



As per C-20 syllabus

Revised Edition-2026



# D-CET

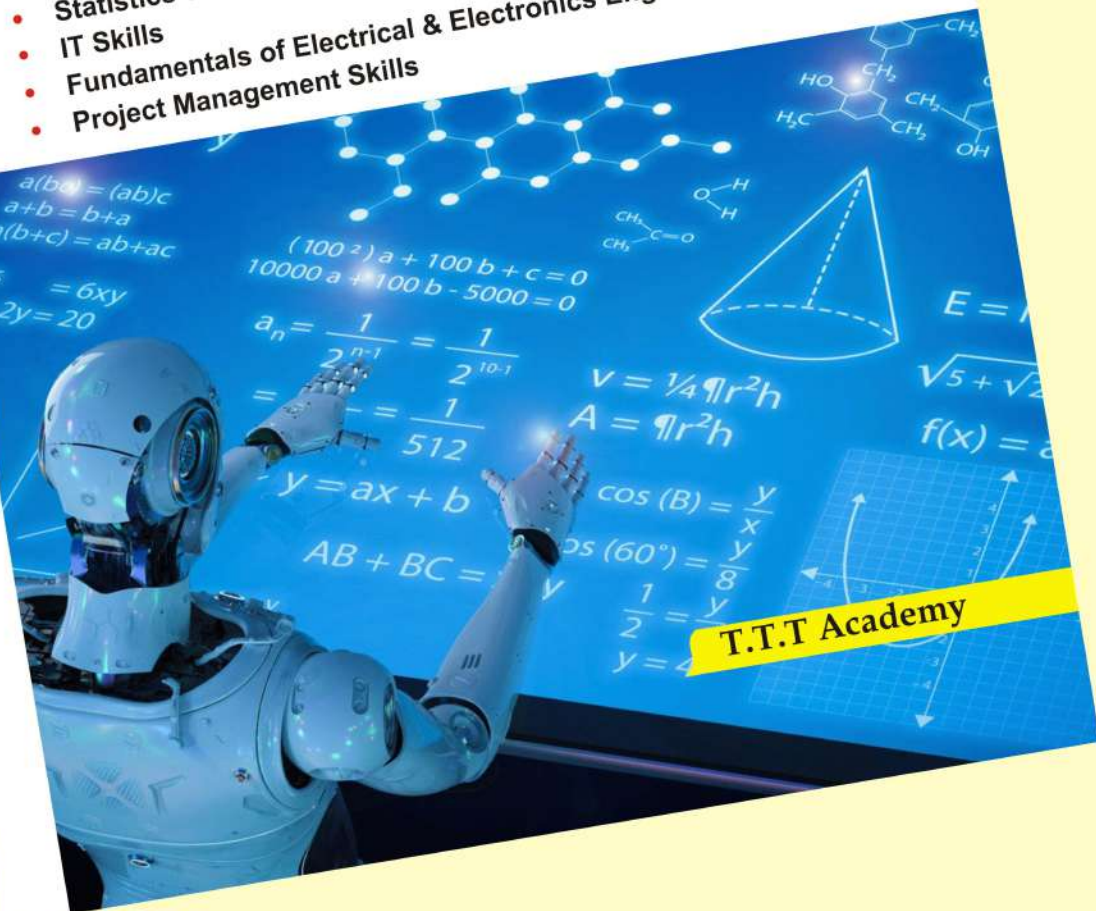
Diploma Common Entrance Test

All 5 in One

- Engineering Mathematics
- Statistics & Analytics
- IT Skills
- Fundamentals of Electrical & Electronics Engineering
- Project Management Skills

D-CET - All in One

T.T.T. Academy



T.T.T. Academy

# D-CET

## Diploma Common Entrance Test

(For Lateral Entry to 3<sup>rd</sup> Semester Engineering)

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## **D-CET Diploma Common Entrance Test**

*(For Lateral entry to 3<sup>rd</sup> Semester Engineering)*

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# INTRODUCTION TO D-CET ENTRANCE EXAM

DCET - Diploma Common Entrance Test which is conducted by the Karnataka Examination Authority (KEA). The entrance exam is a requirement for enrolment in the second-year undergraduate engineering programmes offered through the lateral entry programme. In Karnataka, these programmes are offered at both day and evening colleges.

## D-CET EXAM PATTERN

DCET Conducting Authority	Karnataka Examination Authority
Frequency of Conduct	1 yearly once
Exam level	State level
Languages	English
Application Mode	Online
Mode of Exam	Offline / Online
Exam Duration	3 hours
Number of Subjects	5
Total Questions	100
Total Marks	100
Mode of Counselling	Online

## D-CET TENTATIVE IMPORTANT DATES

Events	Dates
Application form starts	2 <sup>nd</sup> Week of April
Last date for application submission	4 <sup>th</sup> Week of April
D-CET exam date	Month of May
Counselling date	Month of June



**DCET SYLLABUS with effect from the Year 2023**  
**As per C-20 Diploma Curriculum**  
**(Common to all Engineering Diploma Programmes)**

**DURATION : 3 Hours**

**MAXIMUM MARKS : 100**

Sl. No.	TOPICS	MARKS
1	ENGINEERING MATHEMATICS	20
2	STATISTICS & ANALYTICS	20
3	IT SKILLS	20
4	FUNDAMENTALS OF ELECTRICAL & ELECTRONICS ENGINEERING	20
5	PROJECT MANAGEMENT SKILLS	20
<b>TOTAL</b>		<b>100</b>

**DETAILED SYLLABUS**

**1. ENGINEERING MATHEMATICS 20 Marks**

<b>I. Matrices And Determinants (4 Marks)</b>
<ul style="list-style-type: none"> <li>Matrix and types</li> <li>Algebra of Matrices (addition, subtraction, scalar multiplication and multiplication)</li> <li>Evaluation of determinants of a square matrix of order 2 and 3. Singular matrices</li> <li>Cramer's rule for solving system of linear equations involving 2 and 3 variables</li> <li>Adjoint and Inverse of the non- singular matrices of order 2 and 3</li> <li>Characteristic equation and Eigen values of a square matrix of order 2</li> </ul>
<b>II. Straight Lines (4 Marks)</b>
<ul style="list-style-type: none"> <li>Slope of a straight line</li> <li>Intercepts of a straight line</li> <li>Intercept form of a straight line</li> <li>Slope-intercept form of a straight line</li> <li>Slope-point form of a straight line</li> <li>Two-point form of a straight line</li> <li>General form of a straight line</li> <li>Angle between two lines and conditions for lines to be parallel and perpendicular</li> </ul>

- Equation of a straight line parallel to the given line
- Equation of a straight line perpendicular to the given line

**III. Trigonometry (4 Marks)**

- Concept of angles, their measurement, Radian measure and related conversions.
- Signs of trigonometric ratios in different quadrants (ASTC rule)
- Trigonometric ratios of allied angles (definition and the table of trigonometric ratios of standard allied angles say  $900 \pm \theta$ ,  $1800 \pm \theta$ ,  $2700 \pm \theta$ . and  $3600 \pm \theta$ .)
- Trigonometric ratios of compound angles (without proof)
- Trigonometric ratios of multiple angles
- Transformation formulae

**IV. Differential Calculus And Applications (4 Marks)**

- Derivatives of continuous functions in an interval (List of formulae)
- Rules of differentiation
- Successive differentiation (up to second order)
- Applications of differentiation

**V. Integral Calculus And Applications (4 Marks)**

- List of standard integrals and Basic rules of integration
- Evaluation of integrals of simple function and their combination
- Methods of integration
- Concept of definite integrals
- Applications of definite integrals

**2. STATISTICS AND ANALYTICS 20 Marks****I. Statistical Data Collection And Types (3 Marks)**

- Definition of data and classification (qualitative , quantitative discrete and continuous data)
- Data collection tools
  - i) Questionnaires.
  - ii) Survey.
  - iii) Interviews.
  - iv) Focus group discussion
- Data cleaning

**II. Summarization of Data (6 Marks)**

- Descriptive statistics
  - i) Data tabulation (Frequency table)
  - ii) Relative frequency table.
- Grouped data
  - i) Bar graph
  - ii) Pie chart
  - iii) Line graph
  - iv) Frequency polygon
  - v) Frequency curve
  - vi) Relative frequency polygon
  - vii) Histograms
  - viii) Box plot
- Leaf-stem plot

**III. Measure of Location And Dispersion (5 Marks)**

- Determination of central tendencies Range, Mean, Mode and Median for the data
- Determination of absolute measures of dispersion for data like range quartile deviation, mean deviation, standard deviation and variance.
- Skewness and kurtosis graphs

**IV. Introduction To Python Programming (6 Marks)**

- Introduction to PYTHON.
- Syntax of PYTHON.
- Comments of PYTHON.
- Data types of PYTHON.
- Variables of PYTHON.
- If-else in PYTHON.
- Loops in PYTHON.
- Arrays and functions in PYTHON.

**3. IT SKILLS 20 Marks****I. Introduction to Basics of Coding (4 Marks)**

- 1.1 Introduction to computer programming
- 1.2 Algorithms - With sufficient examples
- 1.3 Flowcharts - With sufficient examples
- 1.4 Execute simple programs
- 1.5 Introduction to Application development
- 1.6 Simple android application development

**II. Design And Develop Web Pages (4 Marks)**

- 2.1 Basic web technologies
  - Browser
  - Web - Server
  - Client-Server Model
  - URL
  - SEO techniques
  - Domain names and domain name system.
- 2.2 Creating Web-pages with HTML5 - Static
  - Introduction, Editors
  - Tags, Attributes, Elements, Headings
  - Links, Images, List, Tables, Forms
  - Formatting, Layout, Iframes.
- 2.3 Formatting web pages with style sheets (CSS3).
  - Introduction to CSS
  - Inline CSS, Internal CSS, Classes and IDs
  - div, Color, Floating, Positioning
  - Margins, Padding, Borders
  - Fonts, Aligning Text, Styling Links

<p>2.4 Creating a web page dynamic using JavaScript.</p> <ul style="list-style-type: none"> <li>• Dynamic web page and Introduction to JS</li> <li>• Basic syntax</li> <li>• Functions</li> <li>• Events</li> </ul> <p>2.5 Creating dashboards in websites.</p>	<ul style="list-style-type: none"> <li>• Google docs- bring your documents to life with smart editing and styling tools to help you easily format text and paragraphs;</li> <li>• Google Co-lab (Usage of Jupyter Notebook): Colab notebooks allow you to combine executable code and rich text in a single document, along with images, HTML, LaTeX, and more.</li> <li>• Google App Engine: Google App Engine is a Platform as a Service and cloud computing platform for developing and hosting web applications in Google-managed data centers. Applications are sandboxed and run across multiple servers.</li> </ul> <p>4.5 Working of IoT and IoT components (Only brief introduction and demonstration through videos)</p> <p>4.6 Explain concept of Internet of Things with examples</p> <ul style="list-style-type: none"> <li>• Smart home</li> <li>• Smart city</li> <li>• Smart farming</li> </ul>
<b>III. Business Process Automation / ERP (4 Marks)</b>	
<p>3.1 Introduction to business process automation.</p> <p>3.2 Organization structure and functions composition- Properties and applications</p> <ul style="list-style-type: none"> <li>• Structure</li> <li>• Types</li> <li>• Functional Units</li> </ul> <p>3.3 Workflows 4</p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Components</li> <li>• Use and use cases</li> </ul> <p>3.4 Enterprise resource planning</p> <ul style="list-style-type: none"> <li>• History</li> <li>• Evolution</li> <li>• Uses of ERP</li> </ul>	
<b>IV. Introduction To Cloud And IoT Concepts (4 Marks)</b>	
<p>4.1 Fundamentals of cloud</p> <p>4.2 Cloud service models</p> <ul style="list-style-type: none"> <li>• IaaS (Infrastructure-as-a-Service)</li> <li>• PaaS (Platform-as-a-Service)</li> <li>• SaaS (Software-as-a-Service)</li> </ul> <p>4.3 Cloud deployment types</p> <ul style="list-style-type: none"> <li>• Public,</li> <li>• Private,</li> <li>• Hybrid</li> <li>• Community Cloud</li> </ul> <p>4.4 Cloud services:</p> <ul style="list-style-type: none"> <li>• Google Drive - file storage and synchronization service developed by Google;</li> </ul>	<b>V. Cyber security And Safety (4 Marks)</b>
	<p>5.1 Introduction to Cyber security and cyber safety.</p> <ul style="list-style-type: none"> <li>• Brief awareness on cyber safety measures</li> <li>• Identification of basic security issues in mobile phones and personal computers</li> <li>• Installation of Antivirus software</li> <li>• Firewall concepts</li> <li>• Browser settings</li> <li>• Importance of privacy and Password policy (Best practices).</li> </ul> <p>5.2 Common threats - Demonstration</p> <ul style="list-style-type: none"> <li>• Phishing</li> <li>• DoS attack</li> <li>• Man in the middle attack</li> <li>• Eavesdropping</li> <li>• Spamming</li> </ul>

## 4. FUNDAMENTALS OF ELECTRICAL & ELECTRONICS ENGINEERING

- 20 Marks

I. Electrical Safety	(2 Marks)
<ol style="list-style-type: none"> <li>Electrical Symbols</li> <li>Electrical safety <ul style="list-style-type: none"> <li>Identify Various types of safety signs and what they mean</li> <li>Demonstrate and practice use of PPE</li> <li>Demonstrate how to free a person from electrocution</li> <li>Administer appropriate first aid to victims, bandaging, heart attack, CPR, etc.</li> <li>Fire safety, causes and precautionary activities.</li> <li>Use of appropriate fire extinguishers on different types of fires.</li> <li>Demonstrate rescue techniques applied during fire hazard, correct method to move injured people during emergency</li> <li>Inform relevant authority about any abnormal situation</li> </ul> </li> <li>1.1 Earthing: Types</li> </ol>	
II. Electrical Fundamentals	(5 Marks)
<ol style="list-style-type: none"> <li>Describe the sources of electrical energy.</li> <li>Electrical current, voltage, emf, potential difference, resistance with their SI units.</li> <li>Mention the meters used to measure different electrical quantities. Identification Measuring devices <ul style="list-style-type: none"> <li>Ammeter</li> <li>Voltmeter</li> <li>Wattmeter</li> <li>Ohmmeter</li> <li>Digital Multimeter</li> <li>Megger</li> <li>Tong tester</li> </ul> </li> <li>Explain supply systems like AC, DC. <ul style="list-style-type: none"> <li>Relationship between V, I and R. (Ohms law)</li> </ul> </li> </ol>	

- Behavior of V, I in Series and Parallel DC circuits.
  - Describe open circuit, close circuit and short circuit
  - Equation to find the effective Resistances connected in series
  - Equation to find effective Resistances connected in parallel
  - Resistances connected series and parallel combinations
  - AC sine wave: Sinusoidal voltage, current, amplitude, time-period, cycle, frequency, phase, phase difference, and their units.
  - Electrical work, power and power factor, SI units, mention the meters used to measure them.
- Electrical energy
    - SI units
    - Mention the meters used to measure them
    - Single phase and Three phase supply.

### III. Protective Devices And Wiring Circuits (3 Marks)

- Protective Devices
  - Necessity of Protective Devices
  - Various Protective devices and their functions
  - fuse wire,
  - Glass cartridge fuse
  - HRC fuse
  - Kit-kat fuse
  - MCB
  - MCCB
  - RCCB
  - ELCB
  - Relay
  - Different types of electrician tools and their function.
  - Describe various wiring tools.
  - State procedure of care and maintenance of wiring tools.
- Describe different types of wiring systems.
  - Surface conduit

<ul style="list-style-type: none"> <li>• concealed conduit</li> <li>• PVC casing capping</li> </ul> <ol style="list-style-type: none"> <li>3. Wiring systems and their applications.</li> <li>4. Describe the types of wires, cables used for different current and voltage ratings.</li> </ol>
<b>IV. Electrical Machines and Batteries and UPS (5 Marks)</b>
<ol style="list-style-type: none"> <li>1. Transformer           <ul style="list-style-type: none"> <li>• working principle</li> <li>• Transformation ratio</li> <li>• Types and applications with their ratings</li> </ul> </li> <li>2. Induction motor           <ul style="list-style-type: none"> <li>• Single phase and three phase Induction motor.</li> <li>• Necessity of starters.</li> <li>• Describe DOL AND STAR-DELTA starters.</li> </ul> </li> <li>3. What are different causes and remedies for a failure of starter and induction motor.</li> <li>4. Battery           <ul style="list-style-type: none"> <li>• Types of batteries (Lead acid battery, lithium, sealed maintenance free (SMF) battery, Modular battery).</li> <li>• Selection criteria of batteries for different applications.</li> <li>• Ampere-Hour Capacity.</li> <li>• Efficiency</li> </ul> </li> <li>5. UPS           <ul style="list-style-type: none"> <li>• List the types and applications</li> <li>• Selection criteria of UPS</li> <li>• Sizing of UPS</li> </ul> </li> </ol>
<b>V. Introduction to Electronic Devices and Digital Electronics (5 Marks)</b>
<ol style="list-style-type: none"> <li>1. Compare Conductors, insulators and semiconductors with examples.</li> <li>2. Identification of types and values of resistors-color codes.</li> <li>3. PN junction diode           <ul style="list-style-type: none"> <li>• Symbol</li> <li>• Characteristics</li> <li>• Diode as switch.</li> <li>• Types of diodes and ratings</li> <li>• Applications</li> </ul> </li> </ol>

<ol style="list-style-type: none"> <li>4. Rectifier           <ul style="list-style-type: none"> <li>• Need for AC to DC conversion</li> <li>• Bridge rectifier with and without C filter,</li> <li>• Rectifier IC.</li> </ul> </li> <li>5. Transistor (BJT)           <ul style="list-style-type: none"> <li>• Symbol</li> <li>• Structure</li> <li>• Working principle</li> <li>• Comparison of analog and digital signal</li> <li>• Digital systems, examples.</li> <li>• Binary numbers, Boolean identities and laws.</li> <li>• Digital system building blocks: Basic logic gates, symbols and truth tables.</li> <li>• IC-Definition and advantages.</li> </ul> </li> <li>6. Sensors           <ul style="list-style-type: none"> <li>• Concept</li> <li>• Types: Temperature, Pressure, Water, Light, Sound, Smoke, proximity Sensors, Flow, humidity, voltage, vibration, IR (Principle/working, ratings/specifications, cost, and applications)</li> </ul> </li> <li>7. Actuators           <ul style="list-style-type: none"> <li>• Concept</li> <li>• Types and applications.</li> <li>• Relay as an actuator</li> </ul> </li> <li>8. Microcontroller           <ul style="list-style-type: none"> <li>• As a programmable device and list of real-world applications.</li> <li>• PLC and Their applications.</li> </ul> </li> </ol>
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## 5. PROJECT MANAGEMENT SKILLS 20 Marks

<b>I. Introduction (4 Marks)</b>
<ol style="list-style-type: none"> <li>1. Introduction           <ul style="list-style-type: none"> <li>• Meaning of Project</li> <li>• Features of a Project</li> <li>• Types of Projects</li> <li>• Benefits of Project Management</li> <li>• Obstacles in Project Management</li> <li>• Project Management as Profession</li> <li>• Project Manager and His Role</li> <li>• Project Consultants</li> <li>• What is Operation?</li> </ul> </li> </ol>

<ul style="list-style-type: none"> <li>• Difference between Project and Operation.</li> <li>• What is "Process" in Project Management and Process Groups?</li> <li>• What is Scope? Difference between Project Group Objectives and Project Scope.</li> </ul>	<ul style="list-style-type: none"> <li>• Functions of Project Planning</li> <li>• Steps in Project Planning</li> <li>• Project Planning Structure</li> <li>• Project Objectives and Policies</li> <li>• Tools of Project Planning</li> <li>• Project Scheduling</li> <li>• Time Monitoring Efforts</li> <li>• Bounding Schedules</li> <li>• Scheduling to Match Availability of Manpower</li> <li>• Scheduling to Match Release of Funds</li> <li>• Problems in Scheduling Real-life Projects</li> <li>• Introduction</li> <li>• Situation Analysis and Problem Definition</li> <li>• Setting Goals and Objectives</li> <li>• Generating Structures and Strategies</li> <li>• Implementation</li> <li>• What is Project Evaluation?</li> <li>• Why is Project Evaluation Important?</li> <li>• What are the Challenges in Monitoring and Evaluation ?</li> </ul>
<b>II. Project Administration (4 Marks)</b>	<b>V. Project Control, Review and Audit (4 Marks)</b>
<ul style="list-style-type: none"> <li>• Essentials of Project Administration</li> <li>• Project Team</li> <li>• Project Design</li> <li>• Work Breakdown Structure (WBS)</li> <li>• Project Execution Plan (PEP)</li> <li>• Contracting Plan</li> <li>• Work Packing Plan</li> <li>• Organisation Plan</li> <li>• Systems and Procedure Plan</li> <li>• Project Procedure Manual</li> <li>• Project Diary</li> <li>• Project Execution System</li> <li>• Project Direction</li> <li>• Communication in a Project</li> <li>• Project Co-ordination</li> <li>• Pre-requisites for Successful Project Implementation</li> </ul>	<ul style="list-style-type: none"> <li>• Projected Control Purposes</li> <li>• Problems of Project Control</li> <li>• Gantt Charts</li> <li>• Milestone Charts</li> <li>• Critical Path Method (CPM)</li> <li>• Construction of a Network</li> <li>• Network Technique in Project Scheduling</li> <li>• Crashing Project Duration through Network</li> <li>• Project Review</li> <li>• Initial Review</li> <li>• Post Audit</li> <li>• Performance Evaluation</li> <li>• Abandonment Analysis</li> <li>• Objectives of Project Audit</li> <li>• Functions of Project Auditor</li> <li>• Project Audit Programme</li> <li>• Difficulties in Establishing Audit Purpose and Scope</li> <li>• Digital Technology trends in Project management</li> <li>• Cloud Technology, IoT, AR and VR applications in Project management, Smart Cities</li> </ul>
<b>III. Project Life cycle (4 Marks)</b>	
<ul style="list-style-type: none"> <li>• Phases of Project Life Cycle</li> <li>• Project Management Life Cycle (General)</li> <li>• Project Planning</li> <li>• Project Execution</li> <li>• Project Closure</li> <li>• Project Risks</li> <li>• Types of Risks: Illustrations</li> <li>• Risk Assessment Techniques with Illustrations</li> <li>• Project Cost Risk Analysis</li> <li>• Estimating Time and Cost Overrun Risks</li> <li>• Organization/Procedural/Systemic Reasons for Project Cost Overruns</li> <li>• Time Overruns</li> </ul>	
<b>IV. Project Planning, Scheduling and Monitoring (4 Marks)</b>	
<ul style="list-style-type: none"> <li>• Nature of Project Planning</li> <li>• Need for Project Planning</li> </ul>	

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# **Engineering Mathematics**



MARKS DISTRIBUTION FOR EACH CHAPTER		
Sl. No.	Chapters	Marks
1	Matrices and Determinants	4
2	Straight Lines	4
3	Trigonometry	4
4	Differential Calculus and Applications	4
5	Integral Calculus and Applications	4
Total		20

# Matrices and Determinants

## 1.1 BASIC CONCEPTS OF MATRICES

A Matrix is a rectangular array of numbers or elements, i.e., arrangement of numbers or elements in rows and columns.

Matrix having  $m$  rows and  $n$  columns is of order  $m \times n$  and total number of elements in matrix are  $mn$ . (Read as  $m$  cross  $n$  or  $m$  by  $n$ ). A matrix is denoted by capital letter. The elements of the matrix are enclosed within the square brackets [ ].

$$\text{Ex : } A = \begin{bmatrix} 2 & 5 & -4 \\ 1 & -8 & 3 \end{bmatrix} \begin{matrix} \rightarrow 1^{\text{st}} \text{ row} \\ \rightarrow 2^{\text{nd}} \text{ row} \end{matrix}$$

$$\begin{matrix} \downarrow & \downarrow & \downarrow \\ 1^{\text{st}} \text{ col} & 2^{\text{nd}} \text{ col} & 3^{\text{rd}} \text{ col} \end{matrix}$$

It has 2 rows and 3 columns. Therefore the order of matrix  $A$  is  $2 \times 3$ .

## 1.2 TYPES OF MATRIX

**1. Row Matrix :** A matrix having only one row is called a row matrix. Ex.  $A = [8 \ -1 \ 5]$  is a row matrix of order  $1 \times 3$ .

**2. Column Matrix :** A matrix having only one column

$$\text{is called a column matrix. Ex. } A = \begin{bmatrix} 2 \\ -1 \\ 5 \end{bmatrix} \text{ is a column}$$

matrix of order  $3 \times 1$ .

**3. Square Matrix :** A matrix having equal numbers of rows and columns is a square matrix.

$$\text{Ex : } A = \begin{bmatrix} 2 & 3 \\ -1 & 4 \end{bmatrix}_{2 \times 2} \quad B = \begin{bmatrix} 1 & 5 & 8 \\ 3 & -2 & 1 \\ 5 & 8 & 7 \end{bmatrix}_{3 \times 3}$$

**4. Diagonal Matrix :** A square matrix whose all the elements except the diagonal elements are zero is called a diagonal matrix.

$$\text{Ex : } A = \begin{bmatrix} 5 & 0 \\ 0 & -2 \end{bmatrix} \quad B = \begin{bmatrix} 3 & 0 & 0 \\ 0 & 8 & 0 \\ 0 & 0 & -3 \end{bmatrix}$$

**5. Scalar Matrix :** It is a diagonal matrix in which all the elements in the principal diagonal are same.

$$\text{Ex : } A = \begin{bmatrix} 7 & 0 & 0 \\ 0 & 7 & 0 \\ 0 & 0 & 7 \end{bmatrix} \text{ is a scalar matrix of order } 3 \times 3$$

**6. Unit Matrix or Identity Matrix :** It is denoted by  $I$ . It is a square matrix whose all non diagonal elements are zero and diagonal elements are 1 each.

$$\text{Ex : } I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}_{2 \times 2} \quad I = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}_{3 \times 3}$$

**7. Zero Matrix or Null Matrix :** A matrix whose all the elements are zero is known as a zero matrix. It is denoted by  $0$ .

$$\text{Ex : } 0 = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$$

**8. Equal Matrices :** The matrices  $A$  and  $B$  are said to be equal if their orders are same and elements at the corresponding places are equal.

$$\text{Ex : if } A = \begin{bmatrix} 3 & 4 & 5 \\ 8 & 1 & 2 \end{bmatrix}_{2 \times 3} \text{ and } B = \begin{bmatrix} 3 & 4 & 5 \\ 8 & 1 & 2 \end{bmatrix}_{2 \times 3} \\ \text{then } A = B$$

### 1.3 OPERATION ON MATRICES

**1. Scalar multiplication :** If  $k$  is a scalar (i.e., a single number) and  $A$  is a matrix of any size, then  $kA$  is a matrix obtained by multiplying each elements of  $A$  by the scalar  $k$ .

**Illustration (1)**

$$\text{If } A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \text{ then,}$$

$$kA = k \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} = \begin{bmatrix} ka_{11} & ka_{12} \\ ka_{21} & ka_{22} \end{bmatrix}$$

**Illustration (2)**

$$\text{If } A = \begin{bmatrix} 4 & 2 & 1 \\ 5 & 8 & -2 \end{bmatrix} \text{ then,}$$

$$3A = 3 \begin{bmatrix} 4 & 2 & 1 \\ 5 & 8 & -2 \end{bmatrix} = \begin{bmatrix} 12 & 6 & 3 \\ 15 & 24 & -6 \end{bmatrix}$$

**Illustration (3)**

$$\text{If } A = \begin{bmatrix} 4 & 2 \\ -1 & 3 \end{bmatrix} \text{ then,}$$

$$\frac{1}{2}A = \frac{1}{2} \begin{bmatrix} 4 & 2 \\ -1 & 3 \end{bmatrix} = \begin{bmatrix} \frac{4}{2} & \frac{2}{2} \\ \frac{-1}{2} & \frac{3}{2} \end{bmatrix} = \begin{bmatrix} 2 & 1 \\ -\frac{1}{2} & \frac{3}{2} \end{bmatrix}$$

**2. Addition of matrices :** If  $A$  and  $B$  are two matrices of the same order, then their sum  $A + B$  is defined and is obtained by adding the corresponding elements of  $A$  and  $B$ .

$$\text{Illustration, If } A = \begin{bmatrix} 3 & 2 & 1 \\ 5 & 1 & 4 \end{bmatrix} \text{ and } B = \begin{bmatrix} 2 & 0 & 5 \\ 3 & 1 & 4 \end{bmatrix}$$

$$\begin{aligned} \text{then, } A + B &= \begin{bmatrix} 3 & 2 & 1 \\ 5 & 1 & 4 \end{bmatrix} + \begin{bmatrix} 2 & 0 & 5 \\ 3 & 1 & 4 \end{bmatrix} \\ &= \begin{bmatrix} 3+2 & 2+0 & 1+5 \\ 5+3 & 1+1 & 4+4 \end{bmatrix} = \begin{bmatrix} 5 & 2 & 6 \\ 8 & 2 & 8 \end{bmatrix} \end{aligned}$$

**3. Subtraction of Matrices :** If  $A$  and  $B$  are two matrices of the same order, then their difference  $A - B$  is defined and is obtained by subtracting the elements of  $B$  from the corresponding elements of  $A$ .

$$\text{Illustration, If } A = \begin{bmatrix} 2 & 1 \\ 3 & 8 \\ 9 & 12 \end{bmatrix} \text{ and } B = \begin{bmatrix} 6 & 1 \\ 5 & 3 \\ -1 & 4 \end{bmatrix}$$

$$\text{then, } A - B = \begin{bmatrix} 2 & 1 \\ 3 & 8 \\ 9 & 12 \end{bmatrix} - \begin{bmatrix} 6 & 1 \\ 5 & 3 \\ -1 & 4 \end{bmatrix}$$

$$= \begin{bmatrix} 2-6 & 1-1 \\ 3-5 & 8-3 \\ 9-(-1) & 12-4 \end{bmatrix} = \begin{bmatrix} -4 & 0 \\ -2 & 5 \\ 10 & 8 \end{bmatrix}$$

### Properties of addition of Matrices

If  $A, B, C$  and  $D$  are matrices of same order. Where,  $O$  is the null matrix, then

**i) Commutative law of addition**

$$A + B = B + A$$

**ii) Associative law of addition**

$$(A + B) + C = A + (B + C)$$

**iii) Existence law of identity**

$$A + O = O + A = A$$

**4. Transpose of a matrix :** Let  $A$  be a matrix of order  $m \times n$ . The  $n \times m$  matrix obtained from  $A$  by interchanging its rows and columns is called the **transpose of matrix** and is denoted by  $A'$  or by  $A^T$ .

$$\text{Illustration, let } A = \begin{bmatrix} 2 & -1 \\ 3 & 1 \\ 4 & 5 \end{bmatrix}_{(3 \times 2)}$$

The transpose of  $A$  is  $2 \times 3$  matrix

$$A^T = \begin{bmatrix} 2 & 3 & 4 \\ -1 & 1 & 5 \end{bmatrix}_{(2 \times 3)}$$

$$\therefore 4 - \lambda = 0 \quad \text{and} \quad 3 - \lambda = 0$$

$$\lambda = 4 \qquad \qquad \lambda = +3$$

**60. Find the characteristic equation and its roots**

**of a square matrix**  $A = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$ .

**Solution :** Given  $A = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$

The characteristic equation of  $A$  is,  $|A - \lambda I| = 0$

$$\begin{vmatrix} 1-\lambda & 2 \\ 2 & 1-\lambda \end{vmatrix} = 0$$

$$(1 - \lambda)(1 - \lambda) - (2 \times 2) = 0$$

$$1 - \lambda - \lambda + \lambda^2 - 4 = 0$$

$\lambda^2 - 2\lambda - 3 = 0$  is characteristic equation.

$$\lambda^2 + 1\lambda - 3\lambda - 3 = 0 \text{ (by factorization)}$$

$$\lambda(\lambda + 1) - 3(\lambda + 1) = 0$$

$$(\lambda + 1)(\lambda - 3) = 0$$

$$\lambda + 1 = 0 \text{ or } \lambda - 3 = 0$$

$$\lambda = -1 \text{ or } \lambda = 3$$

$\therefore \lambda = -1, 3$  are characteristic roots of matrix  $A$ .

### PRACTICE MCQ's

**1. If**  $A = \begin{bmatrix} -1 & 7 \\ -4 & 1 \end{bmatrix}$ ,  $B = \begin{bmatrix} 2 & 3 \\ 5 & 4 \end{bmatrix}$  **then**  $A + B$  **is**

a)  $\begin{bmatrix} 1 & 10 \\ 1 & 5 \end{bmatrix}$                       b)  $\begin{bmatrix} 1 & 1 \\ 10 & 5 \end{bmatrix}$

c)  $\begin{bmatrix} -1 & -1 \\ 10 & 5 \end{bmatrix}$                       d)  $\begin{bmatrix} -1 & 10 \\ -1 & 5 \end{bmatrix}$

**2. If**  $A = \begin{bmatrix} 4 & -3 \\ 2 & 1 \end{bmatrix}$  **and**  $B = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}$ , **then**  $2A + B$  **is**

a)  $\begin{bmatrix} 9 & -4 \\ 4 & 3 \end{bmatrix}$                       b)  $\begin{bmatrix} 3 & -1 \\ 5 & 7 \end{bmatrix}$

c)  $\begin{bmatrix} 9 & 4 \\ -4 & 3 \end{bmatrix}$                       d)  $\begin{bmatrix} 3 & -4 \\ -4 & 9 \end{bmatrix}$

**3. If**  $A = \begin{bmatrix} 4 & -6 \\ -2 & 7 \end{bmatrix}$  **then**  $A + A'$  **is**

a)  $\begin{bmatrix} 8 & -8 \\ -8 & 14 \end{bmatrix}$                       b)  $\begin{bmatrix} 14 & -8 \\ -8 & -8 \end{bmatrix}$

c)  $\begin{bmatrix} -8 & 8 \\ 8 & 14 \end{bmatrix}$                       d)  $\begin{bmatrix} 8 & 18 \\ 8 & -4 \end{bmatrix}$

**4. If**  $A = \begin{bmatrix} 1 \\ 4 \end{bmatrix}$ ,  $B = [3 \ 4]$ , **then**  $AB$  **is**

a)  $\begin{bmatrix} 3 & 3 \\ 12 & 16 \end{bmatrix}$                       b)  $\begin{bmatrix} 3 & 4 \\ 12 & 16 \end{bmatrix}$

c)  $\begin{bmatrix} 4 & 3 \\ 16 & 12 \end{bmatrix}$                       d)  $\begin{bmatrix} -3 & -4 \\ 16 & 12 \end{bmatrix}$

**5. The product of**  $A = \begin{bmatrix} 2 & 3 & 1 \\ 0 & -1 & 3 \end{bmatrix}$  **and**  $B = \begin{bmatrix} 4 \\ -1 \\ 5 \end{bmatrix}$

**is**

a)  $[10, 16]$                       b)  $\begin{bmatrix} -10 \\ 16 \end{bmatrix}$

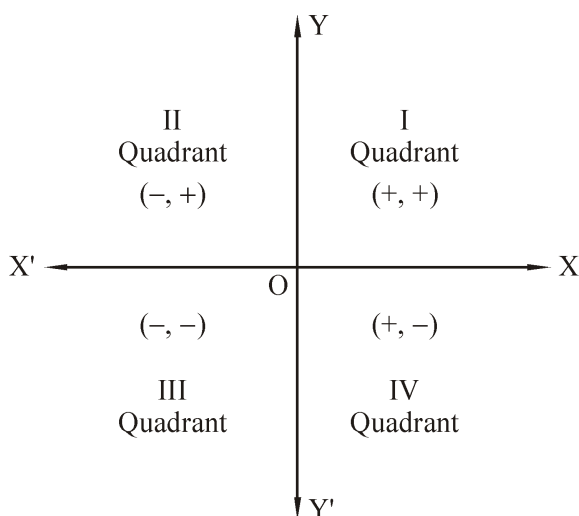
c)  $\begin{bmatrix} 10 \\ 16 \end{bmatrix}$                       d)  $[16 \ 10]$

# Straight Lines

## 2.1 CO-ORDINATE SYSTEM

Analytical geometry deals with the study of the geometrical properties of points and lines by the use of algebraic methods. Thus, it is called algebraic geometry or co-ordinate geometry.

The position of an object or a point is located using cartesian plane



## 2.2 SOME IMPORTANT FORMULA

1. Distance of a point  $P(x, y)$  from origin  $O(0, 0)$

$$D = \sqrt{x^2 + y^2}$$

2. Distance between the points  $(x_1, y_1)$  and  $(x_2, y_2)$

$$D = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

3. Midpoint of the line,  $M = \left[ \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right]$

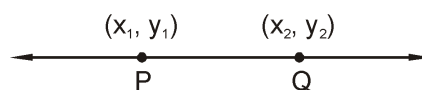
4. Centroid of the triangle

$$C = \left[ \frac{x_1 + x_2 + x_3}{3}, \frac{y_1 + y_2 + y_3}{3} \right]$$

## 2.3 STRAIGHT LINES

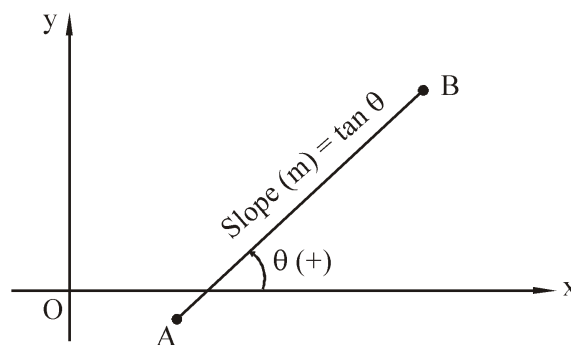
The straight line is the locus of point which moves without changing its direction

A straight line is a figure formed when two points  $P(x_1, y_1)$  and  $Q(x_2, y_2)$  are connected between them, and the line ends are extended to infinity.



### Slope / Gradient of a straight line:

If a straight line makes an angle  $\theta$  with the positive direction of the x-axis, then  $\theta$  is called the inclination and tangent angle ( $\tan \theta$ ) is called the slope ( $m$ ) or gradient of the line.



The slope of a line is generally given as  $m = \tan \theta$

### Note :

1. Slope is **positive**, when  $\theta$  is an acute angle i.e.,  $\theta$  lies between  $0^\circ$  and  $90^\circ$ .
2. Slope is **negative**, when  $\theta$  is an obtuse angle i.e.,  $\theta$  lies between  $90^\circ$  and  $180^\circ$ .
3. Slope is **zero**, when  $\theta$  is equal to  $0^\circ$  or it is **parallel to x-axis**.
4. Slope is **infinite**, when  $\theta$  is equal to  $90^\circ$  or it is **perpendicular to x-axis**.

### EXAMPLE PROBLEMS

**1. What is the slope of a line whose inclination is  $45^\circ$ .**

**Solution :** Given  $\theta = 45^\circ$   
 $\therefore$  slope,  $m = \tan\theta = \tan 45^\circ$   
 $m = 1$

**2. The slope of the line making an angle  $120^\circ$  with x-axis is**

**Solution :**  
 Slope of the line,  $m = \tan\theta = \tan 120^\circ$   
 i.e.,  $m = \tan(180^\circ - 60^\circ) \Rightarrow m = -\tan 60^\circ$   
 $\therefore m = -\sqrt{3}$

**3. The slope of the lines joining the points (3, 2) and (-4, 3) is**

**Solution :**  
 $A(3, 2) = (x_1, y_1)$        $B(-4, 3) = (x_2, y_2)$   
 Slopes of line,  $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3 - 2}{-4 - 3} = \frac{1}{-7} = -\frac{1}{7}$

**4. Find the slope of the line joining the points (2, -3) (6, 1).**

**Solution :** Given  $P(x_1, y_1) = (2, -3)$  and  $Q(x_2, y_2) = (6, 1)$   
 The slope of line,  $m = \frac{y_2 - y_1}{x_2 - x_1}$   
 $m = \frac{1 - (-3)}{6 - 2} = \frac{1 + 3}{4} = \frac{4}{4}$   
 $\therefore m = 1$

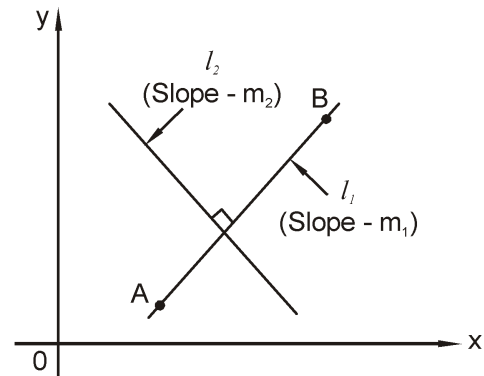
**5. Find the slope of the line parallel to the line joining the points (2, 3) (4, -1).**

**Solution :** Given  $A(x_1, y_1) = (2, 3)$  and  $B(x_2, y_2) = (4, -1)$   
 Slope of line,  $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-1 - 3}{4 - 2} = \frac{-4}{2} = -2$   
 w.k.t slope of the parallel lines are equal.  
 $m_1 = m_2 = m = -2$   
 $\therefore$  Slope of parallel line is  $-2$

**6. Find the slope of the line perpendicular to the line joining the points (-3, 6) and (5, -4).**

**Solution :** Given  $A(x_1, y_1) = (-3, 6)$  and  $B(x_2, y_2) = (5, -4)$

$$\text{Slope of line, } m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-4 - 6}{5 + 3} = \frac{-10}{8} = -\frac{5}{4}$$



The slope of the perpendicular lines condition is

$$m_1 \times m_2 = -1$$

$$-\frac{5}{4} \times m_2 = -1$$

$$m_2 = \frac{-1(4)}{-5} = \frac{-4}{-5} = \frac{4}{5}$$

$\therefore$  Slope of perpendicular line is  $\frac{4}{5}$

**7. If the slope of the line joining the points (2, 5) and (3,  $\lambda$ ) is  $-2$ , find the value of  $\lambda$ .**

**Solution :** Given  $A(x_1, y_1) = (2, 5)$ ,  $B(x_2, y_2) = (3, \lambda)$  and  $m = -2$

$$\text{Slope of line, } m = \frac{y_2 - y_1}{x_2 - x_1} \Rightarrow -2 = \frac{(\lambda - 5)}{(3 - 2)}$$

$$-2(3 - 2) = \lambda - 5$$

$$-6 + 4 = \lambda - 5$$

$$-2 + 5 = \lambda \quad \therefore \lambda = 3$$

**8. Find the slope of the line  $3x - 4y + 8 = 0$ .**

**Solution :** Given  $3x - 4y + 8 = 0$



# Trigonometry

Trigonometry is a branch of mathematics that deals with the study of the relationship between the sides and angle of a right angled triangle.

## 3.1 CONCEPT OF ANGLES AND MEASUREMENT

Angle can be defined as the rotation from the initial point to an endpoint of a ray.

Commonly used terms in describing the angles are:

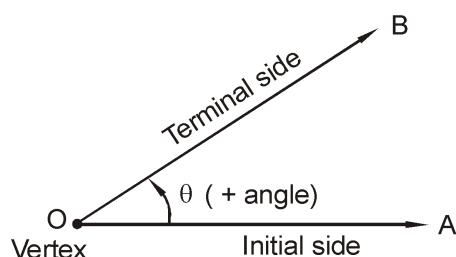
**Initial side :** The original ray

**Terminal side :** The final position of the ray after rotation

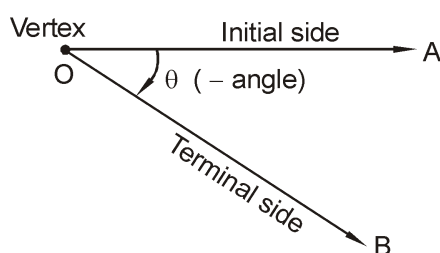
**Vertex :** Point of rotation

**Positive angle :** The direction of rotation is anticlockwise, then the angle is called positive angle.

**Negative angle :** The direction of rotation is clockwise, then the angle is called negative angle.



(i) Positive angle



(ii) Negative angle

The two commonly used units for measurement of angles are :

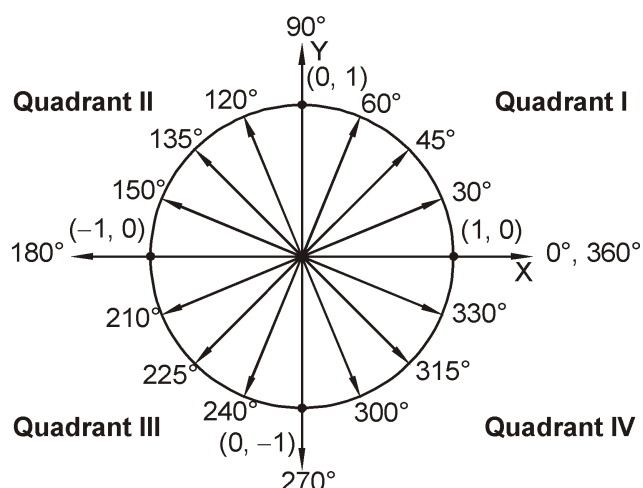
- i) Degree measurement
- ii) Radian measurement

### 3.1.1 Angle measurement - Degree Measure

A complete revolution, i.e., when the initial and terminal sides are in the same position after rotating clockwise, is divided into  $360^\circ$  units called degrees. So, if the rotation from the initial side to the terminal side is

$\left(\frac{1}{360}\right)^{\text{th}}$  of a revolution, the angle is said to be one degree.

It is denoted as  $1^\circ$



Time is measured in hours, minutes and seconds, where, 1 hour = 60 minutes and 1 minute = 60 seconds, similarly, while measuring angles,

- 1 degree = 60 minutes, denoted as  $1^\circ = 60'$
- 1 minute = 60 seconds, denoted as  $1' = 60''$

### 3.1.2 Angle measurement - Radian Measure

Radian is an angle subtended at the center of a circle by an arc, whose length of arc ( $s$ ) is equal to the radius ( $r$ ) of the circle.

### PREVIOUS YEAR MCQ's

1. If  $\tan x = 15/8$  and  $x$  is in the III quadrant then the value of  $(2\sin x - 3\cos x)/(2\cos x + 3\sin x)$  is (DCET - 2013)
  - a)  $61/6$                       b)  $-61/6$
  - c)  $-6/61$                     d)  $6/61$
2. The value of  $\{[\sin(2\pi - \theta) + \cos(-\theta)]/[\tan(-\theta) + \cot(2\pi + \theta)]\} - \{[\sin(\pi/2 + \theta) + \cos(3\pi/2 - \theta)]/[\cot(\pi + \theta) + \tan(2\pi - \theta)]\}$  is (DCET - 2013)
  - a) 0                              b) -1
  - c) +1                            d) -2
3. The value of  $\frac{(\sin 100^\circ + \sin 20^\circ)}{(\cos 100^\circ + \cos 20^\circ)}$  is (DCET - 2013)
  - a)  $\frac{\sqrt{3}}{2}$                           b)  $\frac{1}{2}$
  - c)  $\sqrt{3}$                             d) 1
4. If  $\sin A = 5/13$  and  $\sin B = 4/5$  then the value of  $\cos(A-B)$  is (DCET - 2013)
  - a)  $65/56$                       b)  $56/65$
  - c)  $16/65$                       d)  $-16/65$
5. On simplification the value of  $\frac{(\cos^3 A - \cos 3A)}{\cos A} + \frac{(\sin^3 A + \sin 3A)}{\sin A}$  is (DCET - 2013)
  - a) 3                                b) 1
  - c) 2                                d) 0
6. The value of  $\tan 225^\circ + \cot 135^\circ$  is (DCET-2014)
  - a) 1                                b) -1
  - c) 0                                d) 2
7. If  $\sin \theta = \frac{4}{5}$ ,  $\frac{\pi}{2} < \theta < \pi$ , then  $\frac{3\sin \theta + 4\cos \theta}{3\sin \theta - 4\cos \theta}$  is (DCET - 2014)
  - a)  $\infty$                       b)  $\frac{5}{24}$                       c)  $\frac{24}{5}$                       d) 0
8. The value of  $\cos 20^\circ + \cos 100^\circ + \cos 140^\circ$  is (DCET - 2014)
  - a) 0                                b)  $\cos 50^\circ$
  - c)  $\frac{1}{2}$                               d)  $\sin 50^\circ$
9. If  $\sin(45^\circ - \theta) = \frac{\sqrt{3} - 1}{2\sqrt{2}}$  and  $\theta$  is acute, then  $\theta$  is (DCET - 2014)
  - a)  $60^\circ$                       b)  $15^\circ$                       c)  $75^\circ$                       d)  $30^\circ$
10. If  $\tan \theta = \frac{\sin 2\theta}{1 + \cos 2\theta}$ , then  $\tan 22 \frac{1}{2}^\circ$  is (DCET - 2014)
  - a)  $\sqrt{2} - 1$                       b)  $\sqrt{2} + 1$
  - c)  $1 - \sqrt{2}$                       d)  $1 + \sqrt{3}$
11. The value of  $\sin 225^\circ + \cos(-135^\circ)$  is (DCET - 2015)
  - a)  $\sqrt{2}$                       b)  $-\sqrt{2}$                       c)  $\frac{1}{\sqrt{2}}$                       d)  $\frac{-1}{\sqrt{2}}$
12. The simplified value of  $\frac{\sin(180^\circ - A) \cot(90^\circ - A) \cos(360^\circ - A)}{\tan(180^\circ + A) \tan(90^\circ + A) \sin(-A)}$  is (DCET - 2015)
  - a)  $\sin A$                       b)  $-\sin A$
  - c) 1                                d)  $\operatorname{cosec} A$
13. The value of  $\frac{\sin 2A}{1 + \cos 2A}$  is (DCET - 2015)
  - a)  $2 \tan A$                       b)  $\sin A$
  - c)  $\cot A$                         d)  $\tan A$
14. If  $\tan A = \frac{3}{4}$  and  $\tan B = \frac{1}{7}$ , then the value of  $(A + B)$  is (DCET - 2015)
  - a)  $\frac{\pi}{6}$                       b)  $\frac{25}{23}$                       c)  $\frac{\pi}{4}$                       d)  $\frac{23}{25}$

# Integral Calculus and Applications

## 5.1 INDEFINITE INTEGRAL

Integration is the reverse process of differentiation.

Let  $y = f(x)$  be a function. If  $F(x)$  is the differential co-efficient of  $f(x)$  then  $f(x)$  itself is called as an integral, a primitive or anti-derivative of  $F(x)$  w.r.t. 'x'

It is denoted by  $\int F(x) dx = f(x)$

ie.,  $\int F(x) dx = f(x) \Leftrightarrow F(x) = f'(x)$

Since the derivative of a constant is zero

i.e.,  $\frac{d}{dx} (f(x) + c) = \frac{d}{dx} (f(x)) = F(x)$

$\Rightarrow \int F(x) dx = f(x) + C$

where 'C' is called a constant of integration.

In  $\int F(x) dx$ ,

$\int \rightarrow$  integral sign (elongated s)

$F(x) \rightarrow$  Integrand,  $dx \rightarrow$  w.r.t. 'x'

### Illustrations

$$1. \frac{d}{dx} (x) = 1 \Leftrightarrow \int 1 dx = x + c$$

$$2. \frac{d}{dx} (x^3) = 3x^2 \Leftrightarrow \int 3x^2 dx = x^3 + c$$

$$3. \frac{d}{dx} (\tan x) = \sec^2 x \Leftrightarrow \int \sec^2 x dx = \tan x + c$$

$$4. \frac{d}{dx} (\log x) = \frac{1}{x} \Leftrightarrow \int \frac{1}{x} dx = \log x + c$$

We already know the formulae for the derivatives of some standard functions. From these formulae, we can

write down the corresponding formulae for the integrals of these functions.

## 5.2 LIST OF STANDARD INTEGRALS

$$1. \int x^n dx = \frac{x^{n+1}}{n+1} + C, \quad n \neq -1$$

### Illustrations

$$(i) \int 1 dx = x + C$$

$$(ii) \int x dx = \frac{x^2}{2} + C$$

$$(iii) \int x^2 dx = \frac{x^3}{3} + C$$

$$(iv) \int \sqrt{x} dx = \frac{x^{3/2}}{3/2} + C$$

$$(v) \int x^{3/2} dx = \frac{x^{5/2}}{5/2} + C$$

$$2. \int \frac{1}{\sqrt{x}} dx = 2\sqrt{x} + C$$

$$3. \int \frac{1}{x} dx = \log x + C$$

$$4. \int \frac{1}{x^2} dx = -\frac{1}{x} + C$$

$$5. \int a^x dx = \frac{a^x}{\log a} + C$$

$$6. \int e^x dx = e^x + C$$

### EXAMPLE PROBLEMS

**1. Evaluate**  $\int (x^2 + 4x + 1) dx$

**Solution :** Let  $I = \int (x^2 + 4x + 1) dx$

$$= \int x^2 dx + 4 \int x dx + \int 1 dx$$

$$= \frac{x^3}{3} + 4 \cdot \frac{x^2}{2} + x + C$$

$$= \frac{x^3}{3} + 2x^2 + x + C$$

**2. Evaluate**  $\int \left( 3e^x + \frac{4}{x} + 6 \right) dx$

**Solution :** Let  $I = \int \left( 3e^x + \frac{4}{x} + 6 \right) dx$

$$= \int 3e^x dx + \int 4 \cdot \frac{1}{x} dx + \int 6 \cdot dx$$

$$= 3 \int e^x dx + 4 \int \frac{1}{x} dx + \int 6 \cdot dx$$

$$= 3e^x + 4 \cdot \log x + 6x + C$$

**3. Evaluate**  $\int e^{5x+8} dx$

**Solution :** Let  $I = \int e^{5x+8} dx = \frac{e^{5x+8}}{5} + C$

**4. Evaluate**  $\int (1 + \sin 2x) dx$

**Solution :** Let  $I = \int (1 + \sin 2x) dx$

$$= \int 1 dx + \int \sin 2x dx$$

$$= x - \frac{\cos 2x}{2} + C$$

**5. Evaluate**  $\int \frac{\cos x}{\sin^2 x} dx$

**Solution :** Let  $I = \int \frac{\cos x}{\sin^2 x} dx = \int \frac{\cos x}{\sin x} \cdot \frac{1}{\sin x} dx$

$$= \int \cot x \cdot \operatorname{cosec} x dx = -\operatorname{cosec} x + C$$

**6. Evaluate**  $\int \frac{2}{\cos^2 x} dx$

**Solution :** Let  $I = \int \frac{2}{\cos^2 x} dx = 2 \int \frac{1}{\cos^2 x} dx$

$$= 2 \int \sec^2 x dx = 2 \tan x + C$$

**7. Integrate**  $\int (x-1)(x+1) dx$

**Solution :** Let  $I = \int (x-1)(x+1) dx$

$$I = \int (x^2 - 1) dx$$

$$| (a+b)(a-b) = a^2 - b^2$$

$$= \int x^2 dx - \int 1 dx = \frac{x^3}{3} - x + C$$

**8. Evaluate**  $\int \frac{1}{1 + \cos 2x} dx$

**Solution :** Let  $I = \int \frac{1}{1 + \cos 2x} dx = \int \frac{1}{2 \cos^2 x} dx$

$$= \frac{1}{2} \int \sec^2 x dx = \frac{1}{2} \tan x + C$$

**9. Evaluate**  $\int \frac{1}{1 - \cos 2x} dx$

**Solution :** Let  $I = \int \frac{1}{1 - \cos 2x} dx = \int \frac{1}{2 \sin^2 x} dx$

$$= \frac{1}{2} \int \operatorname{cosec}^2 x dx$$

$$= \frac{1}{2} (-\cot x) + C = -\frac{1}{2} \cot x + C$$



# Statistics and Analytics



MARKS DISTRIBUTION FOR EACH CHAPTER		
Sl. No.	Chapters	Marks
1	Statistical Data Collection and Types	3
2	Summarization of Data	6
3	Measure of Location and Dispersion	5
4	Introduction to Python Programming	6
	Total	20

# Statistical Data Collection and Types

# 1

## 1.1 INTRODUCTION:

Statistics stands for the numerical information from which certain conclusions can be drawn. In this sense the word statistics is used as “figure or numerical information”. When man started counting, comparing and keeping records in one or other way, the subject ‘statistics’ seems to have originated. Sir Ronald A. Fisher is considered as father of Statistics. The Indian scholar Prashanth Chandra Mahalanobis called as father of Indian statistics.

The word statistics seems to have been derived from the Latin word '**status**' or the Italian word '**statista**' or the German word '**statistik**' or the French word '**statistique**'. Statistics is a science of collection, representation, analysis and interpretation of numerical data.

For example:

- “Sales statistics of different products of a company for past few years are recorded for a comparative study.
- The Height of group of 6 boys in cms are: 158, 164, 178, 168, 156, 174.

In these sentences the term statistics refers to numerical statements.

## Main Divisions of Statistics (Branches)

Statistics have two branches, namely **Statistical Methods** and **Applied Statistics**.

**Statistical Methods** are also called mathematical statistics or theory of statistics. It deals with the procedure of statistical analysis of numerical data. It is a tool for decision making.

**Applied Statistics** is the application of statistical methods to concrete situations like Agriculture, Industry, Population, Medicines etc. Some branches of Applied Statistics are,

## Some branches of Applied statistics

1. Biometry (Bio statistics which deals with problems in Biology)
2. Econometrics (Econometrics is a tool to prove or disprove the theories of economics)
3. Demography (Study human population)
4. Statistical quality control (S.Q.C.) (control quality of manufactured goods)
5. Actuarial science (Statistics in the field of insurance)
6. Stylometry (Statistics in literature)
7. Psychometry (Statistics in psychology)

## Function of statistics

1. It presents the facts in a definite form.
2. It simplifies and condenses the size of the data.
3. It facilitates comparison.
4. It enriches our knowledge and widens our experience.
5. It helps in formulating policies.

## Limitations of statistics

1. It does not deal with individuals
2. It does not deal with qualitative data.
3. Statistical laws are true only on an average.
4. Only experts can make the best possible use of Statistics.
5. Statistics is liable to be misused.

## Some basic concepts of Statistics

### Units or Individuals

The objects whose characteristics are studied in any statistical survey are called **units** or **individuals**.



can provide more natural feedback than individual interviews and are easier to organize than experiments or large-scale surveys.

## 1.6 DATA CLEANING

Data cleaning, also known as data cleansing or data scrubbing, is the process of identifying and correcting or removing errors, inconsistencies, and inaccuracies in a dataset. It is an essential step in the data preparation process to ensure the accuracy and reliability of the data.

### Key considerations for data cleaning:

**Remove duplicate entries:** Identify and remove any duplicate records in the dataset. Duplicates can occur due to data entry errors, system glitches, or merging of

datasets. By eliminating duplicates, you avoid skewing the analysis and ensure each observation is unique.

**Check for data consistency:** Examine the relationships between different variables in the dataset to ensure consistency.

**Conduct data quality checks:** Perform various data quality checks, such as checking for data accuracy, completeness, and reliability.

**Document data cleaning procedures:** Keep a detailed record of the steps taken during the data cleaning process. Document the changes made, the reasons behind them, and any assumptions or transformations applied. This documentation helps ensure transparency and reproducibility.

## PRACTICE MCQ's

1. The data classification which is based on variables such as production, cost, height and weight is considered as
  - a) qualitative classification
  - b) quantitative classification
  - c) open end classification
  - d) time series classification
2. The discrete variables and continuous variables are two types of
  - a) open end classification
  - b) time series classification
  - c) qualitative classification
  - d) quantitative classification
3. The classification of data on the geographical basis is also called
  - a) reflected classification
  - b) populated classification
  - c) sampling classification
  - d) spatial classification
4. The set of raw data arranged in ascending or descending order is called
  - a) ordered array
  - b) nominal array
  - c) ordinal array
  - d) interval array
5. The classification on the basis of time order is called as
  - a) disclosed classification
  - b) chronological classification
  - c) external classification
  - d) internal classification
6. If the classification of collected data is based on characteristics such as religion, education and caste, then this is considered as
  - a) open end classification
  - b) time series classification
  - c) qualitative classification
  - d) quantitative classification
7. The process of arranging data on the basis of certain properties in classes or groups is classified as
  - a) classification of data
  - b) reflection of data
  - c) sample of population
  - d) sample observation
8. The father of statistics
  - a) R.A. Fisher
  - b) A.L. Bowley
  - c) Horace Secrist
  - d) Boddington

# Summarization of Data

## 2

In our day to day life, recording of information is very crucial. A piece of information or representation of facts or ideas which can be further processed is known as data. The weather forecast, maintenance of records, dates, time everything is related to the collection of data. The collection, presentation, analysis, organization and interpretation of observations of data is known as statistics or data summarization. Using statistics, predictions about the nature of data can be made based on the previous data is to be studied and observed.

The statistical data which is collected can be represented by various methods such as tables, bar graphs, pie charts, histograms, frequency polygons etc.

In this unit representation and analysis of data is discussed such as:

- Descriptive statistics
- Grouped data
- Frequency distribution Table
- Relative frequency Table
- Bar graph
- Pie chart
- Line graph
- Frequency polygon
- Frequency curve
- Relative frequency polygon
- Histogram
- Box plot
- Leaf-stem plot

## 2.1 DESCRIPTIVE STATISTICS

Descriptive Statistics, as the name suggests, describes data. It is a method to collect, organize, summarize, display and analyze sample data taken from a population.

Descriptive Statistics is not based on probability theory. It paves the way to understand and visualize data better.

### 2.1.1 Grouped Data

Data can be defined as groups of information that represent the qualitative or quantitative attributes of a variable or set of variables, which is the same as saying that data can be any set of information that describes a given entity. Data in statistics can be classified into grouped data and ungrouped data.

Any data that you first gather is ungrouped data. Ungrouped data is data in the raw. An example of ungrouped data is any list of numbers that you can think of. Grouped data is data that has been organized into groups known as classes. Grouped data has been 'classified' and thus some level of data analysis has taken place, which means that the data is no longer raw.

A data class is group of data which is related by some user defined property. For example, if you were collecting the ages of the people you met as you walked down the street, you could group them into classes as those in their teens, twenties, thirties, forties and so on. Each of those groups is called a class.

Each of those classes is of a certain width and this referred to as the Class Interval or Class Size. This class interval is very important when it comes to drawing Histograms and Frequency diagrams. All the classes may have the same size or they may have different classes sizes depending on how you group your data. The class interval is always a whole number.

## 2.2 FREQUENCY DISTRIBUTION TABLE

The frequency ( $f$ ) of a particular observation is the number of times the observation occurs in the data. The distribution of a variable is the pattern of frequencies of the observation. Frequency distributions are portrayed as frequency tables, histograms or polygons.

# Measure of Location and Dispersion

# 3

Charts are frequently very useful to visually represent data, they are inconvenient for the simple reason that they are difficult to display and can not be remembered. It is frequently useful to reduce data to a couple of numbers that are easy to remember, easy to communicate, yet capture the essence of the data they represent.

In this unit statistical data measure of location and dispersion is studied mainly

- Determination of central tendencies Mean, Mode and Median for the data.
- Determination of absolute measures of dispersion for data like range, quartile deviation, mean deviation, standard deviation and variance.
- Skewness and kurtosis graphs and interpretation of results.

## 3.1 DETERMINATION OF CENTRAL TENDENCIES

We consider a random variable  $X$  and a data set  $S = \{x_1, x_2, \dots, x_n\}$  of size  $n$  which contains possible values of  $X$ . The data set can represent either the population being studied or a sample drawn from the population.

We seek a single measure (i.e., statistic) which somehow represents the center of the entire data set  $S$ .

**Central tendency :** It is the property of concentration of the values around a central value in a data.

### Average (Measure of central tendency)

It is a single value that represents the entire mass of data.

### Objectives

1. To get a single value to represent the characteristics of the entire mass of data.
2. To facilitate comparison.

## Essentials of a good central tendency

1. It should be easy to understand and simple to calculate
2. It should be based on all the observations.
3. It should be well defined by a mathematical formula.
4. It should not be affected by abnormal extreme values
5. It should be capable of further algebraic treatment.
6. It should possess sampling stability
7. It should be easily calculated for an open-end distribution.

## Types of averages

1. Arithmetic mean
2. Median
3. Mode
4. Geometric mean
5. Harmonic mean

### 3.1.1 Arithmetic mean (Mean)

Arithmetic mean of a set of observations is their sum divided by the total number of observations. It is denoted by  $\bar{x}$ . That is

$$\bar{x} = \frac{\text{sum of the observations}}{\text{Total number of observations}}$$

#### Case (1) : Ungrouped data (raw data)

If  $x_1, x_2, \dots, x_n$  are ' $n$ ' observations in a data then

$$\bar{x} = \frac{x_1 + x_2 + \dots + x_n}{n} = \frac{\sum x}{n}$$

#### Case (2) : Grouped data

$$\bar{x} = \frac{\sum fx}{N}$$

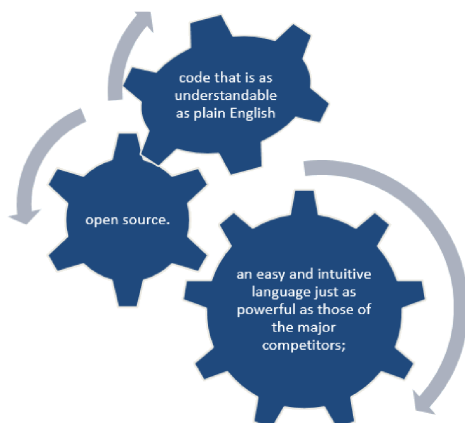
# Introduction to Python Programming

# 4

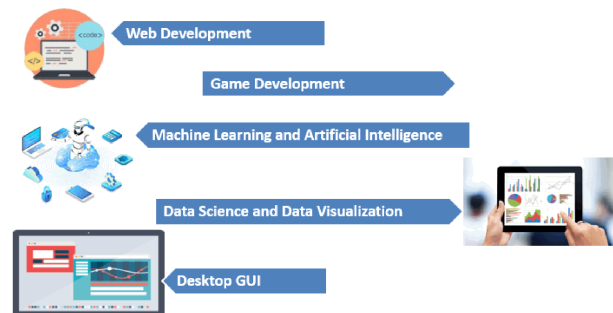
## 4.1 INTRODUCTION TO PYTHON

- It was created by Guido van Rossum, and first released on February 20, 1991.
- Python is a widely-used, interpreted, object-oriented, and high-level programming language with dynamic semantics, used for general-purpose programming.
- It has a simple syntax similar to the English language and it allows developers to write programs with fewer lines than other programming languages.
- It can be used on a server to create web applications, create workflows, connect to database systems, read and modify files, handle big data and perform complex mathematics. It can implement object oriented features, exception handling
- *Object-oriented programming (OOP)* is a programming paradigm that allows you to keep similar data together, and give the ability to modify the data

### Importance of python programming



### Real World Applications



## 4.2 PYTHON SYNTAX

Python syntax can be executed by writing directly in the Command Line

```
>>> print("Hello, World!")  
Hello, World!
```

creating a python file on the server, using the .py file extension, and running it in the Command Line:

```
C:\Users\Your Name>python myfile.py
```

## 4.3 PYTHON COMMENTS

Comments can be used to explain Python code.

Comments can be used to make the code more readable.

Comments can be used to prevent execution when testing code.

### Types of Comments in Python

there are 2types of comments.

- 1.Single-Line Comments
- 2.Multi-Line Comments



# IT Skills



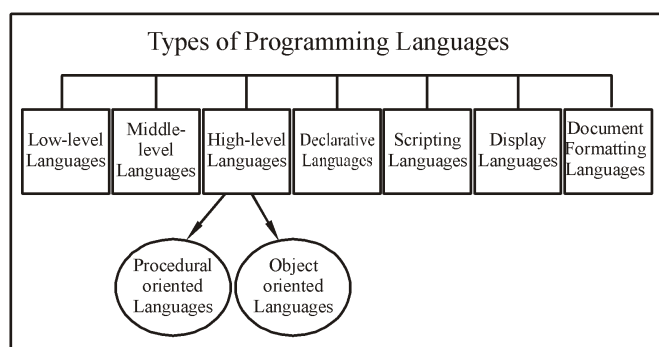
MARKS DISTRIBUTION FOR EACH CHAPTER		
Sl. No.	Chapters	Marks
1	Introduction to Basics of Coding	4
2	Design And Develop Webpages	4
3	Business Process Automation/ERP	4
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Total		20

# Introduction to Basics of Coding

## 1.1 INTRODUCTION TO COMPUTER PROGRAMMING

A computer Program is sequential set of instruction written in same computer language that is used to direct the computer to perform some specific task of computation.

### Different types of Programming Languages



### Low-Level Programming Languages

Low-level programming languages again consists of machine-level languages and assembly-level languages.

- **Machine Language** - Machine language comes under the category of low-level programming language that is built up of 0's and 1's. Some high-level languages are compiled into machine-level languages, so the computer understands the code.
- **Assembly Language** - Assembly language also comes under the category of low-level programming language that is compiled by an assembler. Translation of human-written code is converted into machine code by these assemblers only.

### Middle-Level Programming Languages

Middle-level programming languages are the programming languages that have characteristics of both low-level and high-level languages.

**C Language** - The c programming language acts as a mediator between hardware and programming layer. C is easy to understand and flexible. It is a compiled language and does not use objects and classes. Compilers and editors use C to design their applications.

### High-Level Programming Languages

**Procedural Languages** - Procedural languages are also programming languages in which the written code will pass through many procedures, and the computer executes the program

Examples of procedural languages are **FORTRAN, COBOL, SQL, and GO.**

**Object-Oriented languages** - The object-oriented programming languages which use objects and classes to write code. The usage of objects and classes makes it to solve real-world problems.

object-oriented programming languages are **Java, R, Ruby, Python, C#, JavaScript and Perl.**

### Declarative Languages

A declarative language is a programming language where the programmers concentrate on the goal or result of the program.

An example for a declarative language is "PROLOG," which is similar to SQL

## 1.2 ALGORITHMS

The word Algorithm means "a process or set of rules to be followed in calculations or other problem-solving operations". Therefore Algorithm refers to a set of rules/ instructions that step-by-step define how a work is to be executed upon in order to get the expected results.

An algorithm is defined as step by step procedure to solve a given problem by accepting set of inputs and producing the desired output.



**58. Which of the following is not a channel of mozilla?**

- a) Firefox                      b) Firefox alpha
- c) Firefox Beta              d) Firefox Aurora

**59. Which of the following are automatically loaded and operates as a part of browser?**

- a) Add-ons                      b) Plug-ins
- c) Utilities                      d) Widgets

**60. The \_\_\_\_\_ validator is used to verify that control contains data verify that an entry passes the specified validation logic.**

a) Compare Validator

b) Range Validator

c) Custom Validator

d) Validation Summary

**61. URL stands for?**

A. Universal Research List

B. Universal Resource List

C. Uniform Resource Locator

D. Uniform Research Locator

### KEY ANSWERS

- |         |         |         |         |         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. (d)  | 2. (d)  | 3. (c)  | 4. (c)  | 5. (d)  | 6. (b)  | 7. (d)  | 8. (b)  | 9. (c)  | 10. (d) |
| 11. (a) | 12. (c) | 13. (b) | 14. (d) | 15. (a) | 16. (b) | 17. (a) | 18. (d) | 19. (c) | 20. (a) |
| 21. (d) | 22. (b) | 23. (a) | 24. (c) | 25. (b) | 26. (a) | 27. (b) | 28. (c) | 29. (a) | 30. (c) |
| 31. (a) | 32. (b) | 33. (b) | 34. (d) | 35. (a) | 36. (b) | 37. (d) | 38. (a) | 39. (d) | 40. (b) |
| 41. (a) | 42. (a) | 43. (c) | 44. (b) | 45. (d) | 46. (b) | 47. (c) | 48. (a) | 49. (a) | 50. (d) |
| 51. (a) | 52. (a) | 53. (c) | 54. (b) | 55. (d) | 56. (b) | 57. (c) | 58. (a) | 59. (a) | 60. (d) |
| 61. (a) |         |         |         |         |         |         |         |         |         |

# Business Process Automation/ERP

## 3.1 INTRODUCTION TO BUSINESS PROCESS AUTOMATION:

Business Process Automation also known as business automation or digital transformation is the technology enabled automation of complex business process. It is use of technology to execute difficult tasks or processes in a business manual effort can be replaced.

### Advantages:

1. Improve Accountability, Transparency and enable accurate data.
2. Increase efficiency.
3. Increases Productivity.
4. Reduced operating costs.
5. Reduced time in task execution

## 3.2 Organization structure:

An organization is a social unit of individual that is designed and managed to achieve collective goals.

An organizational structure is a visual diagram of a company that describes what employee's do, when they report to and how decisions are made across the business.

### The process for creating an organizational structure

Plan the future

Consider the past

Build your organizational structure

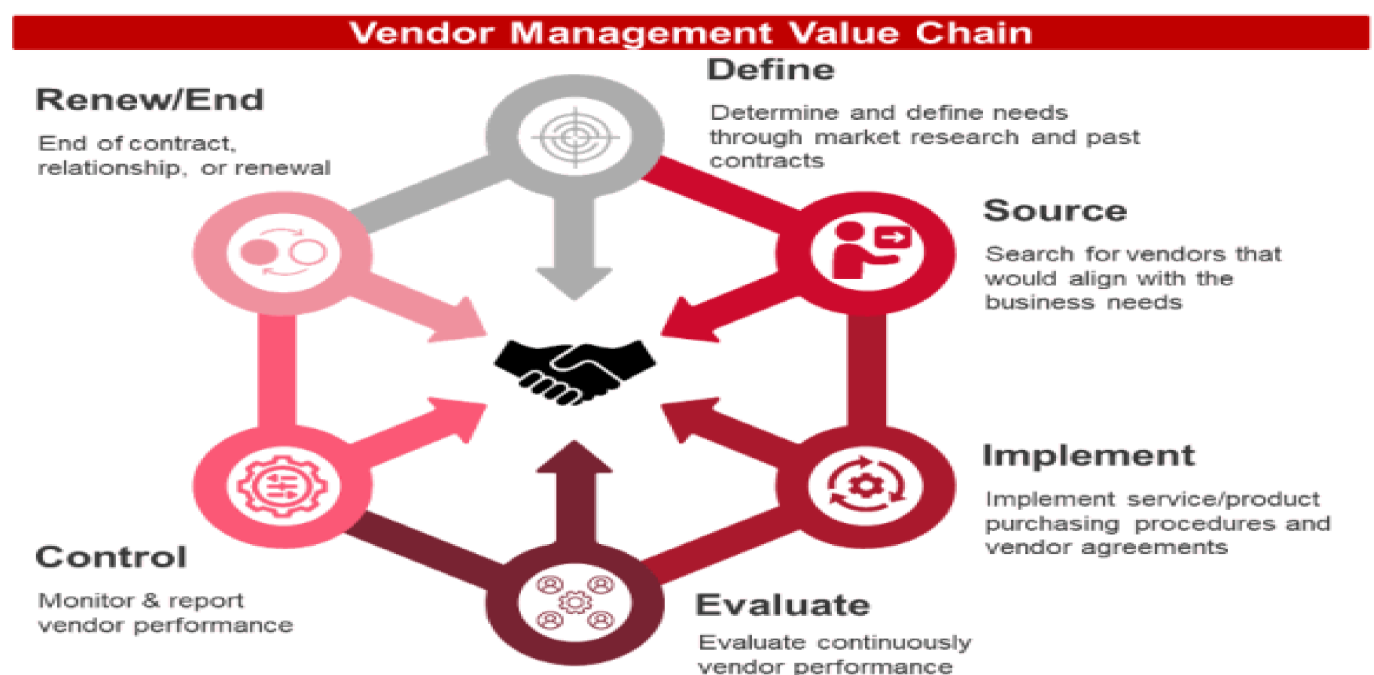
Fill in the people

Balance authority and responsibility

Fill in employee data and metrics

Practice robust performance management of employees

Review your organizational structure annually



# Introduction to Cloud and IOT Concepts

## 4.1 FUNDAMENTALS OF CLOUD:

Cloud computing is a subscription based service where can obtain networked storage space and computer resource over the internet.

### Characteristics of cloud Computing:

- Pay as you use
- No server space required.
- No experts required for hardware and software maintenance.
- Better Data security
- High Flexibility
- Data can be accessed and shared anywhere over the internet.
- Data Recovery is easy.

Cloud computing divided into two

1. Deployment Model
2. Service Model

### Deployment Model Types:

- **Public Cloud:** A public can be accessed by any subscriber with an internet connection and access to the cloud space.  
Ex: Microsoft Azure, Google, AWS (Amazon web service)
- **Private Cloud:** A private cloud is established for a specific group or organization and limits access to just that group.  
Ex: VMware
- **Hybrid Cloud:** A hybrid cloud is a combination of at least two clouds where the clouds include either mixture of public and private.
- **Community Cloud:** A community cloud is shared among two or more organization that have similar requirement.

## 4.2 SERVICE MODEL TYPES

1. Infrastructure as a Service (IaaS)
2. Platform as a Service (PaaS)
3. Software as a Service (SaaS)

- **Infrastructure as a Service (IaaS):** IaaS is also known as Hardware as a Service (HaaS). It is a computing infrastructure managed over the internet. The main advantage of using IaaS is that it helps users to avoid the cost and complexity of purchasing and managing the physical servers.

### Characteristics of IaaS:

There are the following characteristics of IaaS -

- Resources are available as a service
- Services are highly scalable
- Dynamic and flexible
- GUI and API-based access
- Automated administrative tasks

**Example:** DigitalOcean, Linode, Amazon Web Services (AWS), Microsoft Azure, Google Compute Engine (GCE), Rackspace, and Cisco Metacloud

- **Platform as a Service (PaaS):** PaaS cloud computing platform is created for the programmer to develop, test, run, and manage the applications.

### Characteristics of PaaS:

There are the following characteristics of PaaS -

- Accessible to various users via the same development application.
- Integrates with web services and databases.
- Builds on virtualization technology, so resources can easily be scaled up or down as per the organization's need.
- Support multiple languages and frameworks.
- Provides ability to “**Auto-scale**”.

# Cyber security And Safety

# 5

## 5.1 INTRODUCTION TO CYBER SECURITY AND SAFETY

### Cyber Security

Cyber Security is the technology and process that is designed to protect networks and device for attacks, damage or unauthorized access.

### Cyber Safety

Cyber Safety is the safe and responsible use of information and communication technology. It is about helping information safe and secure.

#### 5.1.1 Brief Awareness on cyber Safety Measures

- Keep personal information professional and limited
- Keeps the privacy setting on.
- Practice safe browsing.
- Make sure your internet connection is secure.
- Be careful what you download.
- Choose strong Passwords
- Make online purchases from secure sites.
- Keep your Antivirus program up to date
- Block third party website.

#### 5.1.2 Basic Security Issues in Mobile phones

1. **Data Leakage:** Mobile application is often the course of unintentional data leakage.
2. **Unsecured Wi-Fi:** Free wifi networks are usually unsecured. Never use it to access confidential or personal services like banking and credit card information.
3. **Spyware:** It is unwanted software designed to access your mobile often without your knowledge.
4. **Unsafe Operating System:** Large number of mobile devices is not kept up to date with operating system release.

5. **Unsafe apps:** the mobile phone vendors try to ensure app security through requiring apps to be signed to be downloaded from official app stores.

6. **Lost Devices:** Portable devices are easily lost or stolen.

#### 5.1.3 Installation of Antivirus software

Antivirus software is a class of program designed to prevent, detect and remove malware infections on individual computing devices, networks and IT systems. There are many antivirus products available in market like Avast, McAfee, Kaspersky, Norton, Trend, AVG Anti Virus, AVIRA, PANDA etc. Now we are considering Avast antivirus and below are the steps to install and use this product.

There are many antivirus software are available in market like Avast, Mcfree, 360Total Security, Kaspersky, AVG etc.

Here we are considering 360TotalSecurity antivirus for installation.

1. Open the web browser and download free 360TotalSecurity antivirus.
2. Locate your program under the “Products” tab on the 360 Total Security website. Click the “Download” button to download the anti-virus software for free.
3. Once the program downloads, locate the installer file and double click to open.  
360 tal Security: 360TS\_Setup\_Mini
4. Select your language option and click “Install” to continue the installation process.
5. After installation click on start to setup antivirus.
6. Using antivirus software can perform operation like virus scan, clean-up, speed up etc.

# Protective Devices and Wiring Circuits

# 3

## 3.1 NECESSITY OF PROTECTIVE DEVICES

- *Definition:* Device protection refers to a manner of protecting consumers from electrical faults. The main objective of a protective device is to keep the power system stable by isolating only the components that are under fault, whilst leaving as much of the network as possible in operation. The devices that are used to protect the power systems from faults are called protection devices.
- The risk of a fire increases when an electrical circuit overheats, exceeds its voltage, short-circuiting, and earth faults. These faults can turn out to be severe and cause great damage to lives, property, and electric appliances. Hence, the use of circuit protection devices is critical in every household, business premises, institutions, and factories.

Here's a summarized breakdown of the importance of circuit protection:

- **Protection from electrical damage:** Purchasing electric appliances costs you money, sometimes huge amounts. Using circuit protection devices helps you prevent their damage in case of current surges.
- **Prevention of fires:** Overcurrent can easily set your house on fire and damage all your household property. Thankfully, circuit breakers reduce this risk of fire outbreaks.
- **Prevents ongoing electric shocks and electrocution:** Protective devices, such as RCDs, protect humans from electric shocks that could otherwise turn catastrophic.
- **Saves you money:** Without protective devices, you'd be spending a huge amount of money on electrical repairs every time you experience electric faults.

## 3.2 VARIOUS PROTECTIVE DEVICES AND THEIR FUNCTIONS

- To prevent excessive electrical damage, fire outbreaks, and loss of lives when these faults occur, you need to have circuit protection devices fixed at strategic points along the electric circuit.
- Below are the most common types of circuit protection devices:
  1. Fuse wire or fuse
  2. Glass cartridge fuse
  3. HRC fuse
  4. Kit-kat fuse
  5. MCB
  6. MCCB
  7. RCCB
  8. ELCB
  9. Relay

### 1. Fuse wire or fuse

- A fuse is an electrical safety device that operates to provide overcurrent protection of an electrical circuit.
- Fuse works on the principle of the heating effect of electric current.
- Its essential component is a metal wire or strip that melts when too much current flows through it, thereby stopping or interrupting the current and therefore preventing the appliances from getting damaged.
- Generally, fuse wire is made of an alloy of lead and tin because its resistivity is high and melting point is low.
- The fuse wire is always connected in the live wire of the circuit.

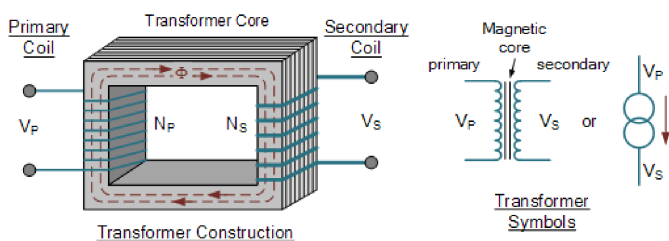
# Electrical Machines and Batteries and UPS

# 4

## 4.1 TRANSFORMER

- A transformer is a device used in the power transmission of electric energy. The transmission current is AC. It is commonly used to increase or decrease the supply voltage without a change in the frequency of AC between circuits.
- Transformer works on the principle of Faraday's law of mutual induction and electromagnetic induction. Faraday's law of electromagnetic induction states that, when a change takes place in the magnetic flux which is linked with a circuit, an electromotive force current will induce in the circuit.
- Transformers are used in a variety of applications, including power generation, transmission and distribution, lighting, audio systems, and electronic equipment. Power generation: Transformers are used in power plants to increase the voltage of the electricity generated by the plant before it is sent to the grid.

## 4.2 TRANSFORMER WORKING PRINCIPLE



Where:  $V_p$  - primary voltage  $V_s$  - secondary voltage  
 $N_p$  - number of primary windings  $N_s$  - number of secondary windings  $\phi$ (ph) - flux linkage

- The transformer, in a simple way, can be described as a device that steps up or steps down voltage. In a step-up transformer, the output voltage is increased, and in a step-down transformer, the output voltage is decreased. The step-up

transformer will decrease the output current, and the step-down transformer will increase the output current to keep the input and output power of the system equal.

- The transformer is basically a voltage control device that is used widely in the distribution and transmission of alternating current power. However, the general purpose of using transformers was to maintain a balance between the electricity that was generated at very high voltages and consumption which was done at very low voltages.
- *There are three components of a Transformer:* Iron Core, Primary Winding (coil), Secondary Winding(coil).
- The two coils – primary coil and secondary coil – on the transformer core. The core laminations are joined in the form of strips. The two coils have high mutual inductance. When an alternating current passes through the primary coil, it creates a varying magnetic flux. As per Faraday's law of electromagnetic induction, this change in magnetic flux induces an EMF (electromotive force) in the secondary coil, which is linked to the core having a primary coil. This is mutual induction.

Overall, a transformer carries out the following operations:

1. Transfer of electrical energy from one circuit to another
2. Transfer of electrical power through electromagnetic induction
3. Electric power transfer without any change in frequency
4. Two circuits are linked with mutual induction

## 4.3 TRANSFORMER RATIO

- The ratio of the number of turns in the secondary coil to the number of turns in the primary coil of the transformer.

# Introduction to Electronic Devices and Digital Electronics

5

## 5.1 COMPARISON OF CONDUCTORS, INSULATORS AND SEMICONDUCTORS WITH EXAMPLES

- The device which controls the flow of electrons is called electronic device. These devices are the main building blocks of electronic circuits.
- The electric current can flow easily through some materials or substance.
- Materials can be classified into three types depending on their electricity conduction
  1. Conductors
  2. Insulators
  3. Semiconductors

- Levels of conductivity are the main difference between conductors, semiconductors and insulators. Conductors display high conductivity, which means they allow energy, such as electricity, heat or sound, to easily flow through them (e.g. copper, silver, water, metals, water, human body). Whereas semiconductors allow a moderate flow (e.g. cotton, sand, germanium) and insulators exhibit low conductivity (e.g. wood, rubber, plastic, glass).
- The Comparison between conductors, insulators and semiconductors is shown in below table

**Table: Comparison between conductors, semiconductor & Insulators**

S No.	Conductors	Semiconductors	Insulators
1	Easily conducts the electrical current.	Conducts the electric current less than conductor and greater than insulator.	Does not conduct any current.
2	Has only one valence electron in its outermost orbit.	Has four valence electron in its outermost orbit.	Has eight valence electron in its outermost orbit.
3	Conductor formed using metallic bonding.	Semiconductors are formed due to covalent bonding.	Insulators are formed due to ionic bonding.
4	Valence and conduction bands are overlapped	Valence and conduction bands are separated by forbidden energy gap of 1.1eV.	Valence and conduction bands are separated by forbidden energy gap of 6 to 10eV.
5	Resistance is very small	Resistance is high.	Resistance is very high.
6	It has positive temperature coefficient	It has negative temperature coefficient	It has negative temperature coefficient
7	Ex : copper, aluminium, etc	Ex : silicon, germanium etc	Ex : Mica, Paper, etc



# **Project Management Skills**





MARKS DISTRIBUTION FOR EACH CHAPTER		
Sl. No.	Chapters	Marks
1	Introduction to Project	4
2	Project Administration	4
3	Project Life Cycle	4
4	Project Planning, Scheduling and Monitoring	4
5	Project Control, Review and Audit	4
Total		20

# Introduction to Project

# 1

## 1.1 INTRODUCTION

Each of us working on a task that has a start and an end.

**"Project is a one short, time limited, goal oriented, required commitment of varied skills and resources to achieve a specific purpose".**

A group of related tasks or jobs aimed at achieving a larger goal.

### Major characteristics of a project

- Has a predetermined goal
- Has a fixed duration
- Involvement of whole team/group is required
- Involves a first time experiment
- Standard performance and specific time cost requirement

## 1.2 FEATURES OF A PROJECT

1. A project is a goal oriented
2. It is temporary in nature.
3. It has a specific life span [start to end]
4. It has a fixed set of objectives
5. A project is unique in nature
6. It consists of non-routinized, non-repetitive and one off activities
7. It involves the use of multiple resources
8. It has a fixed budget
9. Each project has risk and uncertainty associates with it.
10. A project is successful when it needs expectations of your stakeholders.

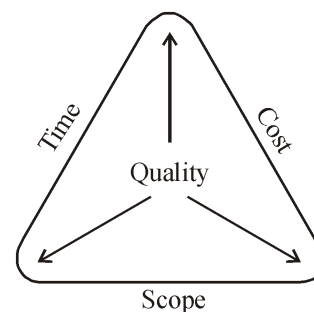
## Reasons to start with the project

1. A customer demand / market demand
2. An organisational need
3. A technological advice
4. A legal requirement

Three major dimensions that defines the project performance.

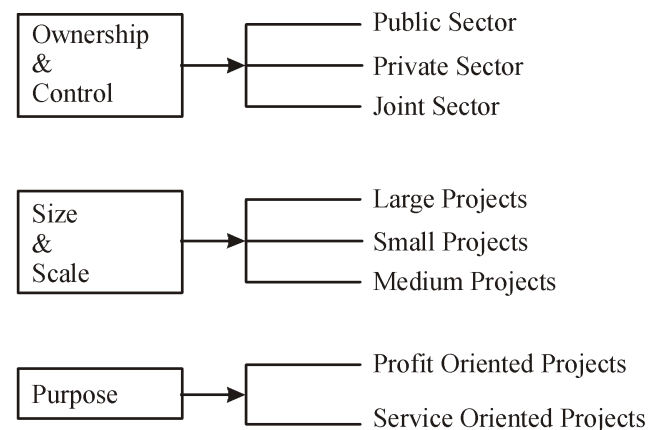
1. Scope
2. Time
3. Resource

The three dimensions are interrelated changes in one of the dimensions directly affect the others.



Performance =  
 $f(\text{Scope, Cost, Time})$

## 1.3 CLASSIFICATION OF PROJECTS



# Project Administration

## 2

### 2.1 ESSENTIALS OF PROJECT ADMINISTRATION

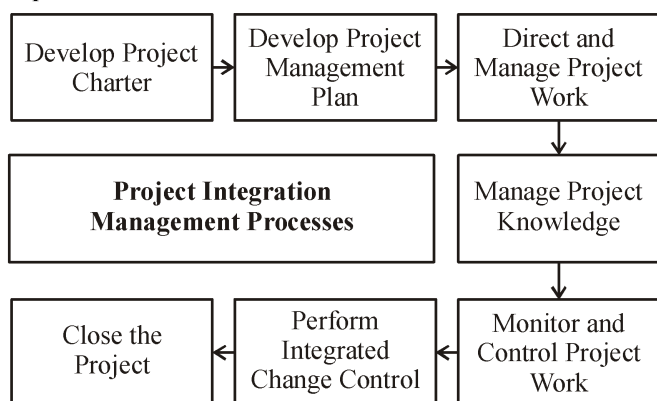
**Project Administration** means activities related to project management and administrative functions concerned with the project including, but not limited to, facilitating arrangements for the project team operations, and overseeing the project's daily functions to ensure deadlines and compliance requirements are met.

The planned project after execution must be coordinated with all the team members and the main objective of project administration is to control the project process.

1. Firstly, the chief executive of the project will create a project chart which is necessary for the project execution.
2. Project chart defines the goal and objective of the project, the role & responsibilities of each member of the team and requests the cooperation of all concerned in the execution of the project.
3. Set the resources required, equipment, and software.
4. Track expenses and predict future costs.
5. Monitor project progress
6. Analyse the risk through risk management
7. Control quality and quantitative.
8. Ensure requirement deliverables.

The whole project administration work as project integration management process from beginning of the project to the end of the project.

Project Integration Management process follow the steps:-



The two system for the management of project are **project work system** and **project control system**.

Project work system can be design by developing and preparing the following tools.

1. Work Breakdown Structure.
2. Project Execution Plan.
3. Project Procedure Manual.

### 2.2 PROJECT TEAM

The project team is the group of people responsible for executing the tasks and producing deliverables outlined in the project plan and schedule, as directed by the project manager, at whatever level of effort or participation defined for them.

#### Types of project team

1. Initial project team.
2. Designated leader/Project manager
3. Core project team.
4. Full project team.
5. Project advisors.
6. Project stakeholders.
7. Process facilitators.

#### 1. Initial Project Team

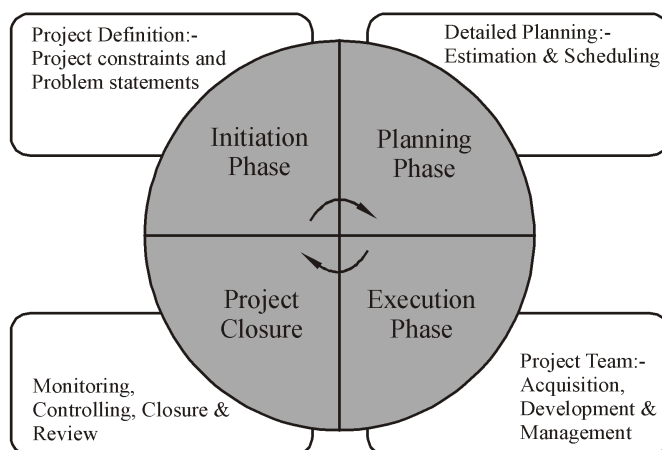
- The initial project team consists of specific people who initially conceive the idea of starting a project.
- The team members are responsible for the planning and execution of the project.
- One of the team members will be designated as the project manager.
- The project manager will be responsible for coordinating the activities amongst the team members.

# Project Life Cycle

## 3.1 INTRODUCTION

Each project has a lifespan, during which it goes through various stages that are collectively referred to as the project life cycle.

The project life cycle is a framework for managing all types of projects and gives project managers instructions for completing projects successfully.



These phases are also known as Project Management Cycles

## 3.2 PROJECT MANAGEMENT LIFE CYCLE

The project management life cycle refers to the stages that a project goes through from its initiation to its closure. It provides a structured approach for managing projects and ensures that they are planned, execute, monitored and controlled in a systematic manner. While different organizations and methodologies may have variations in their project life cycles, the following are the four commonly recognized phases:

### 3.2.1 Project Initiation (Define what needs to be done)

The project begins with the project initiation.

Initiation phase defines those processes that are required to start a new project. The purpose of the project

initiation phase is to determine what the project should accomplish.

Essential project management procedures to initiate project are :

- 1. Project Charter:** Set up of project vision, goals and objectives.
- 2. Making a business case:** It includes a well-structured document that will justify the various aspects like cost, risk and benefits of the project.
- 3. A feasibility study:** Any number of factors starting from economic factors, technical, operational, schedule, resources etc.,
- 4. Identifying deliverables:** The tangible products or services that must be delivered once a project is finished. Deliverables may be physical or abstract in nature.
- 5. Identifying project stakeholders:** Any group of people who can affect or be influenced by the project is referred to as a project stakeholder.
- 6. Financial analysis:** Estimating the cost and benefits of solution

### 3.2.2 Planning Phase (Define how to do, what to be done)

It involves drafting the planning documents that will serve as the team's roadmap for completing the project.

Documents may include:

- **Define the scope:** It is a document that outlines the entire project. The objectives used to gauge the project's performance will also be specified in the scope statement.
- **Work breakdown structure:** It divides the whole project into smaller activities.
- **Communication plan:** During the planning phase of your project, it is important to plan when and how often you will communicate, not only with your team but also your clients and stakeholders.

# Project Planning, Scheduling and Monitoring

## 4

### Project Plan

The project plan decides what, where, who, why, how and when to do the project. The purpose of a project plan is to guide the execution and control the project phases.

A project plan is a series of formal documents that define the execution and control stages of a project.

#### 4.1 NATURE OF PROJECT PLANNING

The project planning helps in streamlining the process of the Project.

Planning helps in the smooth running of the project as every aspect of the project is taken into consideration, and the required solution.

The Project plan consists of three related parts.

1. Scope
  2. Schedule
  3. Cost
1. **Scope:** It states the methods and procedures of each work and the name of the person or organisation unit, responsible for the work.
  2. **Schedule:** It states the estimated time required to complete each work and the interrelationships among the work.
  3. **Cost:** It is stated in the project budget, usually called the control budget.

#### 4.2 NEED FOR PROJECT PLANNING

One of the objectives of project planning is to completely define all the work required so that it will be readily identifiable to each project participant.

There are four basic reasons for project planning.

1. To eliminate or reduce uncertainty.
2. To improve efficiency of the operation.

3. To obtain a better understanding of the objectives.
4. To provide a basis for monitoring and controlling the work

#### 4.3 FUNCTIONS OF PROJECT PLANNING

The functions of the Project Planning are;

1. It should provide a basis for organising the work on the project and allocating responsibilities to individuals.
2. It is a means of communication and coordination between all those involved in the project.
3. It inspires the people to look ahead.
4. It induces a sense of urgency and time consciousness.
5. It establishes the basis for monitoring and control

#### 4.4 STEPS IN PROJECT PLANNING

1. Define the problem to be solved by the project.
2. Develop a mission statement, followed by statements of major objectives.
3. Develop a project strategy that will meet all project objectives.
4. Write a scope statement to define project boundaries (what will and will not be done).
5. Develop a work breakdown structure (WBS).
6. Using the WBS, estimate activity durations, resource requirements, and costs.
7. Prepare the project master schedule and budget.
8. Decide on the project organization structure.
9. Create the project plan.
10. Get all project stakeholders to sign off on the plan.

# Project Control, Review and Audit

## 5

### 5.1 INTRODUCTION

Project control involves a regular comparison of performance against targets, a search for the causes of deviation and a commitment to check adverse variances. Project control serves two major functions:

1. It ensures regular monitoring of performance.
2. It motivates project personnel to strive for the achieving project objectives.

Project control is generally done by establishing the controls and controlling the ongoing activities using those controls.

#### Project Control involves four steps

They are,

1. Setting targets for what should be achieved.
2. Measurement of what is happening and anticipation of what may happen.
3. Comparison between what should happen and what is happening or likely to happen.
4. Taking corrective actions to make things happen, as they should. These four steps should follow each other till the work is completed.

### 5.2 PROJECT CONTROL PURPOSES

The purpose of the project control are:

1. To observe the work in progress.
2. To ensure that it follows the plan.
3. To understand the basic problems.
4. To take appropriate action when necessary

### 5.3 PROBLEMS OF PROJECT CONTROL

Effective control is crucial for the realisation of project objectives. There are three main reasons for poor control of projects. Viz.,

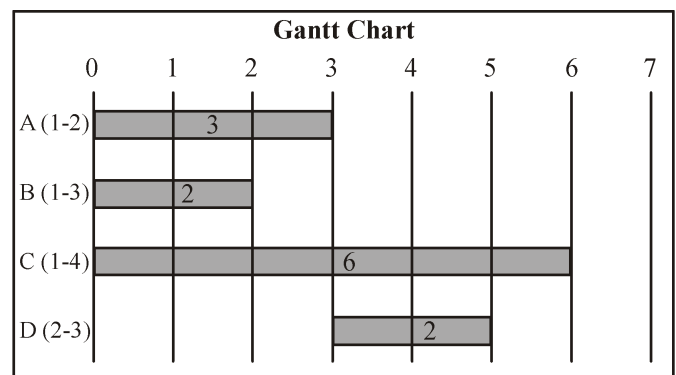
1. Characteristics of the ultra-mega projects like, complexities, maintenance of non-routine activities, co-ordination and communication problems.
2. People problems like, managers do not have required experience and training, lack of competence but have inclination to control projects.
3. Poor control and information system: Delay in reporting performance, inappropriate level of detail, unreliable information.

### 5.4 GANTT CHARTS

In dealing with complex projects a pictorial representation showing the various jobs to be done, and the time and money involved is generally helpful.

One such pictorial charts is the bar chart, was developed by **Henry Gantt**. It consists of two coordinate axes, one representing the time elapsed and the other, jobs or activities performed. The jobs are represented in the form of bars.

The length of a bar indicates the duration of the job or activity.



In figure shown the activities A, B and C can start at the same time and proceed in parallel, though they take different time intervals for their completion. Activity D, however, cannot begin until the activity A is over.

# DCET 2023 - Question Paper & Solutions

1. In a square matrix, if the elements above the principal diagonal are zero, then it is called

- a) Identity matrix
- b) Lower triangular matrix
- c) Upper triangular matrix
- d) Diagonal matrix

Ans : (b)

$$A = \begin{bmatrix} 2 & 0 & 0 \\ 1 & 4 & 0 \\ 2 & 5 & 1 \end{bmatrix}$$

2. The value of  $x$  if  $\begin{bmatrix} x-1 & 2 \\ 2 & 4 \end{bmatrix}$  is singular, is

- a) 3
- b) 8
- c) -2
- d) 2

Ans : (d)

Given matrix  $A = \begin{bmatrix} x-1 & 2 \\ 2 & 4 \end{bmatrix}$  is singular

w.k.t.  $|A| = 0 \quad \therefore$  singular

$$\begin{vmatrix} x-1 & 2 \\ 2 & 4 \end{vmatrix} = 0$$

$$(x-1)4 - 4 = 0$$

$$4x - 4 - 4 = 0$$

$$4x = 8$$

$$x = \frac{8}{4} \quad x = 2$$

3. The inverse of the matrix  $A = \begin{bmatrix} -1 & 0 \\ 5 & 7 \end{bmatrix}$  is

- a)  $-\frac{1}{7} \begin{bmatrix} 7 & 0 \\ -5 & -1 \end{bmatrix}$
- b)  $\frac{1}{7} \begin{bmatrix} 7 & 0 \\ -5 & -1 \end{bmatrix}$
- c)  $-\frac{1}{7} \begin{bmatrix} -7 & 0 \\ -5 & -1 \end{bmatrix}$
- d)  $\frac{1}{7} \begin{bmatrix} 7 & 0 \\ 5 & 1 \end{bmatrix}$

Ans : (a)

Given matrix  $A = \begin{bmatrix} -1 & 0 \\ 5 & 7 \end{bmatrix}$

WKT  $A^{-1} = \frac{1}{|A|} \text{adj } A$

$\therefore$  adjoint of  $A = \begin{bmatrix} 7 & 0 \\ -5 & -1 \end{bmatrix}$

and  $|A| = \begin{vmatrix} -1 & 0 \\ 5 & 7 \end{vmatrix} = -7 - 0 = -7$

$\therefore A^{-1} = \frac{-1}{7} \begin{bmatrix} 7 & 0 \\ -5 & -1 \end{bmatrix}$

4. The eigenvalue of the matrix  $A = \begin{bmatrix} 3 & 0 \\ 1 & 3 \end{bmatrix}$  is

- a) 2, 2
- b) -3, -3
- c) 3, 3
- d) -3, 3

Ans : (c)

Given  $A = \begin{bmatrix} 3 & 0 \\ 1 & 3 \end{bmatrix}$

The characteristic equation of  $A$  is,  $|A - \lambda I| = 0$

$$\begin{vmatrix} 3-\lambda & 0 \\ 1 & 3-\lambda \end{vmatrix} = 0$$

$$(3-\lambda)(3-\lambda) - 0 = 0$$

$$(3-\lambda) = 0 \text{ \& } (3-\lambda) = 0$$

$$\lambda = 3, \lambda = 3$$

5. The two lines  $ax + by = c$  and  $a'x + b'y = c'$  are perpendicular if

- a)  $ab' = ba'$
- b)  $aa' + bb' = 0$
- c)  $a'b + a'b' = 0$
- d)  $ab' + ba' = 0$

**Ans : (b)**Given  $ax + by = c$  and  $a'x + b'y = c'$  are perpendicular

$$ax + by = c \quad \text{---- (i)}$$

$$\therefore m_1 = \frac{-a}{b}$$

$$a'x + b'y = c' \quad \text{---- (ii)}$$

$$\therefore m_2 = \frac{-a'}{b'}$$

$$\therefore m_1 m_2 = -1 \quad (\because \text{lines are perpendicular})$$

$$\left(-\frac{a}{b}\right)\left(-\frac{a'}{b'}\right) = -1$$

$$aa' = -bb'$$

$$aa' + bb' = 0$$

**6. The y-intercept of any line passing through the origin in**

- a) 0      b) 1      c) -1      d) 2

**Ans : (a)**

The y-intercept of any line passing through the origin is zero.

**7. Slope intercept form of straight line is**

- a)  $y + mx - c = 0$       b)  $x = my + c$   
c)  $y = x + m$       d)  $y = mx + c$

**Ans : (d)**The slope intercept from the straight line is  $y = mx + c$ .**8. The tangent of the angle of intersection between two lines with slopes  $m_1$  and  $m_2$  is**

- a)  $\left| \frac{m_1 + m_2}{1 - m_1 m_2} \right|$       b)  $\left| \frac{m_1 + m_2}{m_1 - m_2} \right|$   
c)  $\left| \frac{m_1 - m_2}{1 - m_1 m_2} \right|$       d)  $\left| \frac{m_1 - m_2}{1 + m_1 m_2} \right|$

**Ans : (d)**

The tangent of the angle of intersection between

two lines with slopes  $m_1$  and  $m_2$  is  $\left| \frac{m_1 - m_2}{1 + m_1 m_2} \right|$ **9. If the ladder is inclined to the wall at an angle of  $135^\circ$ , then the inclination in radians is**

- a)  $\frac{4\pi}{3}$       b)  $\frac{3\pi}{4}$       c)  $\frac{2\pi}{4}$       d)  $\frac{4\pi}{5}$

**Ans : (b)**Given angle  $\theta = 135^\circ$ 

$$\begin{aligned} \text{Angle in radian} &= \frac{\pi}{180} \times \theta = \frac{\pi}{180} \times 135 \\ &= \frac{3\pi}{4} \text{ radian} \end{aligned}$$

**10. The value of  $\sin 60^\circ \cos 30^\circ - \cos 60^\circ \sin 30^\circ$  is**

- a)  $\frac{1}{2}$       b)  $-\frac{1}{2}$       c)  $\frac{\sqrt{3}}{2}$       d) 0

**Ans : (a)**

$$= \sin 60^\circ \cos 30^\circ - \cos 60^\circ \sin 30^\circ$$

$$= \frac{\sqrt{3}}{2} \times \frac{\sqrt{3}}{2} - \frac{1}{2} \cdot \frac{1}{2} \times \frac{3}{4} - \frac{1}{4} = \frac{2}{4} = \frac{1}{2}$$

**11. The simplified value of  $\frac{\sin 3A + \sin A}{\sin 3A - \sin A}$  is**

- a)  $\cot A \tan 5A$       b)  $\tan A \cot 2A$   
c)  $\tan 2A \cot A$       d)  $\tan 3A \cot 2A$

**Ans : (c)**

$$\frac{\sin 3A + \sin A}{\sin 3A - \sin A} = \frac{2 \sin\left(\frac{3A + A}{2}\right) \cos\left(\frac{3A - A}{2}\right)}{2 \cos\left(\frac{3A + A}{2}\right) \sin\left(\frac{3A - A}{2}\right)}$$

$$[\because \sin C + \sin D = 2 \sin\left(\frac{C + D}{2}\right) \cos\left(\frac{C - D}{2}\right)]$$

$$[\because \sin C - \sin D = 2 \cos\left(\frac{C + D}{2}\right) \sin\left(\frac{C - D}{2}\right)]$$

$$= \frac{2 \sin 2A \cos A}{2 \cos 2A \sin A} = \tan 2A \cot A$$



# DCET 2024 - Question Paper & Solutions

1. If  $A = \begin{bmatrix} 3 & -2 \\ 4 & 1 \end{bmatrix}$  and  $A - B = \begin{bmatrix} 5 & -3 \\ 4 & 6 \end{bmatrix}$ , then matrix  $B$  is \_\_\_\_\_.

- a)  $\begin{bmatrix} -3 & 2 \\ -4 & -1 \end{bmatrix}$       b)  $\begin{bmatrix} -5 & 3 \\ -4 & -6 \end{bmatrix}$   
 c)  $\begin{bmatrix} -2 & 1 \\ 0 & -5 \end{bmatrix}$       d)  $\begin{bmatrix} 2 & -1 \\ 0 & 5 \end{bmatrix}$

**Ans : (c)**

$$\text{Given, } A = \begin{bmatrix} 3 & -2 \\ 4 & 1 \end{bmatrix} \text{ and } A - B = \begin{bmatrix} 5 & -3 \\ 4 & 6 \end{bmatrix}$$

$$\therefore \begin{bmatrix} 3 & -2 \\ 4 & 1 \end{bmatrix} - \begin{bmatrix} 5 & -3 \\ 4 & 6 \end{bmatrix} = B$$

$$B = \begin{bmatrix} -2 & 1 \\ 0 & -5 \end{bmatrix}$$

2. If  $\begin{bmatrix} 3 & -4 \\ 9 & 2 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 10 \\ 2 \end{bmatrix}$ , then the values of  $x$  and  $y$  are \_\_\_\_\_

- a)  $\left(\frac{2}{3}, -2\right)$       b)  $\left(2, \frac{2}{3}\right)$   
 c)  $\left(-2, \frac{2}{3}\right)$       d)  $\left(\frac{-2}{3}, 2\right)$

**Ans : (a)**

$$\text{Given } \begin{bmatrix} 3 & -4 \\ 9 & 2 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 10 \\ 2 \end{bmatrix}$$

$$\begin{bmatrix} (3x) + (-4y) \\ (9x) + (2y) \end{bmatrix} = \begin{bmatrix} 10 \\ 2 \end{bmatrix}$$

$$\begin{bmatrix} 3x - 4y \\ 9x + 2y \end{bmatrix} = \begin{bmatrix} 10 \\ 2 \end{bmatrix}$$

$$\therefore 3x - 4y = 10$$

$$9x + 2y = 2 \rightarrow \times 2$$

$$3x - 4y = 10$$

$$18x + 4y = 4$$

$$21x + 0 = 14$$

$$21x = 14$$

$$x = \frac{14}{21}$$

$$x = \frac{2}{3}$$

$$\therefore 3x - 4y = 10$$

$$3\left(\frac{2}{3}\right) - 4y = 10$$

$$2 - 4y = 10$$

$$2 - 10 = 4y$$

$$-8 = 4y$$

$$\frac{-8}{4} = y$$

$$\therefore y = -2$$

3. If  $A = \begin{bmatrix} -2 & 6 \\ -2 & 3 \end{bmatrix}$ , then  $A^{-1}$  is \_\_\_\_\_.

- a)  $\frac{1}{18} \begin{bmatrix} 3 & -6 \\ 2 & -2 \end{bmatrix}$       b)  $\frac{1}{6} \begin{bmatrix} 3 & -6 \\ 2 & -2 \end{bmatrix}$   
 c)  $\begin{bmatrix} 3 & -6 \\ 2 & -2 \end{bmatrix}$       d)  $\frac{1}{6} \begin{bmatrix} -2 & 6 \\ -2 & 3 \end{bmatrix}$

**Ans : (b)**

$$\text{Given } A = \begin{bmatrix} -2 & 6 \\ -2 & 3 \end{bmatrix}, |A| = \begin{vmatrix} -2 & 6 \\ -2 & 3 \end{vmatrix} = -6 - (-12)$$

$$|A| = -6 + 12 = 6$$

$$\text{W.K.T. } A^{-1} = \frac{1}{|A|} \cdot \text{adj } A$$

**Ans : (c)**

Explanation : LVDT sensor is used to sense Displacement, Force and Pressure.

**89. A p-n junction diode is a \_\_\_\_\_**

- a) Bidirectional switch
- b) Unidirectional switch
- c) Bidirectional Controlled Switch
- d) Unidirectional Controlled Switch

**Ans : (b)**

Explanation : A P-N junction diode is a unidirectional switch. It allows the flow of current in only one direction i.e., From Anode to Cathode terminal.

**90. The purpose of C Filter in a power supply is to \_\_\_\_\_**

- a) Degrade regulation
- b) Reduce ripple
- c) Reduce gain
- d) Reduce the change of an electric shock

**Ans : (b)**

Explanation : The purpose of C Filter in a power supply is used to decrease unwanted ripple voltage. In a rectifier the C filter is connected in parallel with the load.

**91. Lead acid cell is an example of \_\_\_\_\_**

- a) Secondary cell      b) Solar cell
- c) Primary cell        d) Fuel cell

**Ans : (a)**

Explanation : A secondary cell is a cell that is designed to be recharged with electricity and reused many times.

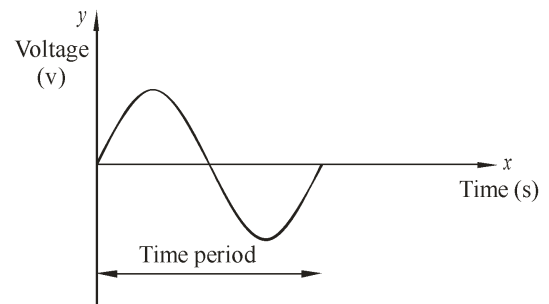
Ex : Lead-Acid, Nickel Cadmium, Lithium ion.

**92. Time taken by the alternating quantity to complete one cycle is called \_\_\_\_\_**

- a) Frequency            b) Time period
- c) Amplitude           d) Wavelength

**Ans : (b)**

Explanation : The time taken by an alternating quantity to complete one cycle is called Time period.



**93. What does "PLC" stand for in the context of Industrial Automation?**

- a) Programmable Logic Circuit
- b) Process Logic Controller
- c) Programmable Logic Controller
- d) Processor Logic Controller

**Ans : (c)**

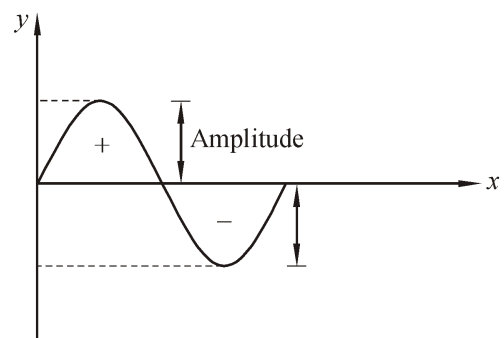
Explanation : PLC stands for Programmable Logic Controller which is used for Industrial Automation.

**94. Maximum value attained by the alternating quantity either in positive half-cycle or negative half-cycle is called \_\_\_\_\_.**

- a) Frequency            b) Altitude
- c) Amplitude            d) Wavelength

**Ans : (c)**

Explanation : Amplitude is the maximum value attained by the Alternating quantity either in positive (or) Negative Half cycle of the waveform



**95. Which of the following statement is correct?**

- a) In series circuit the current through each resistor is different.
- b) In parallel circuit the voltage across each resistor is same.
- c) In parallel circuit the equivalent resistance is sum of individual resistances
- d) In series circuit the reciprocal of equivalent resistance is sum of reciprocal of individual resistances.

**Ans : (b)**

Explanation : The voltage value should be same (or) equal (or) remains constant in the parallel circuit.

**96. The cell which cannot be recharged and reused is \_\_\_\_.**

- a) Secondary cell      b) Battery
- c) Primary cell      d) Simple cell

**Ans : (c)**

A primary cell is a cell that is designed to be used once and discarded and not recharged with electricity and can not reused like a secondary cell.

**97. Specific gravity of a fully charged lead acid battery will be in the range of \_\_\_\_**

- a) 1000 to 1210      b) 1100 to 1310
- c) 1150 to 1310      d) 1230 to 1300

**Ans : (d)**

Explanation : Specific gravity of a fully charged lead acid battery will be in the range of 1230 to 1280.

**98. The best sensor for sensing vibration is \_\_\_\_**

- a) Thermistor      b) Thermocouple
- c) Piezoelectric crystal
- d) Hygrometer

**Ans : (c)**

The piezo electric crystal sensor is used for sensing vibration of an object.

**99. During charging of batteries**

- a) Chemical energy is converted to Mechanical energy
- b) Mechanical energy is converted to Chemical energy
- c) Electrical energy is converted to Chemical energy
- d) Chemical energy is converted to Electrical energy.

**Ans : (c)**

Explanation : During charging of a batteries, Electrical energy is converted to chemical energy.

**100. When an electric stove is connected across 230 volts, 50 Hz AC supply for the duration of one hour and takes a current of 10 amperes, the energy consumed is:**

- a) 230 units
- b) 2.3 units
- c) 23 units
- d) 0.23 units

**Ans : (b)**

Explanation :

$$V = 230V$$

$$I = 10A$$

$$t = 1 \text{ hr}$$

$$\text{Energy} = V \times I \times t$$

$$= 230 \times 10 \times 1$$

$$= \frac{2300}{1000} [\because \text{In terms of units Energy} \div 1000]$$

$$\text{Energy} = 2.3 \text{ units}$$

# DCET 2025 - Question Paper & Solutions

1. Choose the correct answer from the following:

- a) Every identity matrix is a scalar matrix
- b) Every scalar matrix is an identity matrix
- c) Every diagonal matrix is an identity matrix
- d) A square matrix whose each element is one is an identity matrix.

**Ans : (a)**

An identity matrix has 1's on the primary diagonal and all the other elements are zero.

A scalar matrix is a diagonal matrix where all diagonal elements are equal (not necessarily 1). So, an identity matrix is a scalar matrix where the scalar is 1.

2. The value of  $\begin{vmatrix} 3 & 1 & -9 \\ -1 & 2 & 3 \\ 2 & 1 & -6 \end{vmatrix}$  is

- a) 45
- b) 90
- c) 0
- d) -45

**Ans : (c)**

$$\begin{vmatrix} + & - & + \\ 3 & 1 & -9 \\ -1 & 2 & 3 \\ 2 & 1 & -6 \end{vmatrix} = 3 \begin{vmatrix} 2 & 3 \\ 1 & -6 \end{vmatrix} - 1 \begin{vmatrix} -1 & 3 \\ 2 & -6 \end{vmatrix} + (-9) \begin{vmatrix} -1 & 2 \\ 2 & 1 \end{vmatrix}$$

$$= 3(-12 - 3) - 1(6 - 6) - 9(-1 - 4)$$

$$= 3(-15) - 1(0) - 9(-5)$$

$$= -45 - 0 + 45 = 0$$

3. The characteristic equation of  $A = \begin{bmatrix} 1 & -2 \\ 3 & 4 \end{bmatrix}$  is

- a)  $\lambda^2 - 3\lambda - 2 = 0$
- b)  $\lambda^2 - 5\lambda + 10 = 0$
- c)  $\lambda^2 - 5\lambda - 2 = 0$
- d)  $\lambda^2 + 3\lambda + 10 = 0$

**Ans : (b)**

$$|A - \lambda I| = 0$$

$$\begin{vmatrix} (1-\lambda) & -2 \\ 3 & (4-\lambda) \end{vmatrix} = 0$$

$$(1-\lambda)(4-\lambda) - [(3)(-2)] = 0$$

$$4 - \lambda - 4\lambda + \lambda^2 + 6 = 0$$

$$\lambda^2 - 5\lambda + 10 = 0$$

4. If  $|A| I = \begin{bmatrix} -3 & 0 \\ 0 & -3 \end{bmatrix}$ , then  $A \cdot \text{adj } A$  is equal to \_\_\_\_

- a)  $\begin{bmatrix} 3 & 0 \\ 0 & 3 \end{bmatrix}$
- b)  $\begin{bmatrix} 9 & 0 \\ 0 & 9 \end{bmatrix}$
- c)  $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$
- d)  $\begin{bmatrix} -3 & 0 \\ 0 & -3 \end{bmatrix}$

**Ans : (d)**

- For any square matrix  $A$ , the identity matrix  $I$ :  
 $A \cdot \text{adj}(A) = |A| I$  is always true.

$$\therefore |A| I = \begin{bmatrix} -3 & 0 \\ 0 & -3 \end{bmatrix}$$

$$\text{Here } A \cdot \text{adj}(A) = |A| I = \begin{bmatrix} -3 & 0 \\ 0 & -3 \end{bmatrix}$$

5. The slope of the straight line joining two points  $(3, -4)$  and  $(-1, 5)$  is

- a)  $4/9$
- b)  $-4/9$
- c)  $-1/4$
- d)  $-9/4$

**Ans : (d)**

- Slope of straight line,  $m = \frac{y_2 - y_1}{x_2 - x_1}$

$$(3, -4) = (x_1, y_1)$$

$$(-1, 5) = (x_2, y_2)$$

$$m = \frac{5 - (-4)}{-1 - 3} = \frac{5 + 4}{-4} = \frac{9}{-4} = \frac{-9}{4}$$

**92. Assertion (A) : Time overrun can lead to cost overrun in a project.**

**Reason (R) : More time often means, more money spent on labour and resources.**

- a) Both (A) and (R) are true and (R) is the correct explanation of (A)
- b) Both (A) and (R) are true but (R) is not the correct explanation of (A)
- c) (A) is true, but (R) is false
- d) (A) is false, but (R) is true

**Ans : (a / b)**

**93. The full form of CPM in project management is \_\_\_\_\_**

- a) Critical Process Management
- b) Critical Path Method
- c) Continuous Project Monitoring
- d) Cost Planning Model

**Ans : (b)**

CPM - Critical Path Method

**94. Which of the following is NOT a tool of project planning, scheduling and monitoring?**

- a) Gantt Chart      b) Flow chart
- c) PERT Chart      d) Milestone Chart

**Ans : (b)**

Flow chart is not a tool used for project planning scheduling and monitoring.

**95. Project Evaluation can be done \_\_\_\_\_**

- a) At the end of the project only
- b) Throughout the project lifecycle
- c) Only during the planning phase
- d) At the start of the project only

**Ans : (b)**

Project evaluation is done throughout the project life cycle.

**96. Identify the incorrect statement regarding the functions of project planning.**

- a) Defines project goals and objectives

- b) Allocates resources without considering constraints
- c) Establishes a project timeline and milestones.
- d) Identifies potential-risks and mitigates them

**Ans : (b)**

Project planning allocate resources by considering constraints.

**97. Which of the following is NOT a key component of "SMART" goal?**

- a) Time-Bound      b) Random
- c) Achievable      d) Specific

**Ans : (b)**

SMART - Specific, Measurable, Achievable, Realistic, Timely / Time-Bound.

**98. The process of correcting and rectifying the errors in the project is \_\_\_\_\_**

- a) Project Audit      b) Project Monitoring
- c) Project Evaluation      d) Project Review

**Ans : (d)**

Project review is defined as process of correcting and rectifying the errors in the project.

**99. The time estimation for a given project are as follows: Optimistic Time = 4 days, Pessimistic time = 8 days, Most likely time = 6 days. The expected time to complete is \_\_\_\_\_**

- a) 7 days      b) 6 days      c) 5 days      d) 4 days

**Ans : (b)**

$$T_e = \frac{t_o + 4t_m + t_p}{6} = \frac{4 + 4(6) + 8}{6} = \frac{36}{6} = 6 \text{ days}$$

**100. Watching 3D movie is an example of \_\_\_\_\_**

- a) Augmented Reality      b) Virtual Reality
- c) Augmented and Virtual Reality
- d) Cloud Technology

**Ans : (a, b, c)**

Watching 3D movie is an example of both augmented and virtual reality.

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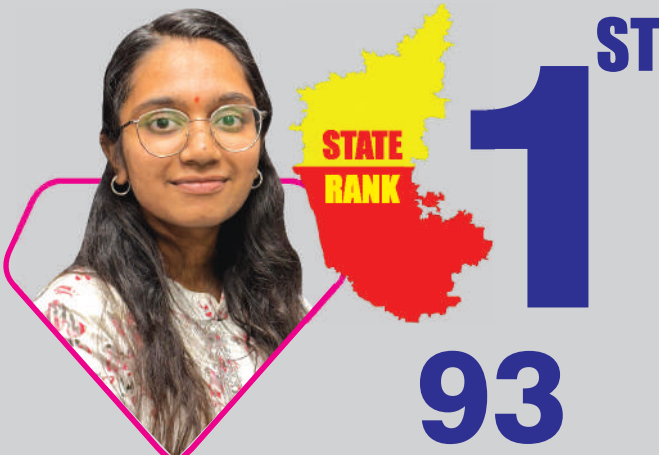
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State 1<sup>st</sup> Rank Holder (DCET - 2023)



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