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PRESIDENCY UNIVERSITY BENGALURU

SCHOOL OF ENGINEERING

SUMMER TERM END TERM EXAMINATION - AUG 2024

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| **Semester : 7th Sem** | **Date : 06/08/2024** |
| **Course Code : ECE3040** | **Time : 1:00pm – 4:00pm** |
| **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 | "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 | (CO 1) | [Knowledge] |
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| 2 | Memory in an embedded system is a physical storage embedded device used to store two data types and is important part of an embedded system. Name the memory with its disadvantage in which the memory is factory programmed by masking and metallization process according to the data provided by the end user. | (CO 1) | [Knowledge] |
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| 3 | The Program Status Register (PSR) is a hardware register that contains information about the state of the processor. Individual bits are implicitly or explicitly read and/or written by the machine code instructions executing on the processor. List the various bits available in the xPSR for the programmer for programming. | (CO 2) | [Knowledge] |
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| 4 | The Thumb-2 mode instruction encoding is variable-length, with a mix of 16-bit instructions and 32-bit instructions. Mention the advantages of Thumb-2 Instruction set over ARM Instruction set. | (CO 2) | [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 \_\_\_\_\_\_\_\_. | (CO 3) | [Knowledge] |
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| 6 | In an OS, the kernel is the smallest and the central component and provides services to manage memory and devices. Kernel are broadly classified into three models Monolithic kernels, Microkernel and Exokernels. Define Monolithic kernels and Microkernel. | (CO 4) | [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. | (CO 4) | [Knowledge] |
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| **PART B** | | | |
| **ANSWER ANY 5 QUESTIONS 5Q X 10M=50M** | | | |
| 8 | Embedded System is an integrated system that is formed as a combination of computer hardware and software to perform specific function. These Embedded systems range from those low in complexity, with a single microcontroller chip, to very high with multiple units, peripherals and networks. Discuss in brief the various cores used in the development of embedded systems. | (CO 1) | [Comprehension] |
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| 9 | The Cortex-M3/M4 processor has registers R0 through R15 and a number of special registers. Program Status Registers (xPSR) is a special register to monitor and to control the internal operations. List the various bits available in the xPSR. | (CO 2) | [Comprehension] |
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| 10 | ARM Processor operates in different processor modes. The purpose of processor modes is to regulate access to Registers/memory and hardware resources so that a process initiated by a specific user can’t access the Registers/memory of other processes or access hardware for which they don’t have permission, thereby helping the operating system to add refined permissions. Illustrate with registers access, the various Processor Modes available in ARM Processor cortex M3/M4. | (CO 2) | [Comprehension] |
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| 11 | The CAN (Controller Area Network) protocol is a set of rules for transmitting and receiving messages in a network of electronic devices. It defines how data is transferred from one device to another in a network and was developed with a specific focus on the auto industry. With block diagram, discuss the operations performed in CAN Bus protocol. | (CO 3) | [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. | (CO 4) | [Comprehension] |
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| 13 | An RTOS allows programmers to write independent, reusable modules to reduce software complexity and shorten the development schedule. Most RTOS vendors provide a full interactive development environment including a source code editor, code manager, linker, downloader, runtime tools, and one or more debuggers. Discuss in brief the limitations of 'off the shelf RTOS'. | (CO 4) | [Comprehension] |
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| 14 | 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. | (CO 4) | [Comprehension] |
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| **PART C** | | | |
| **ANSWER ANY 2 QUESTIONS 2Q X 20M=40M** | | | |
| 15 | a) In ARM Processor, Addressing modes is the way for which an operand is specified for an instruction in the general purpose register or in memory location. Interpret the different addressing modes available in the ARM Processor and output for each of the following cases. Given R1= 25397691h, R2= 6354E1F5h, and R3= 63A65DBCh.  (i) LDR R8, [R1, R3 LSL#3]  (ii) STR R3, [R1, R2 LSR#4]  (iii) STR R2, [R3], R1  (iv) LDR R6, [R1], -R3, LSL#4  (v) Mention the operation of LDMIA r6! {r2- r4} instructions. (15 Marks)  b) Monthly income of four people in a family is $3000h, $3500h, $4000h & $5000h. Write an ALP using ARM instructions to find the average income of the family. (5 Marks) | (CO 2) | [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 developed 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) | (CO 3) | [Application] |
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| 17 | 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 developed 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) | (CO 3) | [Application] |
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