SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)
SRM Nagar, Kattankulathur – 603 203.

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

QUESTION BANK

V SEMESTER

EI3563 INDUSTRIAL AUTOMATION SYSTEMS

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Prepared by

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SUBJECT : EI3563 INDUSTRIAL AUTOMATION SYSTEMS

SEM / YEAR : V / III

UNIT I - AUTOMATION IN MANUFACTURING & PROCESS INDUSTRIES

SYLLABUS

Introduction: Automation in manufacturing system, Principles and strategies of automation, Basic elements of an automated system, Advanced automation functions, Levels of automations, Various Industrial Revolutions, Digitalization and the Networked Economy, Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0.

PART – A

S.No	Questions	BT Level	CO	Competence
1	Name the two major components Production systems.	BLT-1	CO1	Remember
2	What are manufacturing systems?	BLT-1	CO1	Remember
3	How manufacturing systems are distinguished from production systems?	BLT-2	CO1	Understand
4	Manufacturing systems are divided into three categories, according to worker participation. Name them.	BLT-2	CO1	Understand
5	Classify the four functions included within the scope of manufacturing support systems?	BLT-2	CO1	Understand
6	What is fixed automation?	BLT-1	CO1	Remember
7	What are some of its features of fixed automation?	BLT-1	CO1	Remember
8	Why programmable automation is best suited for batch production?	BLT-1	CO1	Remember
9	What is flexible automation and what are some of its features?	BLT-1	CO1	Remember
10	Summarize the objectives of computer-integrated manufacturing.	BLT-2	CO1	Understand
11	What are some of the reasons why companies automate their operations?	BLT-1	CO1	Remember
12	Define automation.	BLT-1	CO1	Remember
13	Name the three basic elements of an automated system.	BLT-2	CO1	Understand
14	Point out the the power requirements of the automated process.	BLT-2	CO1	Understand
15	What are three reasons why decision making is required in a programmed work cycle?	BLT-1	CO1	Remember
16	Compare the closed-loop control system and an open-loop	BLT-2	CO1	Understand

	control system?				
17	What are the advanced automation functions?		**BLT-1**	**CO1**	**Remember**
18	Identify the five levels of automation in a production plant. What is industrial control?		**BLT-2**	**CO1**	**Understand**
19	Summarize the challenges of the Fourth Industrial Revolution.		**BLT-2**	**CO1**	**Understand**
20	Point out the key enablers required in knowledge management while implementation and adoption.		**BLT-2**	**CO1**	**Understand**
21	What are the enablers of innovation?		**BLT-1**	**CO1**	**Remember**
22	List the enablers of Industry 4.0 adoption in MSME.		**BLT-1**	**CO1**	**Remember**
23	What is Industry 4.0 being driven by?		**BLT-1**	**CO1**	**Remember**
24	Write the examples of enablers.		**BLT-2**	**CO1**	**Understand**
	PART B				
1	With neat sketch, describe the Automation and control technologies in the production system.	**(16)**	**BLT-3**	**CO1**	**Apply**
2	Describe the elements of an automated system with a neat diagram.	**(16)**	**BLT-3**	**CO1**	**Apply**
3	Explain the Advanced automation functions.	**(16)**	**BLT-4**	**CO1**	**Analyze**
4	Illustrate the five levels of automation and control in manufacturing.	**(16)**	**BLT-4**	**CO1**	**Analyze**
5	Comparison Between Continuous Control and Discrete Control.	**(16)**	**BLT-4**	**CO1**	**Analyze**
6	Discuss the Automation Principles and Strategies.	**(16)**	**BLT-3**	**CO1**	**Apply**
7	Write the ten Strategies for Automation and Process Improvement.	**(16)**	**BLT-3**	**CO1**	**Apply**
8	Explain the three modes of operation of a modern maintenance and repair diagnostics subsystem.	**(16)**	**BLT-4**	**CO1**	**Analyze**
9	Name three of the four possible strategies in error recovery. Identify the five levels of automation in a production plant.	**(16)**	**BLT-3**	**CO1**	**Apply**
10	Briefly explain the five categories of work cycle programs, as listed in the text?	**(16)**	**BLT-4**	**CO1**	**Analyze**
11	Explain the safety monitoring in detail.	**(16)**	**BLT-4**	**CO1**	**Analyze**
12	Tabulate Levels of Automation in the Process Industries and Discrete Manufacturing Industries.	**(16)**	**BLT-4**	**CO1**	**Analyze**
13	Discuss about the various industrial revolutions Industry 4.0.	**(16)**	**BLT-3**	**CO1**	**Apply**
14	Write short notes on digitalisation and the networked economy.	**(16)**	**BLT-3**	**CO1**	**Apply**

15	Illustrate the 4 Drivers of Industry 4.0. How they will steer the future.	**(16)**	**BLT-4**	**CO1**	**Analyze**
16	Explain the enablers of Industry 4.0.	**(16)**	**BLT-4**	**CO1**	**Analyze**
17	Describe the compelling forces and challeges for industry 4.0.	**(16)**	**BLT-3**	**CO1**	**Apply**

UNIT II - PROGRAMMABLE LOGIC CONTROLLER (PLC)

SYLLABUS

Introduction to PLC, History of PLC, Architecture of PLC, CPU IO Modules Power Supply and Communications, Input and Output Devices, Need of PLC for Industrial Automation, Types of PLC Models. Introduction to PLC Programming: Types of Programming Languages, Ladder logic diagram, Examine On/OFF, timer, counter, data manipulation and other higher level programming instruction with case studies.

PART – A

S.No	Questions	BT Level	CO	Competence
1	Define PLC.	**BLT-1**	**CO2**	**Remember**
2	Compare the PLC and PC.	**BLT-2**	**CO2**	**Understand**
3	Point out the applications of PLC.	**BLT-2**	**CO2**	**Understand**
4	Summarize the I/O modules in PLC.	**BLT-2**	**CO2**	**Understand**
5	List any six brands of PLCs available in the market.	**BLT-1**	**CO2**	**Remember**
6	Give five factors affecting the memory size needed for a particular PLC installation.	**BLT-2**	**CO2**	**Understand**
7	What is the use of timers in PLC.	**BLT-1**	**CO2**	**Remember**
8	Draw the symbol and state the equivalent instruction for each of the following: NO contact, NC contact, and coil.	**BLT-2**	**CO2**	**Understand**
9	Draw the PLC ladder diagram for NAND gate.	**BLT-2**	**CO2**	**Understand**
10	When is the output of PLC counter energized?	**BLT-1**	**CO2**	**Remember**
11	When is the output of a programmed timer energized?	**BLT-2**	**CO2**	**Understand**
12	Draw a ladder logic diagram for single input timer.	**BLT-2**	**CO2**	**Understand**
13	What is the use of MCR instruction?	**BLT-1**	**CO2**	**Remember**
14	Retentive instructions should not be placed within an MCR zone. Justify?	**BLT-2**	**CO2**	**Understand**
15	List the advantages of jump instruction.	**BLT-1**	**CO2**	**Remember**
16	List basic math functions that can be performed on PLCs.	**BLT-1**	**CO2**	**Remember**
17	What standard format is used for PLC math instructions?	**BLT-1**	**CO2**	**Remember**
18	What the jump to subroutine instruction allows the program to do?	**BLT-1**	**CO2**	**Remember**
19	When are the immediate input and immediate output instructions used?	**BLT-2**	**CO2**	**Understand**
20	What are the programming method in PLC?	**BLT-1**	**CO2**	**Remember**
21	Compare the timers and counter functions of PLC.	**BLT-2**	**CO2**	**Understand**

22	Draw the Ladder diagram for AND and NOR gates.		**BLT-1**	**CO2**	**Remember**
23	How PLC is used in sequential control?		**BLT-2**	**CO2**	**Understand**
24	What are the 3 types of sequential circuits?		**BLT-1**	**CO2**	**Remember**
	PART-B				
1	Describe typical PLC input / output system connection with neat sketch.	**(16)**	**BLT-3**	**CO2**	**Apply**
2	Explain the following modules in RTU in detail.		**BLT-4**	**CO2**	**Analyze**
	(i) Digital input modules and output modules.	**(10)**			
	(ii) Digital counter or accumulator modules.	**(6)**			
3	Illustrate the basic architecture of PLC with neat block diagram.	**(16)**	**BLT-4**	**CO2**	**Analyze**
4	Explain in detail about various hardware components present in PLC.	**(16)**	**BLT-4**	**CO2**	**Analyze**
5	Describe Retentive on-delay timer instructions in a PLC with example.	**(16)**	**BLT-3**	**CO2**	**Apply**
6	Develop a Ladder Logic Diagram to ON & OFF a motor with single button; ON at first press and OFF at second press.	**(16)**	**BLT-3**	**CO2**	**Apply**
7	List and explain various data move functions available in PLC.	**(16)**	**BLT-4**	**CO2**	**Analyze**
8	Discuss the difference in operation between following instructions a. MCR b. Timer – Retentive Timer	**(16)**	**BLT-3**	**CO2**	**Apply**
9	Examine the following PLC function with suitable example. a. Less than COMPARE function b. Jump to Subroutine function.	**(16)**	**BLT-4**	**CO2**	**Analyze**
10	Deduce the Timer and Counter instructions- TON, TOFF, RTO, CTU, and CTD.	**(16)**	**BLT-4**	**CO2**	**Analyze**
11	Explain Branch instructions with examples in ladder logic programming.	**(16)**	**BLT-4**	**CO2**	**Analyze**
12	Explain the function of the UP-DOWN counter with the help of timing diagram.	**(16)**	**BLT-4**	**CO2**	**Analyze**
13	Describe the data manipulation instructions used in PLC.	**(16)**	**BLT-3**	**CO2**	**Apply**
14	Discuss the program control instructions used in PLC.	**(16)**	**BLT-3**	**CO2**	**Apply**
15	Develop the ladder logic diagram for the Bottle filling system application.	**(16)**	**BLT-3**	**CO2**	**Apply**
16	Write a PLC program to control traffic lights.	**(16)**	**BLT-3**	**CO2**	**Apply**
17	Draw a ladder logic diagram to control the motor output as per the given logic. Make use of start and stop pushbuttons, 4 switches to turn on and off 2 motors (M), and a buzzer (B).	**(16)**	**BLT-3**	**CO2**	**Apply**

UNIT III - OVERVIEW OF MATERIAL HANDLING SYSTEMS

SYLLABUS

Overview of material handling systems: Types of material handling equipment, Design of the system, Conveyor system, Automated guided vehicle system. Automated Manufacturing Systems: Components, Classification and overview of manufacturing systems, Cellular manufacturing, Flexible manufacturing

system (FMS).					
PART –A					
S.No	**Questions**		**BT Level**	**CO**	**Competence**
1.	Point out the objectives of materials handling?		**BLT-2**	**CO3**	**Understand**
2.	Give the benefits of material handling?		**BLT-2**	**CO3**	**Understand**
3.	Summarize the 3 major functions of materials handling system?		**BLT-2**	**CO3**	**Understand**
4.	List the classification of material handling system?		**BLT-1**	**CO3**	**Remember**
5.	What is the selection of material handling equipment		**BLT-1**	**CO3**	**Remember**
6.	What is the utilization principle of material handling?		**BLT-1**	**CO3**	**Remember**
7.	Define conveyor system.		**BLT-1**	**CO3**	**Remember**
8.	List the benefits of conveyor system.		**BLT-1**	**CO3**	**Remember**
9.	Give the types of conveyor system?		**BLT-2**	**CO3**	**Understand**
10.	Define an Automated Guided Vehicle system.		**BLT-2**	**CO3**	**Understand**
11.	List the versatile application of Automated Guided Vehicle system.		**BLT-1**	**CO3**	**Remember**
12.	Give the key benefits of Automated Guided Vehicle system.		**BLT-1**	**CO3**	**Remember**
13.	List the function of automated manufacturing system?		**BLT-1**	**CO3**	**Remember**
14.	Point out the goals of automation in manufacturing industry?		**BLT-2**	**CO3**	**Understand**
15.	Give the classification of automation		**BLT-2**	**CO3**	**Understand**
16.	Give the classification of manufacturing system.		**BLT-2**	**CO3**	**Understand**
17.	What are the components of manufacturing system?		**BLT-1**	**CO3**	**Remember**
18.	Define cellular manufacturing.		**BLT-1**	**CO3**	**Remember**
19.	Give the major the steps in the Cellular Manufacturing Process.		**BLT-2**	**CO3**	**Understand**
20.	Define FMS.		**BLT-1**	**CO3**	**Remember**
21.	Point out the components of FMS.		**BLT-2**	**CO3**	**Understand**
22.	What are the FMS layout configurations?		**BLT-1**	**CO3**	**Remember**
23.	List the applications of FMSs		**BLT-1**	**CO3**	**Remember**
24.	How FMS classified does based on number of machines?		**BLT-2**	**CO3**	**Understand**
PART B					
1	Illustrate the factors that influence the design of the material handling system.	**(16)**	**BLT-4**	**CO3**	**Analyze**
2	Describe the five categories of material transport equipment commonly used to move parts and other materials in manufacturing and warehouse facilities.	**(16)**	**BLT-3**	**CO3**	**Apply**
3	Give some examples of industrial trucks used in material handling.	**(16)**	**BLT-3**	**CO3**	**Apply**
4	Describe the vehicle management system.	**(16)**	**BLT-3**	**CO3**	**Apply**
5	Outline the vehicle safety and Rail Guided vehicles	**(16)**	**BLT-3**	**CO3**	**Apply**
6	Explain the variety of conveyor equipment is commercially available	**(16)**	**BLT-4**	**CO3**	**Analyze**
7	Describe the Conveyor Operations and Features.	**(16)**	**BLT-3**	**CO3**	**Apply**
8	Outlining the three types of automated guided vehicles.	**(16)**	**BLT-3**	**CO3**	**Apply**
9	Describe the vehicle guidance technologies in automated guided vehicles.	**(16)**	**BLT-4**	**CO3**	**Analyze**
10	Illustrate the key components of a manufacturing system.	**(16)**	**BLT-4**	**CO3**	**Analyze**
11	Explores the various factors that distinguish different types	**(16)**	**BLT-4**	**CO3**	**Analyze**

	of manufacturing systems.				
12	Illustrate the classification of manufacturing systems.	**(16)**	**BLT-4**	**CO3**	**Analyze**
13	Explain the cellular manufacturing system.	**(16)**	**BLT-4**	**CO3**	**Analyze**
14	Outline the analysis of cellular manufacturing system.	**(16)**	**BLT-3**	**CO3**	**Apply**
15	Define flexible manufacturing system. Explain the different types of flexible manufacturing system.	**(16)**	**BLT-4**	**CO3**	**Analyze**
16	Describe the three basic components of a flexible manufacturing system.	**(16)**	**BLT-4**	**CO3**	**Analyze**
17	Outline the FMS application, planning and Implementation issues.	**(16)**	**BLT-3**	**CO3**	**Apply**

UNIT IV- SCADA SYSTEMS

SYLLABUS

Introduction, definition and history of SCADA, typical SCADA System Architecture, Communication requirements, Desirable properties of SCADA system, Features, advantages, disadvantages and applications of SCADA. SCADA Architecture: First Generation-Monolithic, Second Generation-Distributed, Third Generation-Networked Architecture, SCADA systems in operation and case studies.

PART –A

S.No	Questions	BT Level	CO	Competence
1.	Compare PLC and SCADA.	**BLT-2**	**CO4**	**Understand**
2.	List the hardware elements of SCADA.	**BLT-1**	**CO4**	**Remember**
3.	How does the processor identify the location of a specific input or output device?	**BLT-2**	**CO4**	**Understand**
4.	Give the communication architecture for SCADA.	**BLT-2**	**CO4**	**Understand**
5.	What is the necessity to use master station architecture of SCADA.	**BLT-1**	**CO4**	**Remember**
6.	How does SCADA handle issues?	**BLT-1**	**CO4**	**Remember**
7.	Pint out the the communication protocols used in SCADA.	**BLT-2**	**CO4**	**Understand**
8.	List the two main functions of a SCADA system.	**BLT-1**	**CO4**	**Remember**
9.	List the SCADA software used in the industry.	**BLT-1**	**CO4**	**Remember**
10.	Compare SCADA and HMI.	**BLT-2**	**CO4**	**Understand**
11.	Define Device Net.	**BLT-1**	**CO4**	**Remember**
12.	What is meant by Control Net.	**BLT-1**	**CO4**	**Remember**
13.	Demonstrate a real-time operating system,	**BLT-2**	**CO4**	**Understand**
14.	Summarise the role of Human machine interface.	**BLT-2**	**CO4**	**Understand**
15.	Define Master terminal unit.	**BLT-1**	**CO4**	**Remember**
16.	What is Remote terminal unit?	**BLT-1**	**CO4**	**Remember**
17.	Write some of the typical SCADA software components	**BLT-2**	**CO4**	**Understand**
18.	List some typical attacks that might be mounted against SCADA systems.	**BLT-1**	**CO4**	**Remember**
19.	What is meant by Audit and monitoring logs?	**BLT-1**	**CO4**	**Remember**
20.	Define firewalls.	**BLT-1**	**CO4**	**Remember**
21.	How malicious code detection and elimination in SCADA.	**BLT-2**	**CO4**	**Understand**
22.	Write the role of SCADA in the petroleum refining process.	**BLT-2**	**CO4**	**Understand**
23.	Point out the control components in a typical power generation unit.	**BLT-2**	**CO4**	**Understand**

24.	Define SCADA security.		**BLT-1**	**CO4**	**Remember**
	PART B				
1	Explain the components of SCADA with neat sketch.	**(16)**	**BLT-4**	**CO4**	**Analyze**
2	Write short notes on the following		**BLT-3**	**CO4**	**Apply**
	(i) SCADA hardware and Software.	**(10)**			
	(ii) SCADA and local area networks.	**(6)**			
3	Outline about the evolution of SCADA.	**(16)**	**BLT-3**	**CO4**	**Apply**
4	Describe the typical architecture of SCADA with neat sketch.	**(16)**	**BLT-3**	**CO4**	**Apply**
5	With neat sketch explain the typical structure of SCADA using internet and cellular network..	**(16)**	**BLT-4**	**CO4**	**Analyze**
6	Explain SCADA Systems in the Critical Infrastructure such as Pressurized Water Reactor.	**(16)**	**BLT-4**	**CO4**	**Analyze**
7	With the help of neat diagram explain the operation of RTU hardware structure in SCADA.	**(16)**	**BLT-4**	**CO4**	**Analyze**
8	Discuss about the SCADA system desirable properties.	**(16)**	**BLT-3**	**CO4**	**Apply**
9	Evaluate the following communication architecture of SCADA		**BLT-4**	**CO4**	**Analyze**
	(i) Point-to-point architecture and Multi-point architecture	**(8)**			
	(ii) Relay station architecture	**(8)**			
10	Discuss about the SCADA system security issues.		**BLT-3**	**CO4**	**Apply**
11	Describe the features of SCADA. Write the advantages and disadvantages of SCADA.	**(16)**	**BLT-3**	**CO4**	**Apply**
12	With a neat sketch, explain the first generation of SCADA.(monolithic)	**(16)**	**BLT-4**	**CO4**	**Analyze**
13	With neat sketch, describe the second generation of distributed SCADA system.	**(16)**	**BLT-3**	**CO4**	**Apply**
14	With neat sketch, describe the third generation of networked architecture SCADA System	**(16)**	**BLT-3**	**CO4**	**Apply**
15	Discuss the Water Purification System to control and monitor the water purification process.	**(16)**	**BLT-3**	**CO4**	**Apply**
16	Explain the role of the SCADA system in a power generation unit.	**(16)**	**BLT-4**	**CO4**	**Analyze**
17	Explain in any case study using a SCADA System.	**(16)**	**BLT-4**	**CO4**	**Analyze**

UNIT V- DISTRIBUTED CONTROL SYSTEMS (DCS)

SYLLABUS

Introduction - Local Control Unit (LCU) architecture, LCU Process Interfacing Issues, Block diagram and Exploring Various Security Design Strategies for Local Control Units (LCUs)- Networking of DCS. Information gathering, Real-time analysis of data stream from DCS, Historian, Integration of business inputs with process data, Leveraging remote terminal unit (RTU).

PART –A

S.No	Questions	BT Level	CO	Competence
1.	Define Distributed Control System (DCS) with an example.	**BLT-1**	**CO5**	**Remember**
2.	What do you mean by Local Control Unit?	**BLT-1**	**CO5**	**Remember**

3.	Give any two popular industrial communication protocols.		**BLT-2**	**CO5**	**Understand**
4.	Point out the different functions performed by DCS.		**BLT-2**	**CO5**	**Understand**
5.	Summarize the display hierarchy used in the DCS system.		**BLT-1**	**CO5**	**Remember**
6.	Write the important features incorporated in high level engineering interface.		**BLT-2**	**CO5**	**Understand**
7.	What is the need can be satisfied in designing an industrial grade LCU?		**BLT-1**	**CO5**	**Remember**
8.	Predict the function of LCU.		**BLT-2**	**CO5**	**Understand**
9.	Give some application of DCS.		**BLT-2**	**CO5**	**Understand**
10.	Give some communication protocol used in distributed control system.		**BLT-2**	**CO5**	**Understand**
11.	What approaches are used in designing a redundant LCU architecture?		**BLT-1**	**CO5**	**Remember**
12.	Compare the configuration of the controller.		**BLT-2**	**CO5**	**Understand**
13.	Mention the prominent features of graphic display.		**BLT-2**	**CO5**	**Understand**
14.	Classify the factors to be considered for types of communication in DCS.		**BLT-2**	**CO5**	**Understand**
15.	How engineering workstation is different from operator work station in DCS?		**BLT-2**	**CO5**	**Understand**
16.	List the major architectural parameters to be considered for designing a controller for various industrial control applications.		**BLT-1**	**CO5**	**Remember**
17.	Write the important features incorporated in HLEI.		**BLT-2**	**CO5**	**Understand**
18.	Compare individual, centralized and distributive control systems.		**BLT-2**	**CO5**	**Understand**
19.	Generalize some of the bus standard used in process industries.		**BLT-2**	**CO5**	**Understand**
20.	What is the role of communication interfaces in DCS?		**BLT-1**	**CO5**	**Remember**
21.	Point out the various elements in DCS.		**BLT-2**	**CO5**	**Understand**
22.	List the various architecture of DCS.		**BLT-1**	**CO5**	**Remember**
23.	List the various redundant controllers in DCS.		**BLT-1**	**CO5**	**Remember**
24.	Compare LLHI and HLHI.		**BLT-2**	**CO5**	**Understand**
PART B					
1	Describe the generalised DCS architecture with neat diagram.	**(16)**	**BLT-3**	**CO5**	**Apply**
2	Write a summary of some of the key features of distributed control systems.	**(16)**	**BLT-3**	**CO5**	**Apply**
3	Explain the basic elements of Local Control Unit.	**(16)**	**BLT-4**	**CO5**	**Analyze**
4	Illustrate some of the differences in LCU architectures.	**(16)**	**BLT-4**	**CO5**	**Analyze**
5	Outline the concept of function blocks can be appreciated most easily through an example.	**(16)**	**BLT-3**	**CO5**	**Apply**
6	How the DCS can interface with the process.	**(16)**	**BLT-3**	**CO5**	**Apply**
7	Explain the providing security safeguards to LCU.	**(16)**	**BLT-4**	**CO5**	**Analyze**
8	Explain the various security design strategies for Local Control Units.	**(16)**	**BLT-4**	**CO5**	**Analyze**
9	Describe the three basic categories of security approaches in DCS.	**(16)**	**BLT-3**	**CO5**	**Apply**
10	Discuss the conventional point to point wiring and black box facility in DCS	**(16)**	**BLT-3**	**CO5**	**Apply**

11	Describe the network topology in DCS.	**(16)**	**BLT-3**	**CO5**	**Apply**
12	Outline the networking architecture of a DCS is designed to facilitate communication, data exchange, and coordination between different components within a control system.	**(16)**	**BLT-3**	**CO5**	**Apply**
13	Illustrate the data gathering from Distributed Control Systems (DCS) involves collecting real-time data.	**(16)**	**BLT-4**	**CO5**	**Analyze**
14	Describe the data analytics and Real-time analysis of data stream from DCS.	**(16)**	**BLT-3**	**CO5**	**Apply**
15	Describe the historian build, in the context of industrial automation and control systems.	**(16)**	**BLT-3**	**CO5**	**Apply**
16	Explain the Integration of business inputs with process data and leveraging remote terminal unit.	**(16)**	**BLT-4**	**CO5**	**Analyze**
17	With neat sketches, explain different types of displays in DCS systems.	**(16)**	**BLT-4**	**CO5**	**Analyze**