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

VII SEMESTER B.TECH. MECHATRONICS ENGINEERING
END SEMESTER EXAMINATION
SUBJECT: Embedded Systems and RTOS [MTE 4070]

Time: 180 Minutes   MAX. MARKS: 50

> **Instructions to Candidates:**
> ❖ ALL QUESTIONS ARE MANDATORY.
> ❖ Data missing must be suitably assumed.

Sl. No		M	CO	BL	LO	PO
1A	Analyze the significance of biological recycling. Explain any four biological approaches for E-waste recycling.	5	1	4	1	1
1B	A microcontroller is interfaced to 3 slave devices, temperature sensor, LCD controller and an EEPROM. These slaves are accessed by the master and there needs to be full duplex mode of communication between these devices. Identify the most suitable choice for communication interface between the master and slaves. Justify your choice and also explain the protocol structure along with sequence of operation.	3	1	5	2	2
1C	Distinguish between process and thread in RTOS.	2	3	4	1	1
2A	Develop an analytical hardware state diagram for minimizing power consumption in RTOS-supported flash-based FPGAs.	5	3	3	2	2
2B	Explain Inter process communication? Categorize different mechanisms used by various operating systems to share memory.	3	3	4	1	1
2C	Classify different types of message passing techniques through which tasks communicate with each other.	2	3	4	1	1
3A	Compare and contrast between FreeRTOS and Keil RTX5 to assess the comparative advantages and limitations of each open-source real-time operating system for evaluation purposes.	4	3	4	2	2
3B	Consider an industrial STM32 microcontroller data acquisition system. Data collection from multiple sensors (temperature, pressure, etc.) connected via UART communication protocols is the responsibility of this system. Every sensor sends data to the microcontroller periodically. Since temperature data is essential for control decisions, the temperature sensor UART interrupt has a higher priority than the others. Pressure sensors' data does not require immediate attention, hence has lower priority. When the temperature sensor data("T") is received switch ON a buzzer connected to pin 5 of port A. When pressure sensor data("P") is received toggle a LED connected to pin 2 of port B. Create a program to control execute this scenario.	4	2	6	2	2
3C	Distinguish between Monolithic Kernel and Micro Kernel.	2	3	4	1	1

4A	Analyze the concept of multitasking, including its operational principles and the various classifications of multitasking methodologies.	4	3	4	1	1
4B	Distinguish between ARM System Bus, ARM Peripheral Bus, ARM High Performance Bus.	3	2	4	1	1
4C	Out of the 16 registers in STM 32 microcontroller, identify which of the register contents needs to be saved during exception handling and justify the need for it.	3	2	3	1	1
5A	Three processes with process IDs P1, P2, and P3 with estimated time 9,10,4 milliseconds respectively enter the ready queue together. Process P4 with estimated execution completion time 1ms enters the ready queue after 2ms of start of first process and a process P5 with estimated execution time 7ms enters ready queue after 1ms of start of process P1. Calculate the waiting time and Turn Around Time (TAT) for each process. Also estimate average waiting time and average TAT (Assuming there is no I/O waiting for the process) in pre-emptive and non-pre-emptive Shortest Job First (SJF) scheduling.	4	3	5	2	2
5B	Critically evaluate the results obtained for pre-emptive and non-pre-emptive scheduling Q.5A and write the inference. Discuss the drawbacks of SJF.	3	3	5	2	2
5C	Define the terms scheduling and scheduler. Analyze the essential criteria involved in the scheduling process.	3	3	4	1	1