model, then we get the probability of a data point being in different classes and the class with the highest probability is selected.

Ans 12. Sample Space is the set of all possible outcomes of an experiment. To calculate probability, we divide the favourable outcomes of an event by the total number of outcomes in a sample space.

For example, Experiment: Rolling a die

Event: Getting a number greater than 4

Favourable Outcomes: 5, 6

Sample Space (Possible Outcomes): 1, 2, 3, 4, 5, 6

$$\text{Probability} = \frac{\text{Number of Favourable Outcomes}}{\text{Number of Possible Outcomes}} = \frac{2}{6} = 0.33$$

Ans 13. Calculating the probability of rolling an even number when a die is rolled once:
Event: Rolling an even number

Favourable Outcomes: 2, 4, 6. These are the required outcomes.

Sample Space (Possible Outcomes): 1, 2, 3, 4, 5, 6. These are all the possible outcomes.

$$\text{Probability} = \frac{\text{Number of Favourable Outcomes}}{\text{Number of Possible Outcomes}} = \frac{3}{6} = 0.5$$

Ans 14. Sample space:
(1, 1), (1, 2), (1, 3), (1, 4), (1, 5), (1, 6),
(2, 1), (2, 2), (2, 3), (2, 4), (2, 5), (2, 6),
(3, 1), (3, 2), (3, 3), (3, 4), (3, 5), (3, 6),
(4, 1), (4, 2), (4, 3), (4, 4), (4, 5), (4, 6),
(5, 1), (5, 2), (5, 3), (5, 4), (5, 5), (5, 6),
(6, 1), (6, 2), (6, 3), (6, 4), (6, 5), (6, 6)

Favourable outcomes: None

Also, we know that

$$\text{Probability} = \frac{\text{Number of Favourable Outcomes}}{\text{Number of Possible Outcomes}} = \frac{0}{36} = 0$$

So, the given statement is false because the probability is 0.

Ans 15. (*d*) Impossible

We can see that all the balls in the given collection are red, so there is a zero chance of picking a black ball from the collection.

Ans 16. (*a*) Equal probability event
(*b*) Equal probability event
(*c*) Unlikely event
(*d*) Unlikely event

Ans 17. Two examples of impossible events when two fair dice are thrown simultaneously are:
(*i*) Getting the sum of 19 by adding the front faces of the dice.
(*ii*) Getting a negative number on either of the two dice.

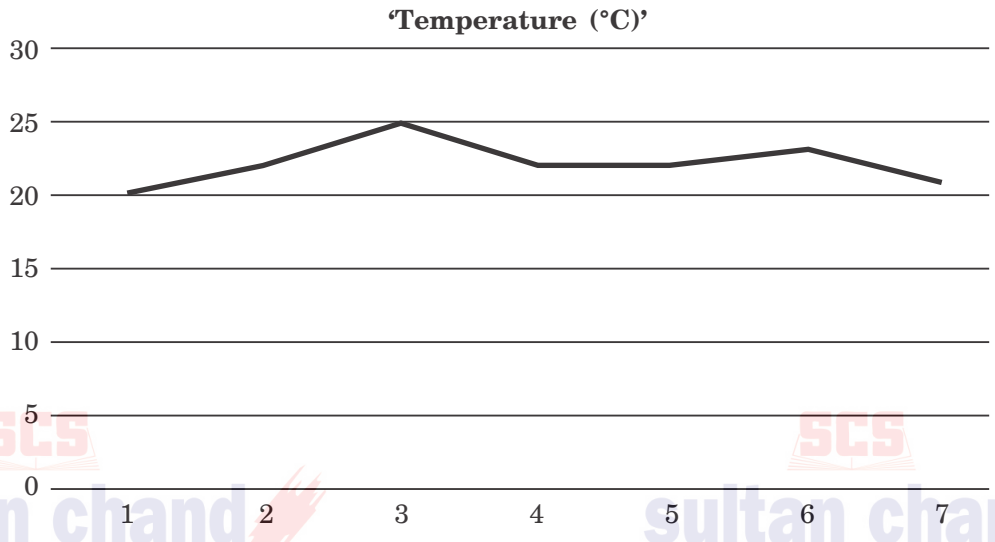
Two examples of equally likely events when two fair dice are thrown simultaneously are:
(*i*) Getting an even sum by adding the front faces of the dice.
(*ii*) Forming a two-digit number with that number being odd.

Ans 18. Mean is the sum of all the values in a dataset divided by the number of values.
Median is the middle value of the ordered dataset.
Mode is the value that appears most frequently. For example, if we have the following data:
1, 2, 2, 3, 3, 3, 2, 2, 1
Then,

$$\text{Mean } \frac{1+2+2+3+3+3+2+2+1}{9} = \frac{19}{9} = 2.11$$

Arranged Values: 1, 1, 2, 2, 2, 2, 3, 3
Median = 2 (since the middle value is 2)
Mode = 2 (since it is the most frequently occurring value)

Ans 19. The following line graph represents the given data:



The Mean, Median and Mode of the given data are as follows:

Mean = $\frac{20+22+25+22+23+21}{7} = \frac{155}{7}$ 22.14

Arranged Values: 20, 21, 22, 22, 22, 23, 25

Median = 22 (since the middle value is 22)

Mode = 22 (since it is the most frequently occurring value)

Ans 20. A dot plot is a simple visual tool that displays data points on a number line, which makes it easy to identify patterns, clusters and outliers. It is used when we have a small dataset.

The following are the steps to create a dot plot:

(*i*) On a number line, mark all the unique items present in a given data.

(*ii*) Iterate through all the items present in the data.

(*iii*) For each item, add a dot above the corresponding position on the number line and stack the dots vertically above each other if the item appears more than once.

Ans 21. Through statistical analysis, we can monitor changes in the volume of hazardous materials and gases, create reports as per the data and check the effectiveness of the policies that are aimed at reducing carbon footprints. This enables us to take urgent actions to reduce hazardous substances and harmful gases from the environment, thereby achieving SDG 13.

Ans 22. Statistics are vital in disaster management for predicting and warning citizens, understanding the impact on populations and infrastructure and planning resource allocation efficiently. Officials can use data to analyze and predict if there are any chances of disaster. In case of any mishappening, they can use the data to provide necessary resources like food, water and medical aid.

Data analysis and statistical methods can improve disaster response by learning from past events to effectively predict any disaster that may happen in the future, thereby making the officials prepared so that they can minimize damage and optimize disaster recovery.

Ans 23. **Identify the number of favourable outcomes**: In this case, the favourable outcomes are the face cards (King, Queen and Jack) in a deck of cards. There are 4 suits in a deck (hearts, diamonds, clubs and spades) and each suit has 3 face cards (King, Queen and Jack).

Favourable Outcomes (total number of face cards) = 12

Identify the total number of possible outcomes: A standard deck of playing cards contains 52 cards in total (13 cards per suit × 4 suits).

Number of Possible Outcomes (total number of cards) = 52

We know,

Probability = $\frac{\text{Number of Favourable Outcomes}}{\text{Number of Possible Outcomes}}$

Thus, = $\frac{12}{52}$ = 0.23

CHAPTER 4: Generative AI

Unsolved Questions

Ans 1. Generative AI is a field of Artificial Intelligence that focuses on developing algorithms and models capable of generating original content, such as images, videos and text, by learning from large datasets.

It is different from traditional AI in the following aspects:

(*i*) Traditional AI gives decisions, makes predictions or classifications as the output. On the other hand, Generative AI gives new content, data, etc., as the output.

(*ii*) Traditional AI has limited creativity while Generative AI is highly creative.

(*iii*) Traditional AI has limited flexibility, following clear and structured rules while Generative AI is flexible as it creates varied and creative output.

Ans 2. Generator and discriminator are the basic components of Generative Adversarial Networks (GANs). The generator is a model that generates realistic images based on its learning from the training data and the discriminator judges whether the images are real or not. Both components are trained simultaneously in a competitive process. Over time, the generator improves its ability to create realistic data and the discriminator becomes better at detecting fake data, resulting in highly realistic outputs.

Ans 3. Variational Autoencoders (VAEs) consist of encoders and a decoder. Encoders are used to compress data while the decoder is used to decompress the data to recreate it. Their applications include face reconstruction, creating artificial data, etc.

On the other hand, Generative Adversarial Networks (GANs) consist of a generator and a discriminator. The generator generates new data and the discriminator decides whether it is real or not. Their applications include realistic graphic creation.

Ans 4. Recurrent Neural Networks (RNNs) are designed to handle sequences of data like sentences or music. An RNN works by remembering past information to predict what comes next, whether it is writing a sentence or composing music. For example, ChatGPT generates stories based on the existing text.

Ans 5. Generative AI presents a wide range of opportunities but it also raises significant ethical concerns such as:

(*i*) *Bias*: If trained on biased data, Generative AI can continue to amplify these biases. For example, AI may favour certain groups based on biased hiring data.

(*ii*) *Privacy*: Generative AI can mimic real people which raises privacy concerns. Deepfakes are AI-generated videos or images that falsely depict people and are created by training AI with personal data without consent.

Ans 6. Deepfakes are the media in which a person's identity is manipulated to appear as someone else's. They pose significant ethical and security challenges by enabling realistic manipulation of media, which leads to spreading misinformation, bullying or invading someone's privacy.

Ans 7. Generative AI can be used to enhance personalized learning experiences by helping students analyze their performance by creating personalized practice problems or adjusting the difficulty level based on an individual's progress. This makes learning more engaging and effective for everyone. For example, AI tutors can assist teachers by providing personalized feedback on the assignments of students and suggesting areas for improvement.

Ans 8. Generative AI has made a positive impact on creative fields like music, art and literature. It is capable of generating lyrics, voices of different artists and background music, all of which help in creating a full-fledged song. Apart from this, we can use Generative AI to create realistic images of people, places or things. It can also create a piece of literature as it can write stories and poetry based on prompts.

Ans 9. Generative AI can help in environmental monitoring by analyzing satellite data, climate patterns and pollution level for deforestation. It can also help in disaster relief by predicting and managing crises through real-time data analysis and by giving step-by-step plans.

Ans 10. Legal challenges related to AI-generated content arise because traditional copyright laws don't account for AI creations. Key issues include determining ownership—whether it belongs to the AI creator, user or AI itself—and liability in cases of misuse or infringement. Another challenge is authorship as AI lacks legal personhood, making it unclear who should be credited as the creator of the content. These gaps in the law complicate how AI-generated works are handled legally.

CHAPTER 5: Introduction to Python

Unsolved Questions

V. Correct the errors in the following code fragments:

Ans. 1.
```
my_var = 10
```
Ans. 2.
```
#This is a comment
```
Ans. 3.
```
identifier123 = 42
```
Ans. 4.
```
a=42
```
Ans. 5.
```
x= "hello" + "42"
```
Ans. 6.
```
result = 10//2
```
Ans. 7.
```
is_valid = True&False
```
Ans. 8.
```
if x==5:
```
Ans. 9.
```
my_list = [1,2,3]
```
Ans. 10.
```
my_list = [1,2,3]
print(my_list[2])
```

VI. Programming Exercises

Ans. 1.
```
print("Row, row, row your boat, Gently down the stream.\
nMerrily, merrily, merrily, merrily, Life is but a dream.")
```
Ans. 2.
```
hours_in_a_year = 365 * 24
print("The number of hours in a year:", hours_in_a_year)
```
Ans. 3.
```
first_name = input("Given name: ")
family_name = input("Family name: ")
street_address = input("Street address: ")
city_postal_code = input("City and postal code: ")

print(f"\n{first_name} {family_name}")
print(street_address)
print(city_postal_code)
```
Ans. 4.
```
x = 27
y = 15
print("Addition: ",x + y)
print("Subtraction: ",x - y)
print("Multiplication: ", x y)
print("Division: " , x / y)
print("Modulus: ", x % y)
```
Ans. 5.
```
number = int(input("Enter a number: "))
print("The number multiplied by seven is: ", (number * 7))
```
Ans. 6.
```
principal = float(input("Enter the principal amount: "))
rate_of_interest = float(input("Enter the rate of interest:
"))
time = float(input("Enter the time in years: "))
simple_interest = (principal * rate_of_interest * time) / 100)
print("Simple Interest: ",simple_interest)
```
Ans. 7.
```
total_sum=0
for i in range(0,4):
    n = int(input("Enter number: "))
    total_sum = total_sum + n
average = total_sum / 4
```

```
print("Sum: " , total_sum)
print("Average: ",average)
```

Ans. 8.
```
fahrenheit = float(input("Enter temperature in Fahrenheit: "))
celsius = (fahrenheit - 32) * 5 / 9

print("Temperature in Celsius: ", round(celsius, 2))
if celsius < 0:
   print("Oh! It's very cold!")
```

Ans. 9.
```
lst = [1, 2, 3, 4, 5]
index = int(input("Enter the index to replace: "))
new_value = int(input("Enter the new value: "))

lst[index] = new_value
print("Updated List: ",lst)
```

Ans. 10.
```
lst = [int(input("Enter a number: ")) for i in range(5)]
print("Max: " ,max(lst))
print("Min: " ,min(lst))
print("Sum: " ,sum(lst))
```

Ans. 11.
```
length = float(input("Enter the length: "))
breadth = float(input("Enter the breadth: "))

area = length * breadth
perimeter = 2 * (length + breadth)

print("Area: ",area)
print("Perimeter: ",perimeter)
```

Ans. 12.
```
price = float(input("Enter the price of the item: "))
quantity = int(input("Enter the quantity: "))

total_amount = price * quantity
print("Total Amount: ",total_amount)
```

Ans. 13.
```
base = float(input("Enter the base of the triangle:* "))
height = float(input("Enter the height of the triangle: "))

area = 0.5 * base × height
print("Area of the triangle: ",area)
```

Ans. 14.
```
total_sum=0

for i in range(0,5):
n= float(input("enter marks "))
total_sum = total_sum + n
average_marks = total_sum/5
print("Average Marks: " ,average_marks)
```

Ans. 15.
```
original_price = float(input("Enter the original price: "))
discount_percent = float(input("Enter the discount percentage:
"))
```

```
discount_amount = (original_price * discount_percent) / 100
discounted_price = original_price - discount_amount

print("Discounted Price: ",discounted_price)
```

Ans. 16.

```
length = float(input("Enter the length: "))
width = float(input("Enter the width: "))
height = float(input("Enter the height: "))

surface_area = 2 (length * width + width * height + height
  * length)
volume = length * width * height

print("Surface Area: " ,surface_area)
print("Volume: " ,volume)
```

Ans. 17.

```
number = float(input("Enter a number: "))

if number > 0:
print("The number is positive.")
elif number < 0:
print("The number is negative.")
else:
print("The number is zero.")
```

Ans. 18.

```
print("First 10 even numbers:")
for i in range(2, 21, 2):
print(i, end=" ")

print("\nFirst 10 odd numbers:")
for i in range(1, 20, 2):
print(i, end=" ")
```

Unsolved Questions

Ans 1. Python allows immediate code execution without compilation, making it ideal for debugging, testing and ensuring platform independence. This feature simplifies development and enhances productivity since errors are identified in real time and changes can be tested instantly.

Ans 2. Two programming languages suitable for AI are as follows:

(*i*) *R:* It is ideal for data analysis and statistical modelling with advanced visualization libraries.

(*ii*) *Java:* It is known for scalability, portability and its use in large-scale AI systems.

Ans 3. Python's simple syntax, readability and flexibility make it ideal for AI and machine learning. Its rich ecosystem of libraries like TensorFlow, scikit-learn and PyTorch provides powerful tools for various tasks. Portability allows Python to run across different platforms without modification while compatibility with other languages ensures seamless integration, making Python a versatile and widely used choice for AI projects.

Ans 4.

Aspect	Interactive Mode	Script Mode
Execution	It executes code line by line in real time.	It executes the entire script at once.
Purpose	It is best for quick testing and debugging.	It is best for writing and saving longer programs.
Code Persistence	It does not save code permanently.	It saves code in `.py` files for reuse.
Output	In this, immediate output after each line is executed.	In this, output is displaced after running the script.
Example	Typing `print ("hello")` in the shell.	Writing and running `print ("Hello")` in a file.

Ans 5. A statement in Python is a command that performs an action, such as printing a value or controlling the program's flow. Example `print("Hello")` or `if x > 5:` . Statements may not produce a direct result or value but are essential for organizing and executing code.

An expression, on the other hand, is a combination of variables, operators or values that evaluates to a single result or value. Examples include `5 + 3` or `x / y`. Expressions are used in calculations or conditions and always produce a value.

Ans 6. In Python, keywords are reserved words with predefined meanings and specific roles within the language syntax and structure. Each keyword represents a specific operation, condition or behaviour and their correct usage is vital for writing valid and meaningful Python code. Examples include if, else, etc.

Ans 7. An identifier is a name used to uniquely identify variables, functions, classes and other objects in Python. It helps reference and manipulate these objects in the code. Identifiers must follow specific rules, such as starting with a letter or underscore, and they are case-sensitive, *e.g.*, `myVar` and `myvar` are different.

Ans 8. Three basic datatypes in Python are as follows:

(*i*) *Number*: It represents numerical data, including integers (int), floating-point numbers (float) and complex numbers (complex). Example: `5, 3.14, 2+3j`.

(*ii*) *Sequence*: It represents ordered collections of elements such as strings (str), lists (list) and tuples (tuple). Strings store text while lists and tuples store multiple items. Example:

- String: "Hello"
- List: [1, 2, 3]
- Tuple: (4, 5, 6)

(*iii*) *None*: It represents the absence of a value or a NULL value. It is often used to indicate that a variable does not have a meaningful value. Example: `result=None`.

Ans 9. The function input() captures user input as a string. It returns the input as a string, irrespective of what the user entered. Strings are versatile and can hold any number of characters but they can't be used directly in numerical operations. If you intend to perform arithmetic operations, you need input to be numeric. Use type conversion to get the input in the required datatype.

Example: `name = input("Enter your name: ")`.

Ans 10. Type conversion is the process of changing the data type of an object from one type to another, ensuring compatibility during operations. The process of conversion takes place in two different ways, based on requirement. To handle them, Python allows implicit and explicit type conversion. Example of type conversion include str to int.

Ans 11. Control statements in Python, such as *if, else, elif* and loops like *while*, play a crucial role in managing the flow of a program's execution. They enable decision-making (*e.g.*, using *if-else* or *if-elif-else*), allowing the program to choose different paths based on conditions and repetition (*e.g.*, with *while* and *for* loops), facilitating iterative tasks. These structures enhance flexibility and logic in coding.

Ans 12. The difference between *for* loop and *while* loop is as follows:

(*i*) *for* loop in Python is used to iterate over a sequence (such as a list, tuple, string or range) or other iterable objects, repeatedly, for each item in the sequence.

(*ii*) *while* loop repeatedly executes a block of code as long as a specified condition is true.

Ans 13. Looping control statements in Python, such as *for* and *while*, allow for repeated execution of a block of code. *for* loop iterates over sequences like lists or ranges whereas *while* loop continues executing as long as a specified condition remains true. These loops are essential for automating repetitive tasks, processing collections of data and controlling the flow of programs based on dynamic conditions.

Ans 14. Lists in Python are ordered, mutable collections that can store multiple items of varying types (*e.g.*, integers, strings or even other lists). Lists are defined using square brackets [ ], with elements separated by commas. Lists are useful because of dynamic storage, versatility, built-in method and ease of iteration.

Ans 15. In Python, elements in a list can be accessed using indexing. List indexing starts from 0, so the first element is accessed with list[0]. Negative indices access elements from the end, where list[–1] refers to the last item. You can also use slicing, *e.g.*, list[1:3], to access a range of elements from a list.

Ans 16.

Aspect	List	Tuple
Mutability	It is mutable (can be modified).	It is immutable (cannot be modified).
Performance	It is slower due to mutability overhead.	It is faster due to fixed structure.
Usage	It is used for dynamic, changeable data.	It is used for fixed, unchangeable data.
Syntax	It is defined using square brackets [ ].	It is defined using parentheses ().

Ans 17. To add elements to a list in Python, consider the following:

(*i*) To add a single element at the end of the list, use append() function.

(*ii*) To insert an element at a specified position (index) in the list, use insert() function.

(*iii*) To add multiple elements, such as elements from another list, to the end of the current list, use extend() function.

Ans 18. To remove items from a list, the following functions can be used:

(*i*) To remove the first occurrence of a specific element from a list, remove() function is used.

(*ii*) To remove and return an element at a specific index from a list, pop() function is used.

(*iii*) del is a statement, not a method, to remove an element or a slice from the list using its index.

Ans 19. In Python, append() method is used to add a single element to the end of a list. It modifies the original list in place without returning a new list. This method is useful for dynamically adding items, such as appending values from loops or user input, helping to grow a list during program execution. For example,

```
my_list = [1, 2, 3]
my_list.append(4)
```

Ans 20. Python's extend() method is used to add multiple elements from an iterable (*e.g.*, a list, tuple, or string) to the end of an existing list. Unlike append(), which adds a single element, extend() adds each element of the iterable individually. It modifies the original list in place. For example,

```
my_list = [1, 2]
my_list.extend([3, 4, 5])
```

IMAGE-BASED QUESTIONS

CHAPTER 1: AI Reflection, Project Cycle and Ethics

Ans 1. The Data Exploration phase comes after Data Acquisition in the AI Project Cycle.

Ans 2. Surveys

Ans 3. (*a*) True Positives (TP): 70 — Emails that were actually spam and correctly predicted as spam.

(*b*) True Negatives (TN): 90 — Emails that were actually not spam and correctly predicted as not spam.

(*c*) False Positives (FP): 30 — Emails that were not spam but incorrectly predicted as spam.

(*d*) False Negatives (FN): 10 — Emails that were actually spam but incorrectly predicted as not spam.

Explanation:

- True Positives (TP): Spam emails that the model successfully identified as spam.
- True Negatives (TN): Legitimate emails that were correctly identified as not spam.
- False Positives (FP): Legitimate emails wrongly marked as spam (may cause users to miss important emails).
- False Negatives (FN): Spam emails that were missed by the model and ended up in the inbox.

CHAPTER 2: Data Literacy

Ans 1. Numerical and Categorical Variables

Ans 2. Graph Type: Pie Chart

Major Use Case: A Pie Chart is used to represent part-to-whole relationships. It shows how different categories contribute to the total sum of a variable, such as sales, profits or quantities. It helps in making quick comparisons between categories by visualizing their relative proportions at a glance.

Ans 3. The illustration represents the DIKW Pyramid, which outlines the hierarchy of processing raw data into valuable insight.

DIKW Model Stages:

(*i*) **Data (Base - Blue Layer):** Raw facts and figures without context (*e.g.*, numbers, symbols).

(*ii*) **Information (Green Layer):** Processed data that has meaning or context.

(*iii*) **Knowledge (Red Layer):** Analyzed information that provides understanding or patterns.

(*iv*) **Wisdom (Orange Layer):** The ability to make sound decisions based on knowledge and experience.

(*v*) **Decision (Yellow Diamond):** The final decisions that are made out of raw data.

CHAPTER 3: Mathematics for AI (Statistics & Probability)

Ans 1. Total number of balls = 4 (red) + 2 (green) + 1 (yellow) = 7

Number of red balls = 4

Probability of randomly picking a red ball:

$$P(\text{Red ball}) = \frac{\text{Number of red balls}}{\text{Total number of balls}} = \frac{4}{7}$$

Thus, the probability of randomly picking a red ball is 4/7 or 57.1%.

Ans 2. Let us first count the total number of equal sections in the spinner:
Total sections = 6 (2 Blue, 2 Yellow, 1 Green, 1 Red)

(*i*) Blue landing on the arrow $P(\text{Blue}) = \frac{2}{6} = \frac{1}{3}$

(*ii*) Yellow landing on the arrow $P(\text{Yellow}) = \frac{2}{6} = \frac{1}{3}$

(*iii*) Green or Red landing on the Arrow $P(\text{Green or Red}) = \frac{1+1}{6} = \frac{2}{6} = \frac{1}{3}$

(*iv*) Neither Green nor Red landing on the arrow

$$P(\text{Not Green or Red}) = 1 - \frac{2}{6} = \frac{4}{6} = \frac{2}{3}$$

CHAPTER 4: Generative AI

Ans 1. The given image depicts the task of Email spam detection, which is classified as Traditional AI.

Ans 2. The left tool, a Text-to-Image Generator, is designed to convert text descriptions into visual outputs. For example, if you input something like 'a boy dancing in rain', it will generate a corresponding image. This tool is image-based and is often used in creative fields such as design, storyboarding, marketing visuals and concept art.

On the other hand, the right tool, a Text-Based Chat AI (like ChatGPT), focuses on responding to textual questions and prompts using natural language. It excels at providing detailed answers, explaining concepts, and assisting with writing, coding and other text-based tasks. This is a text-based generative AI and it serves major use cases such as information search, learning support, writing help and virtual assistance.

So, while the left tool is geared towards creating visual content from the text, the right tool generates detailed textual responses. Both are powerful but they cater to different creative and informational needs.

CHAPTER 5: Introduction to Python

Ans 1. The image shown is an example of **Interactive Mode** in Python.
Major difference between Interactive Mode and Script Mode:

- **Interactive Mode** allows you to execute Python commands one at a time. It is useful for testing small snippets of code or quick calculations.
- **Script Mode** involves writing a complete Python program in a .py file and then running the whole script. It is better suited for developing larger and more complex programs.
  So, the image represents Python's Interactive Mode, where immediate execution and output of expressions occur.

Ans 2. The flow of the process in the given flowchart is as follows:

(*i*) We give A a value

```
A = "Whoops I left my ID at home. You remember me though yeah?"
```

In other words, A is just a sentence — a piece of text.

(*ii*) First decision: "Is A an integer (a whole number)?"

- Since A is actually in the form text (a string), **the answer is NO**, so we follow the **False** branch.

(*iii*) Else-branch action

In the 'False' branch, the flowchart tells us to print:

```
No I don't remember you. You need ID here
```

(*iv*) Final step: After printing that message, the chart shows the guard's next thought (even though it is not printed):

```
B = "coldly look over potential clients freezing in the queue"
```

This just means the guard turns away and looks at the next person.