

TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2080 Chaitra

Exam.	Regular	
Level	BE	Full Marks 80
Programme	BEI, BEX, BCT	Pass Marks 32
Year / Part	III / II	Time 3 hrs.

**Subject: - Embedded System (CT 655)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.



1. Why power is an important design metrics in embedded system? List and explain the different design metrics used in embedded system design. [1+3]
2. Design a custom single purpose processor to find  $x^n$  showing all the steps involved. [8]
3. Describe programmer's view in the context of software development for general purpose processor. Define Debugger, Simulator and Emulator. [5+3]
4. Explain storage permanence of memory. Construct a ROM/PROM to store data shown in table below: [3+5]

Address		Information			
X	Y	F1	F2	F3	F4
0	0	0	1	0	0
0	1	0	1	1	1
1	0	1	0	1	1
1	1	1	0	0	1

5. Define interfacing. Explain the needs of interfacing. Explain Priority arbitration. [1+2+5]
6. What are the different situations when context switching is necessary? Explain the details of steps involved in context switching. Consider Four processes with process IDs P1, P2, P3 and P4 with estimated completion time 7,4,12,3 ms respectively, enters the ready queue together. Process P<sub>5</sub> with completion time 4 ms enters the ready queue after 2 ms of the scheduling of process P<sub>1</sub> starts. Calculate waiting time and turnaround time for each process and average waiting times and average turnaround time in Preemptive Shortest Job First algorithm. Assume there is no I/O waiting for the process. [2+4+6]
7. Draw the block diagram of a closed – loop control system to control speed in an automobile. Design the control system showing all the steps and derive the condition for no oscillation and no unbound output. [2+6]
8. Draw the top – level diagram of a NAND gate using CMOS. Explain the steps involved in Full – Custom IC design. [3+5]
9. List some important features of 8051 microcontroller. Write an Assemble language program to display 9 to 0 in common anode 7-segment display connected at port 1 and show interfacing diagram also. [2+6]
10. Define behavioral model. Write a VHDL code for 4 – bit BPA in structural model. [3+5]

TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2079 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEI, BEX, BCT	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Embedded System (CT 655)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.



1. What are the features of an embedded system? Explain them with examples. [4]
2. Design a dual purposed processor that takes in 10 numbers one at a time and finds the average and the maximum of the 10 numbers. Show algorithm, FSM and Datapath for the processor. [8]
3. How can pipeline be implemented to improve performance of a processor? Write down the features of a DSP. [4+4]
4. a) Compose 4K×5 ROM using 1K×2 ROM. [4]  
b) Explain the impact of cache size in performance of cache memory. [4]
5. How does Interrupt driven I/O operates with Fixed ISR location. Clearly explain the steps by taking suitable example. [8]
6. a) Explain how RTOS differ from GPOS? Differentiate between thread and process. [3+3]  
b) Four processes with process IDs P1, P2, P3 and P4 with priorities 0, 2, 4, 5 and estimated completion time 5, 4, 6 and 4 ms respectively enter the ready queue together. Two new processes P5 and P6 with priorities 1, 3 and estimated completion time 2 and 3 ms respectively enters the ready queue as: P5 enters 1 ms of start of execution while P6 enters ready queue after 3 ms of start of execution of P4. Calculate WT, TAT, AWT, ATAT assuming that there is no I/O waiting for the process using pre-emptive priority based and SJF/SRT algorithm. [6]
7. Compare and contrast between open loop and closed loop control system. Explain PID control system with block diagram and equations. [4+4]
8. What are Full Custom IC technology and Semi-Custom IC technology? Explain the steps involved in IC manufacturing. [4+4]
9. Explain data memory organization in 8051 microcontroller. Write an assembly program for 8051 to count number of 0's in an 8 – bit data stored in ROM at 40H and result in RAM at 41H. [4+4]
10. Explain different architecture model of VHDL. Write a VHDL code to design a traffic light controller unit with necessary assumptions using state machine. [2+6]

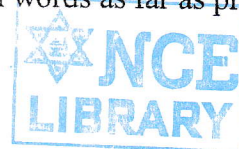
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TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2078 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEI, BCT	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Embedded System (CT 655)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.



1. Define design metric and explain various design metrics of embedded system. [4]
2. Design a single purposed processor that gives the LCM of two digit 8-bit numbers. Start with the algorithm, translate it into state diagram and state transition table. Also draw the required data-path. [8]
3. What do you mean by pipeline? Explain 5 stage pipelining. Describe features of DSP. [1+3+4]
4. Explain the operation of storing data in one Time Programmable ROM. Compose a memory of size  $2^{k+1} \times 2n$  using  $2^k \times n$  sized memory. [3+5]
5. Explain control methods used for communication in interfacing. Describe Daisy-Chain arbitration with the help of a block diagram and steps. [3+5]
6. Briefly explain the different states of task. Consider three processes with process IDs P1, P2, P3 and P4 with estimated completion time 53,17,68,24 ms respectively, enters the ready queue together in order P1, P2, P3, P4. Calculate waiting time and turn around time for each process and average waiting times and average turn around time in Round Robin algorithm with time slice 4 ms. Assume there is no I/O waiting for the process. List Coffman Condition for deadlock. [4+6+2]
7. Differentiate between open – loop and close – loop control system. Design control system for an automobile cruise control in open – loop control system using P control. [2+6]
8. Discuss the advantages and disadvantages of full-custom IC technology. Explain the basic steps of photo lithography process. [8]
9. How are microcontrollers different from microprocessors? Write the features of 8051 microcontroller. Assume that XTAL = 11.0592 MHz, write a program to generate a square wave of 1 kHz frequency on pin P1.5 of 8051 microcontroller using timer. [2+2+4]
10. Draw the state diagram for a sequence detector for the sequence 1011 and then develop a VHDL code based on the state diagram. [3+5]

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TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2077 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject:** - Embedded System (CT 655)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Explain different purpose of embedded system with examples. [4]
2. Design a single phase processor that output Fibonacci numbers upto 'n' places. What are the optimization opportunities in single pupose processors. [5+3]
3. Explain the architecture of general purpose processor. What are the criteria to select the processor? [4+4]
4. Design the internal architecture of 4×4 ROM. Explain the memory write ability and storage permanence with suitable example. [3+5]
5. Define interfacing and write about needs of interfacing. Explain priority arbitration with proper illustration and types. [3+5]
6. Compare task, process and threads. Three processes with process IDs P1, P2, P3 with estimated completion times 6, 8, 2 milliseconds respectively enters the ready queue together. Process P4 with estimated execution completion time 4 milliseconds enters the ready queue after 1 millisecond. Calculate the waiting time and turn around time for each process and the AWT and TAT in the non-preemptive shortest job first scheduling. Describe basic function of real time kernel. [4+5+5]
7. Explain different performance metrics of control system using suitable performance response diagram. Write an algorithm for a PID control. [4+4]
8. Describe briefly about semi custom IC technology. Explain the various steps involved in photolithography. [6]
9. Explain different configuration for seven segment display. Write an assembly program to design a down counter that counts from 99 to 00. [2+6]
10. Using structural model, write a code in VHDL to implement full adder. [8]

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TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2076 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Embedded System (CT 655)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Define Embedded System and classify the embedded system based on generations. What is task synchronization and explain the task synchronization using 'Busy/Wait'. [4+4]
2. Design a custom single-purpose processor that display 1 or 0 if the input integer is prime or not showing all the steps. [8]
3. Explain the design flow of embedded software development. Explain in brief about programmer's view for general purpose processor. [4+4]
4. Define two characteristics of memory: write ability and storage permanence with their different levels. Explain replacement algorithms used in cache memory. [5+3]
5. What is interrupts? How interrupt needed in digital devices? Write a summary of flow of actions for interrupt driven I/O using fixed ISR location. [2+3+3]
6. Explain process life cycle with process state diagram. Three processes with process IDs P1, P2, P3 with estimated completion time 8, 6, 10 ms and priorities 0, 3, 2 (0-highest, 3-lowest) respectively, enters the ready queue together in order P1, P2, P3 (assume only P1 is present in the Ready queue when the scheduler picks it up and P2 and P3 enter ready queue after that). Now a process P4 with estimated completion time 6 ms and priority 1 enters the ready queue after 5 ms of execution of P1. Calculate waiting time and TAT for each process and average waiting time and TAT. Assume there is no I/O waiting for the processes and priority-based scheduling. [3+5]
7. Explain the matrices used to measure the control objectives. Explain software coding of PID controller. [4+4]
8. Discuss the advantages and disadvantages of Full-Custom IC technology. Explain the basic steps of photolithography process. [2+6]
9. Generate a periodic square wave having a period of 15 ms and a duty cycle of 20% in 8051 using assembly programming. The waveform should be produced at pin zero of port two (P2.0). the XTAL frequency is 11.0592 MHz and use Timer 1 in mode 0 (13-bit timer mode)
10. Write an algorithm and VHDL code for custom single purpose processor that calculates the Greatest Common Divisor (GCD) of two numbers as Finite State Machine. [2+6]

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TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2076 Baisakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Embedded System (CT 655)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

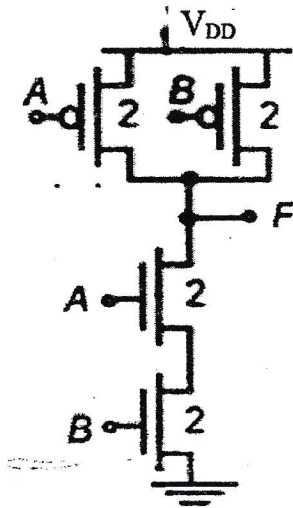
1. Define design metric. Explain all important design metrics of a system. [4]
2. Design a single purpose processor to determine the sum of digits of an integer. Start the design from the function computing the desired result, FSM, datapath and controller. [8]
3. a) Explain with diagram about pipelining? [4]  
b) Briefly explain suitable criteria for selecting Microprocessor in Embedded system. [4]
4. Compose 4K x 16 ROM using 1K x 8 ROMs. Determine which cache memory is better: [5+3]

	Size	Miss Rate	Hit Cost	Miss Cost
Cache A	2KB	15%	2 cycles	30 cycles
Cache B	8KB	5%	4 cycles	30 cycles

5. Which I/O (port based or bus based) is used in 8051 Microcontroller, describe in brief? Explain structure, operation, advantages and disadvantages of daisy chain arbitration method. [2+6]
6. a) Define kernel and explain its types. Explain file system handling of kernel. [3+3]  
b) Three processes with process IDs P1, P2, P3 with estimated completion time 7, 8, 5 ms and priorities 0, 3, 2 (0-highest, 3-lowest) respectively, enters the ready queue together in order P1, P2, P3 (assume only P1 is present in the ready queue when the scheduler picks it up and P2 and P3 enter ready queue after that). Now a process P4 with estimated completion time 10 ms and priority 1 enters the ready queue after 5ms of execution of P1. Calculate waiting time and TAT for each process and average waiting time and TAT. Assume there is no I/O waiting for the process and priority – based scheduling. [6]
7. a) Differentiate between open loop and close loop control system. Which system is better for control system? [4]  
b) What is PID controllers? Explain its type with real time application in embedded system. [4]
8. Explain about PORT 3 of 8051 microcontroller. Using 8051 instructions, control rate of blink of LED at pin P1.1 by two switches at P2.1 and P2.2 (One switch to increase the rate of blink, another to decrease the rate of blink) [2+6]
9. What's the use of VHDL code in embedded system? Design and write a code for Decoder using VHDL. [2+6]

10. Briefly explain semi-custom (ASIC) IC technology and write about its types. Explain IC manufacturing steps of circuit given below.

[3+5]



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Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Embedded System (CT655)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
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1. What is an embedded system? Differentiate it with non embedded systems with suitable example. In RTOS, describe mutual exclusion through sleep and wake for task synchronization. [1+3+4]
2. What is Optimization? What are the parameter you consider for Optimization of single purpose processors. [4+4]
3. Define datapath and controller of a general purpose processor. Explain ASIP with its types. [4+4]
4. Define write ability and storage permanence of memory. Design a ROM to store the following information: [3+5]

X	Y	Z	F1	F2	F3	F4
0	0	0	0	0	1	0
0	0	1	1	1	0	0
0	1	0	0	1	0	1
0	1	1	1	1	1	1
1	0	0	0	0	1	1
1	0	1	0	1	0	1
1	1	0	1	0	1	0
1	1	1	0	0	1	1

5. a) What is interrupt? Explain summary of flow of actions of interrupt driven I/O using fixed ISR location. [4]
- b) What is arbitration? With neat diagram explain Daisy-chain arbitration. [4]
6. Explain the conditions favoring deadlock situation. Three Processes P1, P2 and P3 with estimated completion time 5, 8, 7 ms respectively enters the ready queue together. Calculate WT, TAT for each process and calculate AWT and ATAT using Round Robin Pre-emptive scheduling algorithms with time slice of 2 ms. [2+6]
7. Differentiate between closed – loop and open – loop control systems. Draw a typical block diagram of a PID control system and describe PID turning. [3+5]
8. Draw a top down view and schematic for the following function:  $F = xz + yz'$ . Describe with suitable diagram about positive photoresist used in photolithography. [5+3]
9. What is seven segment display and write its types. Design a circuit with 7 segments display which is used as a counter watch which display second and minute. [2+6]
10. Explain different models is VHDL. Write a VHDL code for a full adder using two half adders and one OR gate in structural model. [3+5]

# Examination Control Division

2075 Baisakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Embedded System (CT655)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. What is a design metric and explain the purposes of embedded system. Define task scheduling, list out its types and explain the factors affecting on selection of scheduling algorithm. [4+4]
2. Design a single-purpose processor that outputs Fibonacci numbers up to 'n' places. Start with a function computing the desired result, translate it into a state diagram, and sketch a probable datapath. [8]
3. Define pipelining and show 6 stage pipeline concepts. Explain DSP with characteristics and advantages. [4+4]
4. Explain the operation of storing data in One Time Programmable ROM. Why it can't be reprogrammed? Compose  $1K \times 8$  ROMs into a  $4K \times 8$  ROM. [2+2+4]
5. What is arbitration? Explain priority arbitration with the help of a block diagram and steps along with its types. [2+6]
6. Define threads and differentiate between user level thread and kernel level thread. Three processes with IDs P1, P2, P3 with estimated completion time 6, 8, 2 milliseconds respectively enters the ready queue together in the order P1, P2, P3. Process P4 with the estimated execution time 4 milliseconds enters the ready queue after 1 millisecond. Calculate the waiting time and Turn Around Time (TAT) for each process and the average waiting time and TAT in the non-preemptive shortest-job-first scheduling. [3+5]
7. Draw the block diagram of closed-loop control system for speed control of an automobile and explain the conditions for no unbound and no oscillation showing all the design steps. [8]
8. Show various steps of photolithography process using appropriate diagrams. Describe briefly about Full custom VLSI technology. [4+4]
9. Explain the addressing modes used in 8051 microcontroller with example. Write an assembly language programming to blink the 8 Led connected at Port 2 of the 8051 microcontroller. [4+4]
10. Explain COMPONENT with its declaration. Write a VHDL code for a JK flip-flop using PROCESS. [3+5]

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Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Embedded System (CT655)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
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1. Define Embedded System. Clarify the statement 'Digital Camera is a good example of an Embedded System'. In RTOS, explain context switching with suitable diagram. [1+3+4]
2. Design a single purpose processor to determine the value of x to the power n. Start the design from the function computing the desired result, FSM, datapath and controller. [8]
3. Explain the design flow of embedded software development. Explain in brief about programmer's view for general purpose processor. [4+4]
4. Define write ability and storage permanence of memory. Explain associative cache mapping technique with its merits and demerits. [3+5]
5. Describe two-level bus architecture in detail. Describe priority arbitration method and compare it with daisy-chain arbitration. [3+5]
6. Write any four differences between thread and process. Three Processes P1, P2 and P3 with estimated completion time 4, 10, 5 ms and priorities 1, 3, 2 respectively enters the ready queue together. A new process P4 with estimated completion time 3 ms and priority 0 enters the ready queue after 5ms of start of operation. Calculate WT, TAT for each process and calculate AWT and ATAT using preemptive priority based scheduling algorithms. [2+6]
7. What are the challenges of modeling a real physical system and how can you overcome it? Write an algorithm to implement the PID controller in software. [3+5]
8. Explain the importance of photolithography in IC manufacturing. Explain the two broad categories of Semi-Custom IC technology. [5+3]
9. Draw the circuit diagram of the minimum configuration for 8051 microcontroller to operate. Also show the connection of LED at P1.7 and switch at P1.1 in the same circuit. Using an Assembly language, generate a pulse of 75% duty cycle at pin P1.7 when the switch at 1.1 is ON. [4+4]
10. Write an algorithm and VHDL code for a custom processor that calculates Least Common Multiple (LCM) of two numbers as a finite state machine. [3+5]

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Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Embedded System (CT655)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. Define embedded system. What are the typical characteristics of embedded system? [1+3]
2. Design a single-purpose processor that calculates Factorial of an integer number 'n'. Start with a function computing the desired result, translate it into a state diagram and sketch a probable datapath. [8]
3. Explain the design flow of embedded software development. Explain in brief about programmer's view for general purpose processor. [4+4]
4. What are the basic techniques for cache mapping? How direct mappings differ from fully associative mapping? [8]
5. Design an interface circuit of a microprocessor with 16-bit address with 2 RAMs and 2 ROMs of 8 Kbyte each. [8]
6. a) How RTOS is different from GPOS? Differentiate between process and thread. [4+4]  
 b) Consider three processes with process IDs P1, P2, P3 with estimated completion time 9, 6, 3 ms respectively, enters the ready queue together in order P1, P2, P3. Calculate Waiting Time and Turn Around Time for each process and average waiting time and average turn around time in RR (Round-Robin) algorithm with time slice 2 ms. Assume there is no I/O waiting for the process. [4]
7. Design an open loop automobile cruise controller and derive the conditions for no oscillation and reduction of road disturbance and determine the performance parameters. [8]
8. Explain the importance of photolithography in IC manufacturing. Explain the two broad categories of Semi-Custom IC technology. [5+3]
9. Describe the different purpose of port 3 and port 2 of 8051 microcontroller. Write an assembly language programming for 8051 microcontroller to read the data from switches connected at port 1 and send it to port 2 for display in LED. [4+4]
10. Explain PROCESS in VHDL. Write a VHDL code for a full adder using 2 half adder as component. [3+5]

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Exam.	Regular		
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**Subject: - Embedded System (CT655)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
  - ✓ Attempt All questions.
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  - ✓ Assume suitable data if necessary.
1. What is an embedded system? List out its different types. Why is it so hard to define? Define deadlock and explain the Coffman's condition for deadlock. [3+1+4]
  2. Develop algorithm; draw the state diagram and design the datapath of a custom single purpose processor that determines the largest of four integers. Propose the block diagram of its controller also. [8]
  3. How general purpose processors differ from application specific instruction set processor (ASIPs)? What are the common features of ASIPs for digital signal processors? [4+4]
  4. Construct  $2^{(k+1)} \times n$  and  $2^{(k)} \times 4n$  memories using  $2^{(k)} \times n$  memory modules. [4+4]
  5. What is arbitration? Explain Priority Arbitration and Daisy Chain Arbitration in brief? [8]
  6. Define Kernel and differentiate between monolithic kernel and micro kernel. Consider three processes with process ID's P1, P2, P3 with estimated completion time 10, 5, 7 milliseconds and priorities 1, 3, 2 (0-highest priority, 3-lowest priority) respectively enters the ready queue together. A new process P4 with estimated completion time 6 ms and priority 0 enters the "Ready" queue after 5 ms of start of execution of P1. Calculate the waiting time and Turn Around Time (TAT) for each process and also calculate the Average waiting time and average TAT for priority Based Preemptive Scheduling Algorithm. Assume there is no I/O waiting for the processes. [3+5]
  7. Explain the metrics used to measure control objectives? Write an algorithm to implement the PID controller in software. [4+4]
  8. Explain Full-Custom, Semi –Custom and PLD schemes used in IC technology with steps and comparison. [8]
  9. What are the important operational features of 8051 microcontroller? Write an assembly program to display 0 to 9 in seven segments display. [3+5]
  10. Write an algorithm and Finite State Machine VHDL code for a custom processor that calculates Greatest Common Divisor of two numbers. [2+6]

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**Examination Control Division**  
**2072 Magh**

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Embedded System (CT655)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
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1. Define Embedded System and classify the embedded system based on Generations. What is task synchronization and explain the task synchronization using "Busy/Wait". [4+4]
2. Explain in detail about the optimization of custom single purpose processors with a suitable example. [8]
3. Define addressing mode and pipelining. Explain data path operation with suitable example. [3+5]
4. Show the differences between SRAM and DRAM. Compose  $1K \times 8$  ROMs into a  $2K \times 16$  ROM. [3+5]
5. Explain port- based and bus – based I/O. Describe the major steps to be followed in interrupt processing by a processor. [3+5]
6. Define thread in RTOS. Explain the concept of multi threading and why is it necessary? Consider three processes with process ID's P1, P2, P3 with estimated completion time 9, 6, 3 milliseconds respectively, enter the ready queue in the order P1, P2, P3. Calculate the waiting time and Turn Around Time (TAT) for process and also calculate the Average waiting time and average TAT in Round Robin algorithm with time slice = 3ms. Assume there is no I/O waiting for the processes. [3+5]
7. Design an open-loop automobile cruise controller and derive the conditions for education of disturbance and determine the performance parameters. [8]
8. What is photolithography and what are its types? Describe the steps that need to be performed before photolithography process. [8]
9. Explain the addressing modes used in 8051 microcontroller with example. Write an assembly language program to blink the 8 LEDs connected at Port 2 of the 8051 microcontroller. [4+4]
10. What is behavioral modeling? Write VHDL code for 2-input multiplexer. [2+6]

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Exam.	Regular		
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**Subject: - Embedded System (CT655)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
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1. a) What are the common characteristics of embedded systems? How does a digital camera satisfy those characteristics? [4]  
b) Briefly describe the kernel operating system services. [4]
2. Design a single-purpose processor that outputs Fibonacci numbers up to 'n' places. Start with a function computing the desired result, translate it into a state diagram and sketch a probable datapath. [8]
3. Briefly explain the criterion for selecting processor? Explain the data path operation and its instruction cycles. [4+4]
4. What do you mean by write ability and storage permanence of memory? Explain associative cache mapping. [3+5]
5. What is the difference between memory-mapped I/O and standard I/O. Explain the operation of peripheral to memory transfer without DMA, using vectored interrupt. [3+5]
6. Differentiate between multiprocessing and multi tasking in RTOS. Three processes with process IDs, P1, P2, P3 with estimated completion time 6, 4, 2 ms respectively, enters the ready queue together in order P1, P2, P3. Calculate waiting time and TAT(Turn Around Time) for each process and average waiting time and TAT. Assume there is no I/O waiting for the processes and RR (Round-Robin) algorithm with time slice = 2 ms. [2+6]
7. Differentiate between closed loop and open loop control system. With neat diagram write the steps for designing Closed loop control system. [3+5]
8. Discuss the advantages and disadvantages of Full-Custom IC technology. Explain the basic steps of photo lithography process. [3+5]
9. Draw the pin diagram of 8051 microcontroller and explain ports 1 and 2 only. Write a program using C-programming language to find the sum between two 8-bit BCD data stored in RAM locations 50H and 51H and store the BCD sum at RAM locations 52H and 53H. [3+5]
10. Write an algorithm and VHDL code for a custom processor that calculates Least Common Multiple (LCM) of two numbers. [3+5]

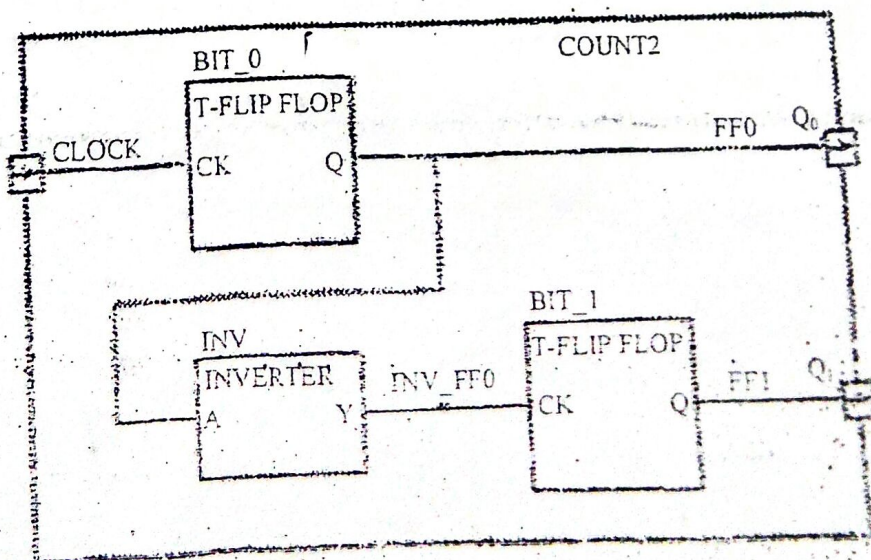
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Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Embedded System (CT655)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. How embedded system is differing than general purpose computing system? Importance of Kernel operating system in embedded systems. [4+4]
2. Show the algorithm, FSMD, FSM, data-path, and controller design for a dual-purpose processor that can calculate the factorial of a number and also check if that number is a prime number. [8]
3. Describe the control unit sub-operations with its instruction cycles. [8]
4. What is enhanced DRAM built around the conventional DRAM core? Write the cache replacement policies. [5+3]
5. Write down each step for peripheral to memory transfer without dynamic memory access using vectored interrupt. [8]
6. In priority based scheduling, three processes IDs P1, P2, P3 with estimated completion time 10, 5, 7 msec. and priorities 1, 3, 2 (0-highest and 3-lowest priority) respectively enters the ready queue together. A new process P4 with estimated completion time 6 ms and priority 0 enters 'Ready' queue after 5 ms of start of execution of P1. Assume all the processes contain only CPU operation and no I/O operations are involved. [8]
7. Draw a clear block diagram of a closed-loop control system and explain its various parts. Differentiate between P, PI, PD, and PID controllers. [4+4]
8. What are IC manufacturing steps in semiconductor industries? Describe the alignment and exposure techniques in photolithographic process in IC fabrications. [5+5]
9. Describe in detail the addressing modes of the 8051 microcontroller. Write a short program in assembly language that computes a precise 5-millisecond delay using the 8051 microcontroller. [4+4]
10. How entity is declared in VHDL programming? A circuit composed of two T-flip flops and an inverter shown in figure below, convert it in to VHDL code. [3+5]



Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Embedded System (CT655)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. What are the major purposes of embedded system? How general purpose operating system is differing than real time operating system? [4+4]
2. What are the optimization opportunities in single purpose processors? Explain with an example. [8]
3. What are the differences between datapath and control unit? Explain the control unit sub-operation. [2+6]
4. What is cache memory? Write cache mapping techniques. [2+6]
5. What are the differences between strobe and handshake protocol? Write the Daisy-Chain arbitration. [4+4]
6. Provide at least 6 differences between threads and processes. Three processes with process IDs P1, P2, P3 with estimated completion times 4, 6, 5 milliseconds and priorities 1, 0, 3 respectively enters the ready queue together. Calculate the waiting time and turn-around-time for each process and the average waiting time and turn around time in preemptive priority based scheduling algorithm, by assuming zero is the highest priority and three is the lowest priority. [3+5]
7. What are the evaluation steps used in general control systems input? Explain controller design using PD and PI controller. [3+5]
8. Why photolithography process role is important in IC technology? Explain with suitable example. [8]
9. Write an assembly and C program to display 0 to 9 in seven segment display. [8]
10. Write an algorithm and VHDL code for a custom processor that calculates Greatest Common Divisor (GCD). [3+5]

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Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Embedded System (CT655)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. What is an Embedded system? Describe its various applications. [1+3]
2. Design a dual-purpose processor that calculates the median and variance of 5 numbers entered by the user, by showing the algorithm, FSMD, FSM, data-path and controller design. [8]
3. Differentiate between application specific instruction set-processor and general purpose processor. Also discuss on issues related to selection of a particular processor. [8]
4. Design a ROM that will store the following words in the corresponding addresses. [5]

X	Y	z	F <sub>1</sub>	F <sub>2</sub>
0	0	0	1	0
0	0	1	1	0
0	1	0	0	1
0	1	1	0	1
1	0	0	0	0
1	0	1	1	1
1	1	0	0	1
1	1	1	1	0

5. Compose  $2^{k+1} \times m$  memory using  $2^k \times m$  memories. [3]
6. Describe the purpose of the direct-memory-access (DMA) controller. Draw the flow of actions between peripheral and memory using DMA. [2+2]
7. Describe the advanced communication principles used in embedded systems. [4]
8. Distinguish between process and thread. Write different states of task with appropriate example. [6]
9. What are the advantages of multithreading program? Write a simple multithreading program in C. [6]
10. Write the pseudo-code for a PID controller. What is the purpose of PID tuning, and what are the benefits of computer based control implementations? [4+4]
11. Explain the IC manufacturing steps with a neat block diagram. [5]
12. List the three major IC technologies with brief definitions. [3]
13. Write 8051 program and draw circuit diagram to display number from 99 to 00 in seven segment display. The program should write in both assembly and C. [8]
14. How does a FPGA differ from a microcontroller? Design a sequence detector for the string "1101", that outputs a one when the input matches this string, show the FSM and its VHDL implementation. [1+7]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Embedded System (CT655)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
  - ✓ Attempt All questions.
  - ✓ The figures in the margin indicate Full Marks.
  - ✓ Assume suitable data if necessary.
1. Differentiate between single-purpose processors, general-purpose processors, and application-specific processors. Using the simplified revenue model, derive the percentage revenue loss equation for any rise angle, rather than just for 45 degrees. [2+2]
  2. What is optimization? Explain optimization of single purpose processor in detail with suitable example. [8]
  3. Describe the operation of general - purpose processor in terms of datapath and controller. [5]
  4. Explain the testing and debugger. [3]
  5. Describe ROM and introduce its types in detail. Sketch the internal design of a  $4 \times 3$  ROM. [6+2]
  6. Explain different types of arbitration methods used in peripherals devices to gain control of system bus. Describe the significance of I<sup>2</sup>C serial communication protocol. [8]
  7. Describe the context switching process in detail. Three processes with process IDs P1, P2, P3 with estimated completion times 6, 8, 2 milliseconds respectively enters the ready queue together. Process P4 with estimated execution completion time 4 milliseconds enters the ready queue after 1 millisecond. Calculate the waiting time and turn-around-time for each process and the average waiting time and turn-around-time in the non-preemptive shortest-job-first scheduling. [3+3]
  8. Explain in detail the Coffman conditions that favor deadlock. Differentiate between user-level threads and Kernel-level threads. [3+3]
  9. Explain the operation of a PID control with a clean block diagram. [5]
  10. Define the following terms used in control system: Controller, Plant, Actuator. [3]
  11. Describe the steps involved in manufacturing an IC. Show the top-down view of the circuit  $F = xz + y$  on an IC. [4+4]
  12. Show the internal structure of the 8051 microcontroller. Provide a comparison chart of the 8051 family members. [4+4]
  13. Write the code for BCD counter to display 0 to 9999 in seven segment using VHDL. [8]

**Examination Control Division**  
2069 Bhadra

Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Embedded System (CT655)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. What are the common characteristics of embedded systems? Explain. [4]
2. Design a processor that calculates the LCM of two numbers. Show the design of data path only and construct the diagram of controller. [8]
3. What are the programmer considerations? Explain the software development processes according to embedded systems. [2+6]
4. a) Explain the operations of storing and erasing the data in UV-EPROM. [6]  
b) Describe the cache write techniques. [2]
5. Explain arbitration systems that implemented to communicate with peripheral devices from the microprocessor. Differentiate between memory mapped I/O with standard I/O. [8]
6. Explain the basic functions of Real-time kernel. [6]
7. Describe the control switching mechanism. [4]
8. Define throughput of a system. [2]
9. What is PID tuning? Discuss on the practical issues related with computer based control. [8]
10. Define the photolithography. Explain the various steps involved in photolithography. [2+6]
11. Why 8051 microcontroller is used ? Write an assembly program to get data from P0 and send it to P1 and compare with corresponding C program. [3+5]
12. Write the VHDL code for processor (GCD) that calculates greatest common divisor of two integer data with its state diagram. [8]

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