Name:

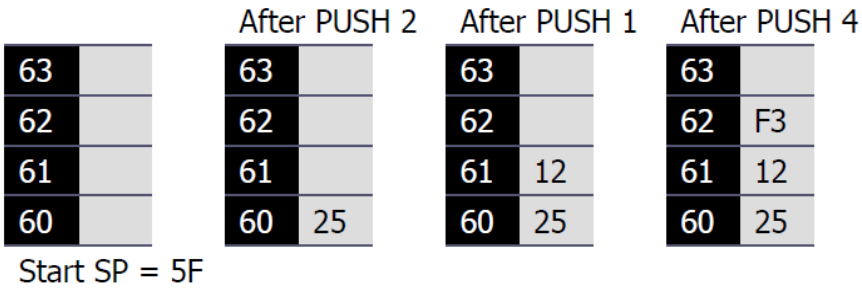
Enrolment No:

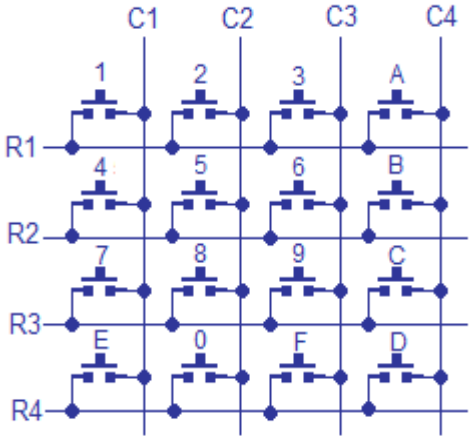
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, April/May 2018

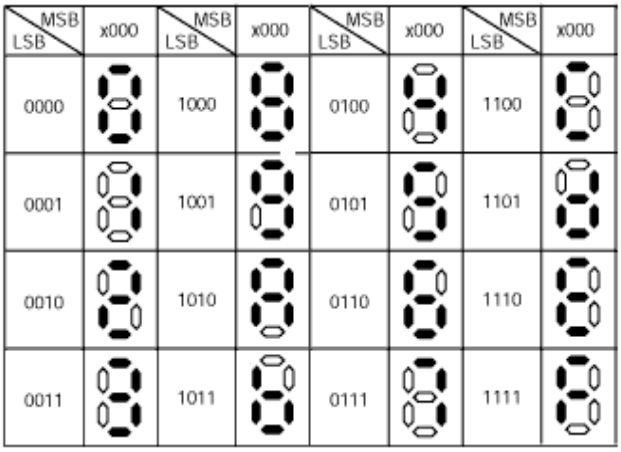
Course: **Embedded Systems (ELEG-464)** **Semester: VIII**
Program: **B.Tech Instrumentation & Control Engineering**
Time: 03 hrs. **Max. Marks: 100**

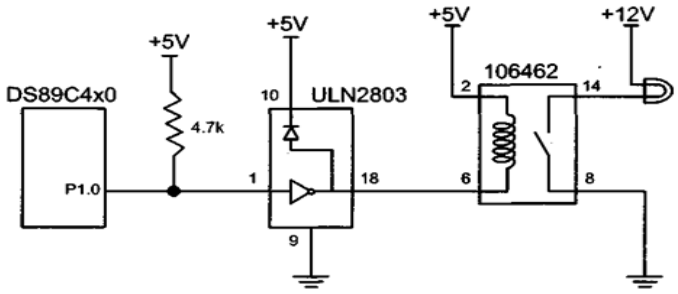
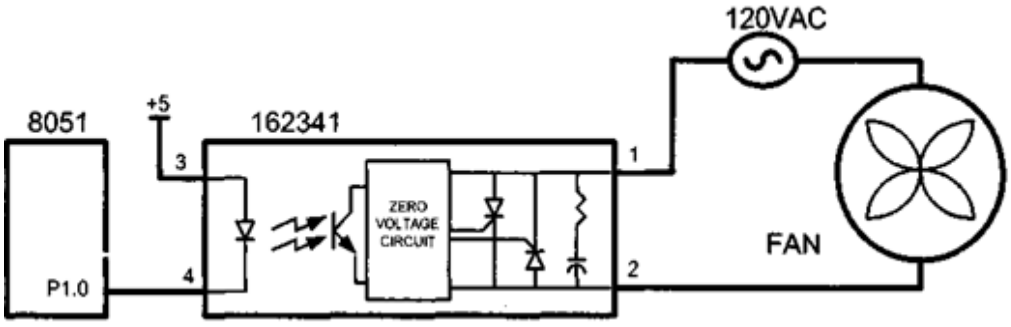
Instructions: *Assume necessary data in programming if required.*

SECTION A (4 x 5 = 20 Marks)

S. No.	*Attempt All the questions*	Marks	CO
Q.1	What is Embedded System? Comment on the design matrices for the product development in embedded system?	**4**	**CO1**
Q.2	Comments on the different data types used in 801 Embedded 'C' programming. Write an 8051 C program to send the hex values for the ASCII characters of 0, 1, 2, 3, 4, 5, A, B, C and D to port P1.	**4**	**CO4**
Q.3	Comment on the different addressing modes employed in 8051 microcontroller. Examine the stack for 8051 microcontroller. Show the contents of the register and SP after execution of PUSH 4 instructions. All values are in hex.  Fig. 1 Position of contents	**4**	**CO3**
Q.4	Assume that the word "UPES" is burned into ROM locations starting at 200H and the program is burned into ROM locations starting at 0. Analyze the method to support the program functionality and state where "UPES" is stored after this program is run, also develop the code for same. **OR** Draw the structure for assembly language program flow and discuss the steps to burn the program in microcontroller.	**4**	**CO3**
Q.5	Find the time delay generated by the following subroutine for 8051 microcontroller, If XTAL = 11.0592 MHz. HERE: MOV R0, # 200 AGAIN: DJNZ R0, AGAIN RET Suggest the best techniques to increase the delay obtained for the subroutine and estimate value.	**4**	**CO5**

SECTION B (8 x 5 = 40 Marks)			
	Attempt All the questions		
Q.6	Explain the use of line driver IC MAX-232 and DB-9 connector used in serial communication and interface with 8051 microcontroller.	**8**	**CO4**
Q.7	Draw the block diagram of 8051 microcontroller and pin layout with the complete description of each pin and units of block.	**8**	**CO1**
Q.8	What is Semaphore? Explain the different types of Semaphore.	**8**	**CO2**
Q.9	Develop the data path architecture for the GCD controller for the two numbers X = 40 and Y = 50. Discuss the state table and FSMD. Also compare the custom GCD with the GCD running on a 300 MHz processor with two operand inductions and one clock cycle per instruction.	**8**	**CO2**
Q.10	Interface the stepper motor to 8051 microcontroller with the help of optoisolator. A switch is connected to pin 2.7 of 8051 microcontroller. Write a program to monitor the status of switch and perform the followings (a) If SW = 0, the stepper motor moves clockwise. (b) If SW= 1, the stepper motor moves counterclockwise.	**8**	**CO5**
SECTION-C (20 x 2 = 40 Marks)			
	Attempt any two of the followings (Case Studies)		
Q.**11**	The interfacing of a hex keypad to 8051/8085 microcontroller/ microprocessor is very essential while designing embedded system projects which requires character or numeric input or both. For examples projects like digital code lock, numeric calculator etc.  *Fig.2 Hex keypad* Before going to the interfacing in detail, let's have a look at the hex keypad. Hex key pad is essentially a collection of 16 keys arranged in the form of a 4 × 4 matrix. Hex keypad usually have keys representing numerics 0 to 9 and characters A to F. The simplified diagram of a typical hex key pad is shown in the figure below. The hex keypad has 8 communication lines namely R1, R2, R3, R4, C1, C2, C3 and C4. R1 to R4 represents the four rows and C1 to C4 represents the four columns. When a particular key is pressed the corresponding row and column to which the terminals of	**20**	**CO3**

	the key are connected gets shorted. For example if key 1 is pressed row R1 and column C1 gets shorted and so on. The program identifies which key is pressed by a method known as column scanning. In this method a particular row is kept low (other rows are kept high) and the columns are checked for low. If a particular column is found low then that means that the key connected between that column and the corresponding row (the row that is kept low) is been pressed. For example if row R1 is initially kept low and column C1 is found low during scanning, that means key 1 is pressed. (a) Based on the discussed case, develop the algorithm of keypad interfacing (b) WAP to display all the numerical values and characters. Use any microprocessor and microcontroller.		
Q.12	Programming a 7-Segment display is so easy as to program a LED array but here pattern should be generate in a manner so as it appears as a meaningful character and with cascaded mode we also need to send "clear" (0) or "set bit" (1) signal on respected pins of port two in order to enable or disable respected 7-Segment display. The signals on Port zero which can generate meaningful characters on 7-Segment display are listed in fig. 3(a) below.  Fig 3(a) Pattern of 7 segments  Fig 3(b) Output **(a)** Develop the Embedded 'C' code or assembly program to support output shown in fig. 1(b) with interface the 8051 microcontroller using one segment. **(b)** Draw and discuss the interface diagram with the four segments and method of displaying the output. **(c)** Replace the Seven Segment with 16 x 2 LCD. Draw the interface diagram and write embedded 'C'code to display the same data on LCD.	**20**	**CO4**

Q.13	Digital systems and microcontroller pins lack sufficient current to drive the relay. While the relay's coil needs around 10 mA to be energized, the microcontroller's pin can provide a maximum of 1-2 mA current. For this reason, we place a driver, such as the ULN2803, or a power transistor between the microcontroller and the relay as shown in Fig.4  Fig.4 Connection of relay Another widely used relay is the solid-state relay. In this relay, there is no coil, spring, or mechanical contact switch. The entire relay is made out of semiconductor materials. Because no mechanical parts are involved in solid-state relays, their switching response time is much faster than that of electromechanical relays. Another problem with the electromechanical relay is its life expectancy. The life cycle for the electromechanical relay can vary from a few hundred thousands to few million operations. Wear and tear on the contact points can cause the relay to malfunction after a while. Solid-state relays have no such limitations. Extremely low input current and small packaging make solid-state relays ideal for microprocessor and logic control switching. They are widely used in controlling pumps, solenoids, alarms, and other power applications. Some solid-state relays have a phase control option, which is ideal for motor-speed control and light-dimming applications. Fig.5 shows control of a fan using a solid-state relay (SSR).  Fig.5 8051 Connection to a Solid-State Relay (a) Develop the code for ON and OFF the Fan. (b) Develop the code for control the fan for dimming light application. (c) Comment on the use of Reed switch relay in wheel applications	**20**	

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Q.1	What is the different between general-purpose processor and single purpose processor? Comment on the design matrices for the product development in embedded system?	4	CO1
Q.2	Draw the structure for assembly language program flow and discuss the steps to burn the program in microcontroller. **OR** Assume that the word "UPES" is burned into ROM locations starting at 200H and the program is burned into ROM locations starting at 0. Analyze the method to support the program functionality and state where "UPES" is stored after this program is run, also develop the code for same.	4	
Q.3	Comments on the different data types used in 8051 Embedded 'C' programming. Write an 8051 C program to send the hex values for the ASCII characters of 0, 1, 2, 3, 4, 5, A, B, C and D to port P1.	4	CO4
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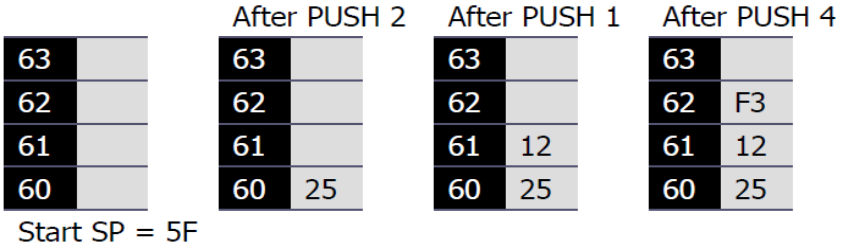
Q.5	Comment on the different addressing modes employed in 8051 microcontroller. Examine the stack for 8051 microcontroller. Show the contents of the register and SP after execution of PUSH 4 instructions. All values are in hex.  Fig. 1 Position of contents	4	CO3

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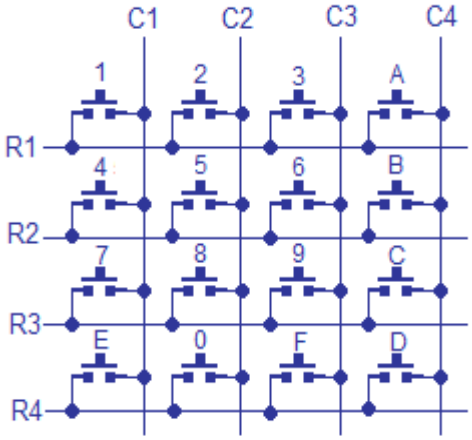
Q.**11**	The interfacing of a hex keypad to 8051/8085 microcontroller/ microprocessor is very essential while designing embedded system projects which requires character or numeric input or both. For examples projects like digital code lock, numeric calculator etc.  *Fig.2 Hex keypad* Before going to the interfacing in detail, let's have a look at the hex keypad. Hex key pad is essentially a collection of 16 keys arranged in the form of a 4 × 4 matrix. Hex keypad usually have keys representing numerics 0 to 9 and characters A to F. The simplified diagram of a typical hex key pad is shown in the figure below. The hex keypad has 8 communication lines namely R1, R2, R3, R4, C1, C2, C3 and C4. R1 to R4 represents the four rows and C1 to C4 represents the four columns. When a particular key is pressed the corresponding row and column to which the terminals of	**20**	**CO3**

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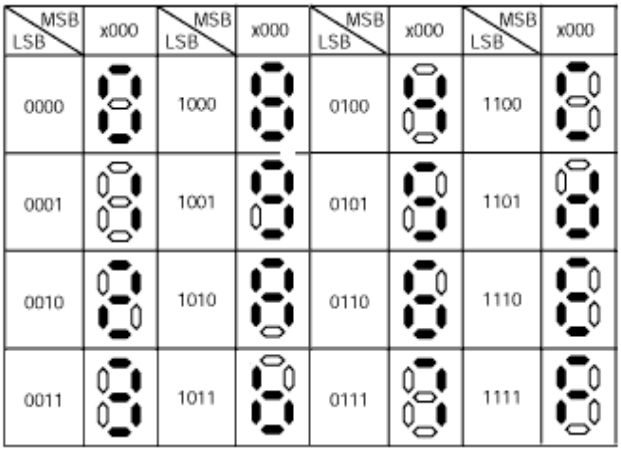
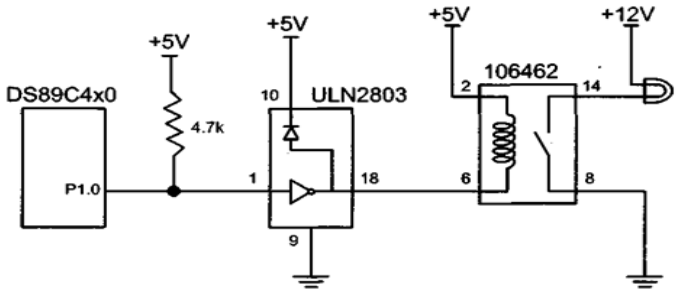
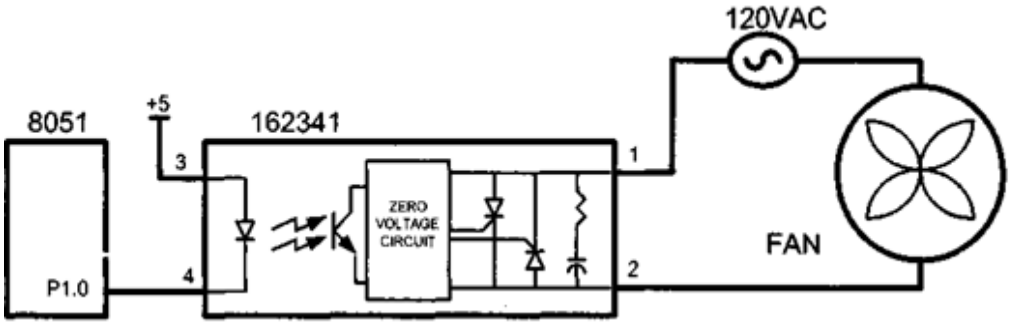
Q.12	Programming a 7-Segment display is so easy as to program a LED array but here pattern should be generate in a manner so as it appears as a meaningful character and with cascaded mode we also need to send "clear" (0) or "set bit" (1) signal on respected pins of port two in order to enable or disable respected 7-Segment display. The signals on Port zero which can generate meaningful characters on 7-Segment display are listed in fig. 3(a) below.  Fig 3(a) Pattern of 7 segments  Fig 3(b) Output **(d)** Develop the Embedded 'C' code or assembly program to support output shown in fig. 1(b) with interface the 8051 microcontroller using one segment. **(e)** Draw and discuss the interface diagram with the four segments and method of displaying the output. **(f)** Replace the Seven Segment with 16 x 2 LCD. Draw the interface diagram and write embedded 'C'code to display the same data on LCD.	**20**	**CO4**

Q.13	Digital systems and microcontroller pins lack sufficient current to drive the relay. While the relay's coil needs around 10 mA to be energized, the microcontroller's pin can provide a maximum of 1-2 mA current. For this reason, we place a driver, such as the ULN2803, or a power transistor between the microcontroller and the relay as shown in Fig.4  Fig.4 Connection of relay Another widely used relay is the solid-state relay. In this relay, there is no coil, spring, or mechanical contact switch. The entire relay is made out of semiconductor materials. Because no mechanical parts are involved in solid-state relays, their switching response time is much faster than that of electromechanical relays. Another problem with the electromechanical relay is its life expectancy. The life cycle for the electromechanical relay can vary from a few hundred thousands to few million operations. Wear and tear on the contact points can cause the relay to malfunction after a while. Solid-state relays have no such limitations. Extremely low input current and small packaging make solid-state relays ideal for microprocessor and logic control switching. They are widely used in controlling pumps, solenoids, alarms, and other power applications. Some solid-state relays have a phase control option, which is ideal for motor-speed control and light-dimming applications. Fig.5 shows control of a fan using a solid-state relay (SSR).  Fig.5 8051 Connection to a Solid-State Relay (d) Develop the code for ON and OFF the Fan. (e) Develop the code for control the fan for dimming light application. (f) Comment on the use of Reed switch relay in wheel applications	**20**	