Reg. No.										

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

DEPARTMENT OF MECHATRONICS ENGINEERING

VII SEMESTER B.TECH. (MECHATRONICS ENGINEERING)
END SEMESTER EXAMINATIONS, Dec, 2020

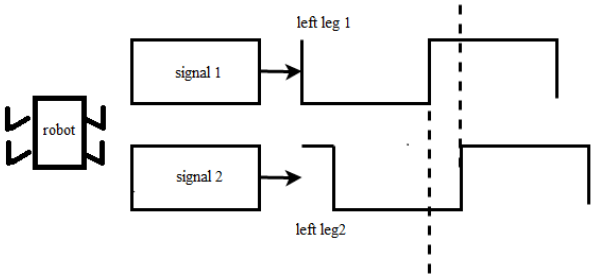
SUBJECT: MECHATRONICS SYSTEM DESIGN [MTE 4101]
Date:23-12-2020 Time: 2:00 PM-5:00PM

Time: 3 Hours **MAX. MARKS: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Any data not provided may suitably assumed.

Q. No	Question	M	CO	PO	LO	BL
1A.	An Automotive Industrial plant has a job shop for Industrial Robots for spot welding of car frames. The job shop section has 14 industrial robots working in synchronized code method i.e., each robot can operate in its own workspace. The entire job shop is protected with a metal cage for human safety. The cage has only one door with a laser sensor module for counting the people. On DD/MM/YYYY, the sensor counted 10 humans entering the job for maintenance and on exit door 9 people have come out, while the display counter erroneously shown 10 due to hardware fault, and control engineer started the operation. The human left behind was accidentally hit by an industrial robot. The human is under critical condition and on-board safety inspector calls for inspection of electronics safety system. As a safety engineer and representee of Indian Government, address the above case and generate the case study report addressing the workmen's compensation act 1923 for Industrial accidents with legal actions of violations. Also address IEC standards for electrical safety measures under ISO 26262 as a future guideline for the industry.	**6**	**1**	**6**	**15**	**1, 3**
1B.	You are CEO of a company. Why would you have your employees sign a "non-compete clause" (NCC) as a requirement for employment?	**2**	**1**	**6**	**15**	**1**
1C.	Summarize the IEEE code of ethics.	**2**	**1**	**8**	**5, 8**	**1**
2A.	Develop an ARM assembly language program to perform the following operation. IR sensor is used to scan the rough surface in a robot and received signal was found to be noisy. Assume that the microcontroller collects the samples of signal from photodiode. ADC converts the arriving signal to digital samples and stores in the RAM. Assume ROM starts at 0x00000000, and RAM starts at 0x20000000, Incoming data is stored at address 0x2000003C onwards. Develop a	**6**	**2**	**1, 2**	**1, 2**	**3, 4**

	low pass filter (as an average of 8 samples) and store the noise free samples at the address 0x20000040 onwards.					
2B.	List the applications of stack in the microcontroller. Elaborate the advantages of stack memory with examples of Embedded C codes.	**4**	**3**	**1, 2**	**1, 2**	**1**
3A.	Write an Embedded C Code to blink RGB LED at P2.0, P2.1, P2.2 on MSP432P401R launchpad at a frequency of 10KHz individually one after another for 5 times using Timer 32 for delay generation.	**5**	**3**	**1, 2**	**1, 2**	**3**
3B.	List the use of watchdog timer as a timer and interval timer.	**2**	**3**	**1, 2**	**1, 2**	**1**
3C.	Write the steps for generating two interrupts through NVIC and its IPR registers. Also mention the importance of IPSRx, PRIMASK, HARDFAULT and BASEPRI in interrupt priorities.	**3**	**3**	**1, 2**	**1, 2**	**1**
4A.	Explain two different DAC techniques: R-2R ladder and binary weighted. Pick the best DAC technique that can be generalized.	**4**	**3**	**2**	**2**	**4**
4B.	The overall goal of the problem is to design a system that sinusoidally oscillates a high-power LED at 1 Hz, in which the LED goes bright-dim-bright once a second. Generate a table with 16 different brightness's with the values varying sinusoidal between 0 to 1. Mention the proper equation to generate the signal and write these values as an array with duty cycle to glow the LED accordingly. Use Timer A0, Capture block 1 to generate the required signal. Show the hardware interface between the microcontroller and the LED. Full brightness occurs at 3.3V. Cheat sheet is attached at the end.	**6**	**4**	**1, 2**	**1, 2**	**3, 4**
5A.	Mention the legal actions of violations in e-Waste management under Indian regulatory.	**2**	**4**	**6**	**5**	**1**
5B.	For a locomotion of bio inspired robot with 4 legs, two signals are fed to the left legs of robots. However, the robots fail to keep the legs at the same time. To resolve the problem, signal generators are checked using the waveform display machine. Inspect the problem between two signals as shown in the display monitor (Fig 5B). Find the lag between the signals using the Timer-A module of MSP432 with an Embedded C code required to correct the signals. Select the appropriate cheat sheet from the list.  Fig 5B: Bio inspired robot with 4 legs, and output of signal generators	**8**	**4**	**1, 2**	**1, 2, 4, 6**	**3, 4**

Data Sheet

TIMER 32 REGISTERS

Bits	**7**	**6**	**5**	**3-2**	**1**	**0**
TIMER32_y->CONTROL	**ENABLE**	**MODE**	**IE**	**PRESCALE**	**SIZE**	**ONESHOT**
TIMER32_CONTROL_**XX**_x	**1-enable,** **0-disable**	**1- free running mode,** **0- periodic**	**1-enable interrupt** **0-disable interrupt**	**0=/1,** **1=/16,** **2=/256.**	**0- 32 bits,** **0-16 bits**	**1-oneshot** **0-wrap**

25	Timer32_INT1	T32_INT1_IRQn	T32_INT1_IRQHandler
26	Timer32_INT2	T32_INT2_IRQn	T32_INT2_IRQHandler

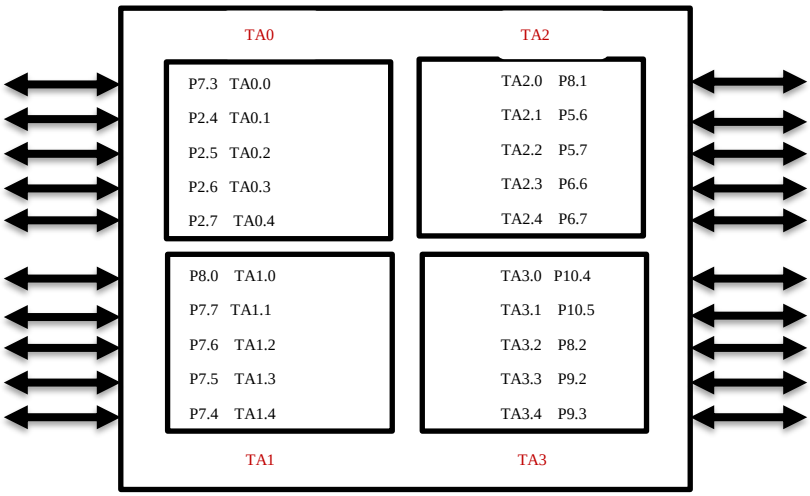
TIMER32_y->LOAD	Load register
TIMER32_y->INTCLR	Clear flag
TIMER32_y->VALUE	Check the counter value

TIMER A REGISTERS

Bits	**9-8**	**7-6**	**5-4**	**2**	**1**	**0**
TIMER_A**y**->CTL	**TASSEL**	**ID**	**MC**	TA**CLR**	TA**IE**	TA**IFG**
TIMER_A_CTL_**XX**_x	**0-TACLK,** **1-ACLK** **2-SMCLK,**	**0-/1,** **1=/2,** **2=/4,** **3=/8**	**0-stop,** **1-up** **2- continuous,**	**1-clear counter**	**1-enable timer interrupt**	**1-timer overflow flag set**

Bits	**15-14**	**13-12**	**11**	**10**	**8**	**7-5**	**4**	**3**	**2**	**1**	**0**
TIMER_A**y**->CCTL	**CM**	**CCIS**	**SCS**	**SCCI**	**CAP**	**OUTMOD**	**CCIE**	**CCI**	**OUT**	**COV**	**CCIFG**
TIMER_A_CCTLN_XX_x	0-no edge, 1- rising, 2-falling, 3-both	0-CCInA, 1-CCInB, 2-GND, 3-VCC	1-Synchronize timer clock	1-Observe synchronized input	1-capture 0-compare	0-output, 1-set, 2-toggle/reset, 3-set/reset, 4-toggle, 5-reset, 6- toggle/set, 7-reset/set	1-enable interrupt	Capture input value	Bit value		Set for capture in capture mode Set if compare is true in compare mode

Bits	**3-0**
TIMER_Ay->EX0	**TAIDEX**
TIMER_A_EX0_**XX**_x	**0-/1, 1=/2, 2=/3, 3=/4, 4=/5, 5=/6, 6=/7, 7=/8.**



8	Timer_A0	TA0_0_IRQn	TA0_0_IRQHandler	TA0CCR0-CCIFG
9	Timer_A0	TA0_N_IRQn	TA0_N_IRQHandler	TA0CCR1-6, TAIFG
10	Timer_A1	TA1_0_IRQn	TA1_0_IRQHandler	TA1CCR0-CCIFG
11	Timer_A1	TA1_N_IRQn	TA1_N_IRQHandler	TA1CCR1-6, TAIFG
12	Timer_A2	TA2_0_IRQn	TA2_0_IRQHandler	TA2CCR0-CCIFG
13	Timer_A2	TA2_N_IRQn	TA2_N_IRQHandler	TA2CCR1-6, TAIFG
14	Timer_A3	TA3_0_IRQn	TA3_0_IRQHandler	TA3CCR0-CCIFG
15	Timer_A3	TA3_N_IRQn	TA3_N_IRQHandler	TA3CCR1-6, TAIFG