MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

DEPARTMENT OF MECHATRONICS

III SEMESTER B.TECH. (MECHATRONICS)

END SEMESTER EXAMINATIONS, JANUARY 2022

SUBJECT: MICROCONTROLLER BASED SYSTEM DESIGN [MTE 2153]

(27/01/2022)

Time: 75 minutes

Instructions to Candidates:

- Answer **ALL** the questions.
- *Data not provided, may be suitably assumed*

Q. No		M	CO	PO	LO	BL
1	For the assembler directive EQU identify the correct instruction/s i) data EQU label+16 ii) data EQU 0x23,0x34 iii) data EQU 0x1C, CODE32 iv) data EQU 0x12345678 Ans: a) i , iii, iv b) i, iv c) ii, iv d) i,ii,iii,iv	1	2	1	1	4
2	Identify the correct statement/s for the UART i) For Oversampling Baud or high-frequency baud rate generation the value of register UCOS16 =1. ii) A high-to-low transition starts an asynchronous data communication iii) A logic low appears on the communication line when the transmission line is idle iv) Asynchronous communication requires a common clock a) i and ii b) i,ii,iii c) i,iii d) All correct	1	3	2	2	4
3.	For the directive DCD identify the correct instruction/s. i) value DCD 20,30,1 ii) value DCD abc+4 iii) vlaue DCD 0x3f123abc iv) value DCD 0,0,0 Ans: a) i and ii b) i,ii,iii c) i,iii d) i,ii,iii,iv	1	2	1	1	4
4	Analyze the given code snippet. LDR R2, =0x7FFFFFFD	1	2	2	2	4

	LDR R1, =0x04 MVNS R1, R2 At the end of execution, the content of register R1 is _____ a) 0x80000002 b) 0x7FFFFFFD c) 0x00000002 d) None of the above					
5.	A barrel shifter uses _____logic for shifting the data to a number of bits specified. a) Combinational b) Sequential c) Logarithamic d) arithmatic	1	1	1	1	2

6.	Analyze the given code snippet.
	
	LDR R2, =0x7FFFFFFD
	
	LDR R1, =0x04
	
	MVNS R1,R2
	
	After the execution of the code, content of the Flags N, Z, C, V respectively are _____
	
	(i) N=0, Z=0, C=0, V=0
	(ii) N=1, Z=0, C=0, V=1
	(iii) N=1, Z=0, C=0, V=0
	(iv) N=0, Z=0, C=1, V=0
		1	2	2	2	4

7.	The sequence of product life cycle in order to ensure functional safety must be i) Planning, Installation, Modification, Testing, ii) Planning, Installation, Testing, Modification iii) Installation, Modification, Testing, Planning iv) Planning, Testing, Modification, Installation	1	4	7	9	2
8	Evaluate the following instruction and identify the value in R1. Let R2=0x0000FFFF RBIT R1, R2 (Reverses the bit order on a 32 bit word) a)0xFFFF0000 b) 0x0000FFFF c) 0xFFFFFFFF d) 0x00FFFFFF Ans: 0xFFFF0000	1	2	2	2	3
9.	Choose the functional blocks present in MSP432P401R a) Fixed point unit b) Memory protection unit	1	1	1	1	2

	c) Debug Access Port d) MIMD vector processing unit i) b,c,d ii) b,c iii) c,d iv) all the above					
10.	An embedded C code is written to turn ON 2 LED's connected to pin P2.0 and P2.1, when a switch S1(connected to pin P2.2) is pressed. To perform this operation the value to be initialized in P2->DIR register is _____ (NOTE: Port X Direction: 0b = input, 1b = output #) 0x01 #) 0x03 #) 0x0011 #)None of the above Ans: 0x03	1	3	3	3	4
11.	An embedded C code is constructed to turn ON 2 LED's connected to pin P2.0 and P2.1, when a switch S1(connected to pin P2.2) is pressed. To perform this operation the value to be initialized in P2->REN register in pull up mode is _____ a) 0x01 b)0x0100 c)0x04 d)none of the above	1	3	3	3	4
12.	Identify which of the option is correct? (i) STMIB = LDMDA (ii) STMIB = LDMIB (iii) STMDB = LDMIB (iv) STMDB = LDMDB Ans: STMIB & LDMDA	1	2	1	1	4
13.	Recognize assembly instruction to load 4 words starting from the memory location 0x80000000 into the registers r0-r3? (Assume r9 contains the base address 0x80000000) a) LDMDB r9, {r0-r3} b) LDMIB r9, {r0-r3} c)LDMIA r9, {r0-r3} d) LDMDA r9, {r0-r3}	1	2	2	2	4
14.	Recognize the correct statement/s for RISC: a) Complexity found in hardware side b) Separate instructions are used for load and store data to/from the memory c) Instruction length may vary d) Pipelining can be used easily i) a,b ii) b,d iii) a,b,c iv) b,c,d	1	1	1	1	4
15.	When the number of stages in a pipeline increases from 3 to 5, then the _____.	1	1	1	1	2

	a) Throughput reduces b) Latency reduces c) Throughput and latency increase d) Throughput increases and latency reduces					
16.	The Logical Instructions are: ORR, EOR, TEQ, AND, TST, BIC, MOV, MVN V flag is unaffected by the logical data processing instructions. The reason/s for this is/are a) Since V flag and C flag are always the same after any logical operations b) Because it will delay the execution of logical operations c) V flag is relevant only when an Arithmetic operation is performed d) None of the above	1	2	2	2	4
17.	Identify the correct statement/s for the UCAxSTATW register • Contains the data received (Receiver Buffer) • Contains the data to be transmitted (Transmitter Buffer) • Observe changes in the MSP432 system • Settings for the modulation control word register	1	3	1	1	4
18.	There is one 16-bit register available in the MSP432 microcontroller to control the WDT A module. This register is called a) WDTCTL b) WDTPW c) WDTCNTCL d) WDTSSEL	1	2	2	2	4
19.	LDR R13,=0x00000024 STMDB R13!,{R6,R7,R14} Analyze the given ARM Code and supporting data. At the end of the program, the address and content of stack pointer is _____ and _____. a) 0x00000018, 0x000000FF b) 0x00000018 ,0x00000034 c) 0x00000012,0x000000FF d) 0x00000012, 0x00000034 Register | Data in Register R6 | 0x000000FF R7 | 0x00000045 R14 | 0x00000034	1	2	2	2	4
20.	_____ Register is used to set the priority for Interrupts. a) PRIMASK b) FAULTMASK c) BASEPRI d) CONTROL	1	1	1	1	4
21.	The interrupt flag must be cleared in the corresponding ISR to_____ a. To avoid re-entry to the same ISR repetitively b. Interrupt is disabled if the flag is not cleared c. Interrupts from the same source may cause error	1	3	1	1	2

	d. None of the above					
22.	Choose the correct statement/s in association with functional safety a) Multiplying critical components ensure maximum functions without single point of failure. b) Redundant components must be identical c) Clustering is used for availability d) Hardware debugging and firmware consistency is expected. i) a,c,d ii) a,b,c iii) b,c,d iv) all of the above	1	4	7	9	4
23.	The following statements are true with respect to watchdog timer. (i)it is 16 bit timer/counter (ii) used to system reset after the predefined time interval (iii) used as interval timer for generating periodic interrupts. (iv) it is password protected. a. i,ii,iii,iv b. i,ii,iv c. ii,iii,iv d. ii,iii	1	3	1	1	4
24.	Stack Operation is performed using _____ addressing mode. (a) Immediate (b) Direct (c) Indirect (d) Register	1	2	1	1	2
25.	Identify the correct statement/statements with respect to timer in MSP432 microcontroller. 1. There are four identical Timer_A module in the MSP432 microcontroller. 2. In Continuous mode, the timer counts up until it reaches 0XFFFF. 3. TAxCCTLy register is used to Loads the value for count, PWM generation. 4. In Continuous mode, the timer counts up until it reaches 0X0FFF. i) 1,2,3 ii) 1,2 iii) 1,3,4 iv) all of the aboveM	1	3	1	1	4
26.	A register R1 contains signed 32 bit representation of value -5 which is passed through a sign extend block. The data at the output of sign extend block is a) 0x00000005 b) 0xFFFFFFF5 c) 0x0000000B d) 0xFFFFFFFB	1	1	1	1	2
27.	Identify the correct statement/statements with respect to NVIC in MSP432 microcontroller. 1. The NVIC supports 64 interrupt inputs, with up to eight programmable priority levels in the MSP432 microcontroller. 2. The NVIC supports 16 interrupt inputs, with up to six programmable priority levels in the MSP432 microcontroller. 3. The NVIC supports 16 interrupt inputs, with up to eight programmable priority levels in the MSP432 microcontroller. 4. The NVIC supports 64 interrupt inputs, with up to six programmable priority levels in the MSP432 microcontroller.	1	3	1	1	4

28.	The number of registers available in the MSP432 microcontroller to control each Timer A module are 1. 18 2. 16 3. 8 4. 12	1	3	1	1	2
29	Identify the correct statement/statements with respect to stack pointer in MSP432 microcontroller. 1. R16 register points to top of the stack 2. Top of the stack is Highest address containing the data 3. Stack grows in the upward direction 4. Address gets decremented after PUSH operation a)	1	2	1	1	4
30.	Choose the correct statement/statements a. The CMP instruction subtracts the value of Operand2 from the value in Rn. b. The CMN instruction adds the value of Operand2 to the value in Rn. c. The CMN instruction is same an ADDS instruction, except that the result is discarded. d. The CMP instruction adds the value of Operand2 to the value in Rn. i) a,b ii) b,d iii) a,b,c iv) all of the above	1	2	1	1	4

DEPARTMENT OF MECHATRONICS

III SEMESTER B.TECH. (MECHATRONICS)

END SEMESTER EXAMINATIONS, JANUARY 2022

SUBJECT: MICROCONTROLLER BASED SYSTEM DESIGN **[MTE 2153]**

(27/01/2022)

Time: 75 minutes **MAX. MARKS: 20**

Instructions to Candidates:

- Answer **ALL** the questions.
- *Data not provided, may be suitably assumed*

Q. No		M	CO	PO	LO	BL
1.	A Mall has an automated door at the entrance. A IR sensors placed on top of the door. When a person is detected the sensors give an active high. (Note: consider the case of only one person entering at a time). When an IR sensor detects a high signal door opens automatically using the servo motors activated by MSP432P401R.The door must remain open for 3 seconds using a clock frequency of 3MHz. Develop an embed C code to implement this application. (Assume IR sensor is connected to pin P2.0 and P2.1, Generate delay using timer 32).	5	3	3	5	6
2.	In an industry 4 different sensors are connected to 4 pins namely pin P1.3,P1.2,P1.1,P1.0 to monitor the environment in the production unit. A particular pattern of input indicates a situation where the operator's attention is needed which is done by glowing an LED. LED is connected to pin P2.0. The 32bit data from the sensors is stored in a memory location starting from 0x00000032. Read the input and count the number of input pins (P1.3-P1.0) that are high. If the count is an odd number the pattern is detected, and the LED should be turned ON. If that pattern is not detected keep LED OFF. Develop ARM assembly program to perform this operation using MSP432P401R.	3	2	3	5	6
3.	At a given time ARM processor is running in user mode. An interrupt request occurs by the external device attached to it. Specify to which mode ARM processor enters due to this interrupt. Differentiate between the two modes of operations in an ARM processor.	2	1	1	1	4
4.	A microwave oven consists of several electronic components such as transistors, on chip clocks etc. Discuss the various risk associated with microwave oven due to the presence of electronic components. Classify its failure rates with help of a plot. Differentiate the types of	4	4	7	9	4

	failure in electronics.					
5.	The serial port of MSP432 microcontroller is connected to the COM port of the desktop PC and on the PC we are using a hyper terminal program to send and receive data serially. Upon pressing a switch of MSP432 microcontroller, the sequence "Ready" is to be sent to PC. Develop an embedded C code to perform this operation. Select the baud rate to be 57600. Use Clock settings to generate SMCLK as 12MHz. Use Port 3 of MSP432 for communication.	**3**	**3**	**3**	**5**	**6**
6.	MSP432P401R is used by XYZ company as a controller for a product to design smart lighting in a house such that if the natural light in the room is less than 50%, lights adjust to 50%. If natural light is less than 40%, lights increase to 60%, and so on. This helps for when the shades are drawn, or on a cloudy day in the middle of summer. Mention the functional Safety standards required and analyze the risk parameters.	**3**	**4**	**7**	**7,10**	**4**