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PRESIDENCY UNIVERSITY BENGALURU

SCHOOL OF INFORMATION SCIENCE

MAKE UP EXAMINATION - JULY 2024

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| **Semester : 7th Sem** | **Date : 9th July 2024** |
| **Course Code : ECE3040** | **Time : 9:30am – 12:30pm** |
| **Course Name : Embedded Systems** | **Max Marks : 100** |
| **Program : B.Tech** | **Weightage : 50%** |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *Question paper consists of 3 parts.*
3. *Scientific and non-programmable calculator are permitted.*
4. *Do not write any information on the question paper other than Roll Number.*

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| **PART A** | | | |
| **ANSWER ANY 5 QUESTIONS 5Q X 2M=10M** | | | |
| 1 | Embedded systems possess certain specific characteristics and these are unique to each Embedded system. Describe any two caharacteristics of Embedded System. | (CO 1) | [Knowledge] |
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| 2 | Quality attributes are the set of system functional and non-functional requirements that are used to evaluate the system performance. Define the following Operational quality attributes of the Embedded System. i) Throughput ii) Reliability | (CO1) | [Knowledge] |
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| 3 | In ARM processor instruction set is a set of codes that the processor can understand. It contains instructions or tasks that control the movement of bits and bytes within the processor. State the operation of MRS and MSR instructions with its significance. | (CO2) | [Knowledge] |
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| 4 | The extended instruction set in Thumb-2 is a superset of the 16-bit Thumb instruction set, with additional 16-bit instructions alongside 32-bit instructions. Mention the advantages of Thumb-2 Instruction set over ARM Instruction set. | (CO2) | [Knowledge] |
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| 5 | The value of the resistor is selected to establish the proper LED current. For an active logic, the voltage applied to LED is about 3.3V, and the power delivered to the LED will be controlled by its current. If the desired brightness requires for the given operating point of 2.3 V at 10 mA, then the resistor value should be \_\_\_\_\_\_\_\_. | (CO3) | [Knowledge] |
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| 6 | The working principle of stepper motor is Electro-Magnetism. The step angle is the basis of the movement of a stepping motor and it depends on the total number of magnetic poles of the motor. A stepper Motor has 6 phases and 8 rotor tooth as shown in figure below, find the step angle and Total number of steps N required to complete one revolution. http://guqbms.inpods.com:57953/api/v1/downloadFile?fileId=33075&tenantid=13 | (CO3) | [Knowledge] |
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| 7 | An RTOS (Real-Time Operating System) is a type of operating system that is designed to meet the requirements of real-time applications, which require quick and predictable responses to events. RTOS are of 3 types Hard RTOS, Soft RTOS and Firm RTOS. Define Hard RTOS and Soft RTOS. | (CO4) | [Knowledge] |
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| **PART B** | | | |
| **ANSWER ANY 5 QUESTIONS 5Q X 10M=50M** | | | |
| 8 | Memory in an embedded system is a physical storage, where an embedded device uses the memory to store the data that the processor receives and manipulates it or to store long-term information about the instructions that the CPU executes. Briefly describe the Memory Systems used in Embedded Systems. | (CO1) | [Comprehension] |
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| 9 | Registers are important components of processor architecture. The registers are high speed temporary memory used by CPU during program execution. The CPU architecture consists of different types of registers used to perform a specific function during the various stages of instruction cycles. Explain the various registers present in ARM cortex M3/M4 processors with their significance. | (CO2) | [Comprehension] |
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| 10 | I2C is a serial communication protocol that only requires two signal lines. It was designed for communication between chips on a printed circuit board (PCB). The I2C protocol includes arbitration and collision detection capabilities which allow smooth communication along the bus which make a good choice for many embedded design applications. With suitable diagram illustrate the I2C Bus Protocol used in designing embedded systems. | (CO3) | [Comprehension] |
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| 11 | There are over 100 RTOS available in the commercial market. Selection of these RTOS for a given Embedded system is very difficult due to the issues in compatibility with the hardware platform and architecture of the target system. Indicate the salient features for the following RTOS-MicroC/OS-II, VX Works, RTLinux and Free RTOS. | (CO4) | [Comprehension] |
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| 12 | Kernel is an essential foundation of embedded Operating System (RTOS) which interacts with devices, allocating memory and handling interrupts and requests from processes running on the embedded system.  Elaborate the functionality of kernel in RTOS with suitable examples. | (CO4) | [Comprehension] |
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| 13 | While designing embedded systems, the quality attributes play a vital role in building the quality of the embedded system. There are two quality attributes, operational & non-operational. Operational quality attribute signifies the operation or functioning of an embedded system. Explain in brief the various operational quality attributes of an embedded systems. | (CO1) | [Comprehension] |
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| 14 | The addressing mode refers to the way in which the operand of an instruction is defined and it specifies a rule for interpreting or modifying the address field of the instruction before the operand is actually executed. Illustrate the different addressing modes available in the ARM Processor and output for each of the following cases. Given R0= 52120211h, R1= 10131514h, and R3= 01221FEEh.         (a) LDR R5, [R1, R0 LSR#3] (b) STR R3, [R0, R1 LSL#4] (c) STR R1, [R3], R0 (d) LDR R2, [R1], -R3, LSR#4 | (CO2) | [Comprehension] |
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| **PART C** | | | |
| **ANSWER ANY 2 QUESTIONS 2Q X 20M=40M** | | | |
| 14 | a) The addressing mode refers to the way in which the operand of an instruction is defined and it specifies a rule for interpreting or modifying the address field of the instruction before the operand is actually executed. Interpret the different addressing modes available in the ARM Processor and output for each of the following cases. Given R0= 3290A0BDh, R1= FD01C288h, and R3= 2B12934Ah.         (i) LDR R5, [R1, R0 LSR#3] (ii) STR R3, [R0, R1 LSL#4] (iii) STR R1, [R3], R0 (iv) LDR R2, [R1], -R3, LSR#4        (v) AND R6, R1, R2, LSR R3                        (15 Marks)  b) Consider two 16 bit data that are stored in two different registers of ARM Processor. It is required to perform addition between them. Write an ALP using ARM instruction to perform 16 bit addition on these two numbers.      (5 Marks) | (CO2) | [Application] |
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| 15 | a) A group of pins present on the processor is called a port. There exists a circuitry between the pin and its port’s registers to communicate between the processor and the external devices connected to it. It can be configured as inputs or outputs. Interpret the I/O port operation performed in Processor of the embedded system with suitable diagrams.    (10 Marks)  b) C programming is a general-purpose, procedural  programming language. The basic syntax style of implementing C language is very simple, easy, fast, and portable and supports function-rich libraries. Therefore C Programming is used in Embedded System to develop Embedded software (Firmware). Write a C program to print English words of numbers from 0 to 5 using (i) if-else statement (ii) Switch statement. Indicate the importance of each statement.  (Hint: if "0" is entered it should print "Zero")      (10 Marks) | (CO3) | [Application] |
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| 16 | a) In embedded systems, I/O (Input/Output) ports are essential components that allow the ARM Processor or microcontroller to interact with the external world, including sensors, actuators, and other devices. I/O ports are used to transfer data to and from the processor and the external environment. Interpret the I/O port operation performed in Processor of the embedded system with suitable diagrams.     (10 Marks)  b) Embedded C Programming is used develop Embedded software.  C language is more generalized than assembly language since assembly is processor dependent. In C programming, a loop statement is used to repeat a block of code until the specified condition is met. Write a C program to print numbers from 1 to 10 using (i) while loop and (ii) for loop. Indicate the importance of each loop.          (10 Marks) | (CO3) | [Application] |
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