

Subject Code: 17664

Model Answer

Important Instructions to examiners:

1) The answers should be examined by keywords and not as word-to-word as given in the model answer scheme.

2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.

3) The language errors such as grammatical, spelling errors should not be given more Importance. (Not applicable for subject English and Communication Skills.)

4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.

5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.

6) In case of some questions credit may be given by judgments on part of examiner of relevant answer based on candidate's understanding.

7) For programming language papers, credit may be given to any other program based on equivalent concept.

	Remark	Total
		Mar
		ks
Attempt any Three of the following		12
State benefits of automation.(any four)		04
Benefits of Automation:		
1)Increases productivity	01 mark	
2) Increases product quality	for each	
3)Increases flexibility and convertibility	benefit	
4) Reduces manpower	(max. 4	
5)Reduction of personal accident	marks)	
6) Reduces cost of product		
7) Better inventory control		
8) Increases profit		
Note : Any other relevant points should be considered .		
Draw labeled diagram of DC input module. Give its specification		04
Discrete Input Signal Signal VI Signal Conditioning	02 marks for diagram &	
	Discrete Input Signal	Discrete Input Signal



WINTER – 15 EXAMINATION

	 Specification of DC i/p module at rated 24V DC 1) Rated voltage and current -+24V DC at 4mA 2) Specified operational voltage range - 0-+30V DC 3) Absolute maximum i/p voltage-+35V DC for 0.5 sec. 4) Signal Delay -5 millisecond (ON to OFF or OFF to ON) 5) Input power - 0.2 Watts/point at 24V DC. 			02 mark for specificat ion (Any four)	
iii	List different relay ty	pe instruction	ns of PLC with symbols.		04
1S	The relay type instruct 1) NO 2) NC 3) One shot 4) Latch 5) Unlatch	ons are listed	as,	02 mark for list (any four)	
	Relay type instruction relay control logic into 1)Examine IF Closed 2) Examine IF Open 3) Output Energies	s with three contact symb	fundamental symbols are used to translate olic logic are listed as,	and 02 mark	
	Relay type instruction relay control logic into 1)Examine IF Closed 2) Examine IF Open 3) Output Energies	s with three contact symb	fundamental symbols are used to translate olic logic are listed as, Description	e and 02 mark for symbols (any two)	
	Relay type instruction relay control logic into 1)Examine IF Closed 2) Examine IF Open 3) Output Energies Instruction Normally Open or Examine On	s with three contact symbol Symbol XIC	fundamental symbols are used to translate olic logic are listed as, Description Input instruction, normally open, or examine if On	e and 02 mark for symbols (any two)	



Subject Code: 17664

Ans	Indicating		and here and the second second	02	
	LED	Contra	ol to Power	Marks	
	22 × 1	Circui	Interface	for neat	
	*			labeled	
	LED1 Opto-is	olator		diagram	
			* Os women]		
		Amplifier =			
			Ţ.		
			/		
	Discrete Input Signal		θ		
	Or relevant diagram should	be considered.			
				02 marks	
	Explanation :			for	
				explanati	
	In DC o/p module data from	n CPU is sent to o/p mod	lule. There is opto isolator	on	
	for safety of CPU from fiel	d devices. It is nothing b	out LED & Opto transistor.		
	Then this signal is amplified	l and given to control po	wer circuit or relay driving		
	circuit Dc operating devices	s are connected to this o/t	module		
	encult . De operating devices		inodule.		
1 b)	Attempt any ONE of the fo	llowing			06
(i)	1) Differentiate Relay cont	rol and PLC control or	basis of reprogramming		03
(-)			······································		
	and speed				
Ans	and speed				
Ans	and speed Point	Relay Control	PLC Control	1.5	
Ans	Point Reprogramming	Relay Control uses	PLC Control uses	1.5 marks	
Ans	Point Reprogramming	Relay Control Relay control uses	PLC Control PLC control uses different languages such	1.5 marks for each	
Ans	and speed Point Reprogramming	Relay Control Relay control uses hardwired logic which	PLC Control PLC control uses different languages such	1.5 marks for each	
Ans	and speed Point Reprogramming	Relay Control Relay control uses hardwired logic which is fixed. It can be	PLC Control PLC control uses different languages such as ladder logic which	1.5 marks for each points (Maximu	
Ans	and speed Point Reprogramming	Relay Control Relay control uses hardwired logic which is fixed. It can be changeable by altering	PLC Control PLC control uses different languages such as ladder logic which are programmable and	1.5 marks for each points (Maximu	
Ans	and speed Point Reprogramming	Relay Control Relay control uses hardwired logic which is fixed. It can be changeable by altering the way devices are	PLC Control PLC control uses different languages such as ladder logic which are programmable and easily changed. It is	1.5 marks for each points (Maximu m of 03	
Ans	and speed Point Reprogramming	Relay Control Relay control uses hardwired logic which is fixed. It can be changeable by altering the way devices are connected.	PLC Control PLC control uses different languages such as ladder logic which are programmable and easily changed. It is field programmable by	1.5 marks for each points (Maximu m of 03 marks)	
Ans	and speed Point Reprogramming	Relay Control Relay control uses hardwired logic which is fixed. It can be changeable by altering the way devices are connected.	PLC Control PLC control uses different languages such as ladder logic which are programmable and easily changed. It is field programmable by user	1.5 marks for each points (Maximu m of 03 marks)	
Ans	and speed Point Reprogramming	Relay Control Relay control uses hardwired logic which is fixed. It can be changeable by altering the way devices are connected.	PLC Control PLC control uses different languages such as ladder logic which are programmable and easily changed. It is field programmable by user	1.5 marks for each points (Maximu m of 03 marks)	
Ans	and speed Point Reprogramming Speed	Relay Control Relay control uses hardwired logic which is fixed. It can be changeable by altering the way devices are connected.	PLC Control PLC control uses different languages such as ladder logic which are programmable and easily changed. It is field programmable by user Speed of execution is	1.5 marks for each points (Maximu m of 03 marks)	
Ans	and speed Point Reprogramming Speed	Relay ControlRelay control useshardwired logic whichis fixed. It can bechangeable by alteringthe way devices areconnected.Speed of execution isless	PLC ControlPLC control usesdifferent languages suchas ladder logic whichare programmable andeasily changed. It isfield programmable byuserSpeed of execution isHigh.	1.5 marks for each points (Maximu m of 03 marks)	
Ans	and speed Point Reprogramming Speed	Relay Control Relay control uses hardwired logic which is fixed. It can be changeable by altering the way devices are connected. Speed of execution is less	PLC ControlPLC control usesdifferent languages suchas ladder logic whichare programmable andeasily changed. It isfield programmable byuserSpeed of execution isHigh.	1.5 marks for each points (Maximu m of 03 marks)	
Ans	and speed Point Reprogramming Speed	Relay Control Relay control uses hardwired logic which is fixed. It can be changeable by altering the way devices are connected. Speed of execution is less	PLC ControlPLC control usesdifferent languages suchas ladder logic whichare programmable andeasily changed. It isfield programmable byuserSpeed of execution isHigh.	1.5 marks for each points (Maximu m of 03 marks)	
Ans 1 b)	and speed Point Reprogramming Speed 2) What is Fixed PLC? Explanation	Relay ControlRelay control useshardwired logic whichis fixed. It can bechangeable by alteringthe way devices areconnected.	PLC ControlPLC control usesdifferent languages suchas ladder logic whichare programmable andeasily changed. It isfield programmable byuserSpeed of execution isHigh.	1.5 marks for each points (Maximu m of 03 marks)	03
Ans 1 b) i)	and speed Point Reprogramming Speed 2) What is Fixed PLC? Explanation	Relay ControlRelay control useshardwired logic whichis fixed. It can bechangeable by alteringthe way devices areconnected.	PLC ControlPLC control usesdifferent languages suchas ladder logic whichare programmable andeasily changed. It isfield programmable byuserSpeed of execution isHigh.	1.5 marks for each points (Maximu m of 03 marks)	03
Ans 1 b) i) Ans	and speed Point Reprogramming Speed 2) What is Fixed PLC? Exp The PLC which has limited for the place of the place o	Relay Control Relay control uses hardwired logic which is fixed. It can be changeable by altering the way devices are connected. Speed of execution is less	PLC Control PLC control uses different languages such as ladder logic which are programmable and easily changed. It is field programmable by user Speed of execution is High.	1.5 marks for each points (Maximu m of 03 marks)	03
Ans 1 b) i) Ans	and speed Point Reprogramming Speed Speed 2) What is Fixed PLC? Exp The PLC which has limited f system are called as Fixed PLC	Relay Control Relay control uses hardwired logic which is fixed. It can be changeable by altering the way devices are connected. Speed of execution is less plain Fixed number of I/O and r LC.	PLC Control PLC control uses different languages such as ladder logic which are programmable and easily changed. It is field programmable by user Speed of execution is High.	1.5 marks for each points (Maximu m of 03 marks) 01 mark for fixed	03
Ans 1 b) i) Ans	and speed Point Reprogramming Speed 2) What is Fixed PLC? Exp The PLC which has limited f system are called as Fixed PI Explanation: -	Relay Control Relay control uses hardwired logic which is fixed. It can be changeable by altering the way devices are connected. Speed of execution is less plain Fixed number of I/O and r LC.	PLC Control PLC control uses different languages such as ladder logic which are programmable and easily changed. It is field programmable by user Speed of execution is High.	1.5 marks for each points (Maximu m of 03 marks) 01 mark for fixed PLC	03
Ans 1 b) i) Ans	and speed Point Reprogramming Speed 2) What is Fixed PLC? Exp The PLC which has limited f system are called as Fixed PI Explanation: - It is also called as Micro PL	Relay Control Relay control uses hardwired logic which is fixed. It can be changeable by altering the way devices are connected. Speed of execution is less plain Fixed number of I/O and r LC. C or Unitary PLC. Fixed	PLC Control PLC control uses different languages such as ladder logic which are programmable and easily changed. It is field programmable by user Speed of execution is High.	1.5 marks for each points (Maximu m of 03 marks) 01 mark for fixed PLC	03
Ans 1 b) i) Ans	and speed Point Reprogramming Speed 2) What is Fixed PLC? Explanation The PLC which has limited f system are called as Fixed PL Explanation: - It is also called as Micro PL CPU and limited I/O such as	Relay Control Relay control uses hardwired logic which is fixed. It can be changeable by altering the way devices are connected. Speed of execution is less plain Fixed number of I/O and r LC. C or Unitary PLC. Fixed I(20 Inputs -12 Outputs,	PLC Control PLC control uses different languages such as ladder logic which are programmable and easily changed. It is field programmable by user Speed of execution is High. equired to control of small PLC has power supply , 32 I/O).	1.5 marks for each points (Maximu m of 03 marks) 01 mark for fixed PLC 02 marks	03



WINTER – 15 EXAMINATION





Subject Code: 17664

<u>Model Answer</u>

	lar A)	nguage: Grap	s and text-based languages. bhical languages :	for list of PLC language	
		i)	Ladder Logic Diagram (LD)		
		ii)	Function Block Diagram (FBD)		
		iii)	Sequential Function Chart or Grafcet (SFC)		
	B)	Text	-based languages :		
		i)	Instruction List (IL)		
		ii)	Structured Text (ST)		
	Explanation	on of]	PLC programming languages:		
	i)	Ladd instru simil	ler logic diagram(LD): It is a type of graphical language having the uctions in graphical symbol format. Ladder program is very lar to electrical wiring diagram, so it is easy to understand.	5 marks For	
	ii)	Funct instru more	tion Block Diagram (FBD): The primary concept behind FBD is data flow in this actions are composed of operational blocks, Each block has one or inputs and outputs.	explanati on of PLC language (01 mark	
	iii)	Seque This requi	ential Function Chart or Grafcet (SFC): language is used for performing simultaneously operations ired for controller in complex machine process	for each PLC language explanati	
	iv)	Instru low l opera	It is similar to assembly language programming, in this evel computer language like mnemonic codes are used to specify the ation of each rung of ladder diagram.	on in brief)	
	v)	Struc	ctured Text (ST):		
			It is a high level computer type language like Basic or C. It is		
		capat	ble to perform calculations on values other than binary.		
b.	Draw lad After 20 heater is	lder di Sec p <u>switc</u> h	iagram for when start button is pressed pump is switched on. ump is switched off and heater is switched on. After 10 sec ned Off. After 10 sec heater is switched off		08
Ans				08 marks for ladder diagram	



WINTER – 15 EXAMINATION





WINTER – 15 EXAMINATION

	$\frac{1}{1} + \frac{1}{1} + \frac{1}$	(Steps wise ladder diagram marking should be done)	
Q.3	Attempt any four of the following		16
0)	Cive the function of following components of DLC		04
a)	(i)CPU (ii) Memory		04
Ans b)	 CPU: It performs arithmetic and logic functions It decodes and executes instructions It executes operating system, manages memory, monitors inputs, It evaluates the user logic, turns on the appropriate outputs, It handles communication and interactions with other components Memory: Stores data and programme instructions There mainly two types of memory Ram , ROM RAM is used to store user or temporary data. ROM is used to store operating system and fixed data used by State needs of Automation(Four points) 	02 marks 02 marks 02 marks 04	
Ans	• For better productivity	01 marks	



Subject Code: 17664

	• For better control of process	for each	
	• For better quality	point	
	• For reducing man power	-	
	• For reducing cost of product		
c)	Describe with diagram sourcing input module		04
Ans	The interface diagram of PLC input module as sourcing is shown in figure. In operation ,PLC input module as sourcing, current from power supply first flows from input module to load and then to common terminal so the input module acts as source of current .	02 marks for descripti on 02 for diagram	
d)	Describe I/O addressing of PLC		04
Ans	 I/O addressing of PLC: The addressing is necessary to deal with data files for their identification. It is identified by a letter called an identifier and a file number. The basic addressing elements include, type, slot, word and bit. Type: the type determine if an input or output being addressed Slot: the slot number is the physical location of the I/O module. This may be combination of rack number and slot number when using expansion of rack Word and bit: These are used to identify the actual terminal connection in a particular I/O module. 	04 marks for descripti on	



WINTER – 15 EXAMINATION

Subject Code: 17664

Filetype Filenymbay element number Sub elema number above #15. This addressing format is for Allen Bradley PLC (Another format should be considered) Give the maintenance guidelines of a PLC system 04 e) Guidelines for maintenance of PLC: 01 mark Ans 1) Periodically check the tightness of I/O Module terminal screws. They can for each became loose over period point 2) Periodically check for corrosion of connecting terminals. moisture & (any corrosion atmospheres can cause poor electrical connections relevant 3) Replace the PLC batteries used for backup in time 4 points) 4) Have a written check list, control list for each PLC 5)Make sure that components are free of dust 6) Stock commonly needed spare parts 7) Keep duplicate record of operating programs being use Q.4 Attempt any three of the following 12 a) Draw the format of ON delay timer with waveform. Explain each bit of ON (i) 04 delay timer Format of ON Delay timer: Ans 01 mark for format



WINTER – 15 EXAMINATION





MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2005 Certified)

WINTER – 15 EXAMINATION

	3) High speed encoder		
	4) Stepper motor control		
	5) Thermocouple input module		
	6) Remote I/O sub scanner		
	(Description of any two):-	01 mark	
	1) Communication module: - The communication modules are used to	for each	
	communicate with programming devices, displays, plant computers.	descripti	
	other PLC's. The four common communication modules are ASCII	on	
	modules local I/O adapter modules the serial data modules network	(Any	
	interface modules	(Ally two	
	2) PTD input modulo: This module interfaces RTD 's to a PLC	cnocialty	
	And other types of resistance input devices such as potentiometers	specially modulo)	
	And other types of resistance input devices such as potentionneters.	mouule)	
(•••)	It consists of bridge circuit inter, amplifier, and isolator circuits.	 	0.4
(111)	State the types of comparison instruction of a PLC system and give the		04
	details of any two		
Ans	Types of comparison instruction:	02 mark	
	1)EQU(Value, Value)	for types	
	2)NEQ(Value, Value)		
	3)LES(Value,Value)		
	4)LEQ(Value,Value)		
	5)GRT(Value,Value)		
	6)GEQ(Value,Value)	02marks	
	1) EQU: This instruction is used to check or test two values for equality	(01 mark	
		for each	
		Instructi	
	EQU O:0/0	on)	
	Source B		
	2) NEQ: This is used to test inequality of two values		
	1		
	NEQ D: 0/D		
	Source A C		
	Source 13		
(iv)	State any two precautions when placing PLC in an enclosure.		04
Ans	1) Allow maximum convection cooling, all controller components should be	02 marks	
	mounted vertically, in some cases components mounted horizontally will	for each	
	obstruct air flow	Point.	
	2)The power supply has a higher heat dissipation, so power supply should be		
	installed at the top of the enclosure above all other equipment, with adequate		
	spacing between power supply and the top of the enclosure		
	3) The CPU should be located at a comfortable working level that is either to or		
	below the power supply. If the CPU and power supply are contained in a single		
	PLC unit then the PLC unit should be placed toward the top of the enclosure		
	1 20 unit, and the i 20 unit should be placed toward the top of the chelosule		



WINTER – 15 EXAMINATION

Subject Code: 17664

with no other components directly above it, unless there is sufficient space Note: any other relevant precaution Q4. Attempt any ONE of the following 06 b) Explain the functions of and organization of RAM and ROM in PLC 06 (i) Ans **Functions of RAM and ROM:** 03 marks **RAM**: This is volatile memory. It is used to store ladder program, which is not for lost when power is OFF as battery backup is provided to RAM in PLC functions **ROM:** It is used to store the program information that allows the CPU to interpret and act on ladder program which is store in Random access memory Memory organization of PLC: 03 marks File type Identifier logical Address File for number organiza tion 0 \$0:0 to \$ 0:30 0 Output Ι \$I:0 to \$ I:30 Input 1 Status \mathbf{s} \$S:0 to \$ S:n 2 Bit В \$B3:0 to \$ B3:255 3 т 4 \$T4:0 to \$T4:255 Timer С \$C5:0 to \$ C5:255 5 Counter Control R \$R6:0 to \$ R6:255 6 7 Ν \$N7:0 to \$ N7:255 Integer F 8 \$F8:0 to \$F8:255 Floating point 9 Network Х \$X9:0 to \$ X9:255 User Defined Х \$X10 :0 to \$ X255:255 10 **Explanation:** A processors memory area has thousands of memory location that store information known as words or registers The information is stored in binary forms 1, 0 Bits stored in words and words are stored in data files ٠ Range of 1 word in memory is from -32768 to +32676 • File types are o/p image file and i/p, status file, bit, counter file, integer, floating point The user selects the file type depending on the requirement.

(ii) List any four I/O module selection criteria

06



WINTER – 15 EXAMINATION





WINTER – 15 EXAMINATION

Subject Code: 17664

Ans To develop the ladder diagram, the following input & output are considered . input 04 marks output Stast = I:0/1 for Light = 0:0/1 ladder diagram (Step (EN) T4:0 wise 1:01 T4:1/DN Time Base 15 marking Pr=5 for ladder) T4:0/TT 0:011 TON (EN) T411 Time Base 15 T4:0/DH Pr=5 ii) 04 Draw a ladder diagram for two motor operation the following conditions. (1) When start push button starts motor M1 and motor M2. Stop push button stops motor M1 first and after 15 second (2) motor M2. Ans List of inputs and their addresses 04 marks I: 0/0Start buttonfor ladder Stop button-I:0/1 diagram List of outputs and their addresses (Step Motor M1 – O: 0/0wise marking Motor M2 – O: 0/1for OFF delay timer -T4.1 ladder)



Subject Code: 17664





WINTER – 15 EXAMINATION

Subject Code: 17664

08 marks adder diagram: stepper motor for S: ODN 10/1 ladder TON diagram 14:0 (Step Base: 0.01 wise Pr : 50 marking T4: 0/DN for TON EN) ladder) 14:1 T.B = 0.015ec Pr = 50 T4:0/1T 0:0/1 t٢ 0:0/1 CTU (Cu) C5:0 Pr=10 C 5:0/DN TON . (m) 74:2 T.g. = 1 0:0/2 Pr=20 0:0/2) 7:2/DN 0:0/2 C5;0 4:2/DN (RES) Attempt any FOUR of the following 06 16 Give redundancy in PLC modules with a neat diagram. 04 a) Ans **Redundancy :** 03 marks • Redundancy means extra system components or mechanisms added to for explanati decrease the chance of total system failure. Different types of redundancy are available in PLC like redundancy for on a CPU module, power module, bases and communication module is available. CPU redundancy system is composed of separate bases for ideal • redundancy structure. In case an error occurs in an active CPU module, a backup module is automatically converted to active one for continuous operation. In these cases two processors can be tied into one I/O system and some • means is provided that switches control from the failure CPU to the backup when a failure CPU to the backup when a failure occurs as shown in Fig. 01 mark for diagram



Subject Code: 17664

	 Full Switchover CPU 2 CPU 1 Switchover CPU 2 To LO The working of total system is reliability of its operation. The safety of critical load is increased by transferring it from a failed power module to an alternative source of power. Thus, reliability can be increased by selective use of redundancy. 		
b)	Explain with waveforms up counter.		04
Ans .	Explanation: When i/p to count up counter goes true the Acc value will be increased by 1, not matter how long the i/p is true. So every true rung condition acc will increment by 1. When acc value reaches the preset value the counter DN bit will be set. For example as shown in figure $\frac{f: 0/0}{f: 0.5: 0.6N} \xrightarrow{f: 0.10}{f: 0.5: 0.6N} \xrightarrow{f: 0.10}{f: 0.5: 0.6N}$ IN example preset value is 5, in waveform when /p goes high then CU bit also goes high and Acc values is incremented by 0. When next high i/p arises at counter i/p then CU bit also goes high and Acc value becomes equal to preset value then DN bit is set and related o/p device is ON. This Dn bit remains high until counter is reset by reset instruction. When reset instruction is executed counter gets reset and DN bit also goes low and Acc also goes to zero	02 marks for explanati on 02 marks for wavefor ms	



Subject Code: 17664

<u>Model Answer</u>





WINTER – 15 EXAMINATION

Subject Code: 17664

01 mark Ans each for Dana Handling Instauctions:instructio Convert to BCD or TOD Instruction n format TOD CONVENT to BCD Destination 2) convest From BCD or FRD Lostruction FRD Convert from BCD SOUVCE Destination Radian Degrees or DEG Instruction DEG Radians to Degrees Destination to Radian or RAD Instruction 4) Degrees RAD Degree to Radians Destination Or Any other four data handling instruction should be considered Give the details of troubleshooting in PLC system 04 e) **Troubleshooting in PLC:** 04 marks The troubleshooting of PLC system can be done in for explainat following manner. ion Input devices e.g. switches can be manipulated to give the open and closed contact conditions and the corresponding LED on the input module observed. It should be illuminated when the input is closed and not when it is open. Failure of LED to illuminate could be, because the input device is not correctly operating/ there is incorrect wiring connection to the input module/the input device is not correctly powered or LED or input



Subject Code: 17664

module is faulty.	
For output devices that can be safely started, Push button might have been installed so that each output can be tested.	
Another method that can be used to test inputs and outputs is termed as forcing.	
This involves software, rather than mechanical switching ON or OFF, being used with instructions from the programming panel to turn ON or OFF inputs/outputs.	
In order to do this, a PLC has to be switched into the forcing or monitor mode by pressing a key marked FORCE or selecting that mode on a screen display.	
A portion of the program may operate properly in the FORCE mode but not during actual operation. For example input IN 0045 may operate correctly in the FORCE mode but not in actual operation. This would indicate that the input, IN0045, is malfunctioning because of internal or external reasons	