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**PRESIDENCY UNIVERSITY  
BENGALURU**

**SET B**

**SCHOOL OF ENGINEERING  
END TERM EXAMINATION - JAN 2024**

**Semester :** Semester VII - 2020  
**Course Code :** ECE3040  
**Course Name** Embedded Systems  
**Program :** B.Tech.

**Date :** 04-JAN-2024  
**Time :** 9:30AM - 12:30 PM  
**Max Marks :** 100  
**Weightage :** 50%

**Instructions:**

- (i) Read all questions carefully and answer accordingly.
- (ii) Question paper consists of 3 parts.
- (iii) Scientific and non-programmable calculator are permitted.
- (iv) Do not write any information on the question paper other than Roll Number.

**PART A**

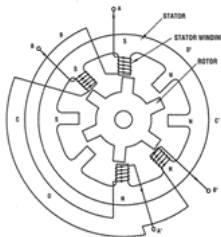
**ANSWER ALL THE QUESTIONS**

**5 X 2M = 10M**

1. An Embedded System is an electronic/electro-mechanical system designed to perform a specific function and is a combination of both hardware and firmware(software). Describe the following characteristics of Embedded systems
  - (i) Reactive and Real Time
  - (ii) Distributed

(CO1) [Knowledge]
2. LPC21XX is widely used processor from ARM 7 family. It comes with preloaded with many inbuilt peripherals. List any four features of LPC21xx processor.

(CO2) [Knowledge]
3. The angle at which the rotor of a stepper motor moves when one pulse is applied to the input of the stator is the step angle. For the given stepper Motor as shown in figure below, find the step angle and Total number of steps N required to complete one revolution.



(CO3) [Knowledge]

4. The brightness of an LED depends on the applied electrical power ( $P=I*V$ ). A desired brightness is obtained by setting the current flowing through it. A LED is connected to port pin of the processor with operating point of 1.7 V and 1 mA. For the positive logic interface, calculate the value of resistor to have desired brightness in the LED.

(CO3) [Knowledge]

5. 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.

(CO4) [Knowledge]

## PART B

### ANSWER ALL THE QUESTIONS

5 X 10M = 50M

6. 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]

7. 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.

(CO2) [Comprehension]

8. 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.

(CO3) [Comprehension]

9. 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]

10. 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'.

(CO4) [Comprehension]

## PART C

ANSWER ALL THE QUESTIONS

2 X 20M = 40M

11. 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)
- (CO2) [Application]
12. 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 to 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]