

**REAL TIME EMBEDDED SYSTEM
(ECEN 4241)**

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 4 (four) from Group B to E, taking one from each group.*

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) High performance and predictability are major concerns of embedded systems design
 - (a) Irregularity
 - (b) Predictability
 - (c) Completeness
 - (d) Singularity
- (ii) The onetime cost for research, design, develop and test a new product is called
 - (a) Unit cost
 - (b) Total cost
 - (c) NRE cost
 - (d) Research cost
- (iii) RISC based system uses
 - (a) only load and store instruction to access memory
 - (b) mostly a single clock to complete an instruction cycle
 - (c) register for major arithmetic operations
 - (d) All of these
- (iv) The bus for transfer of data and address are the same in the architecture for
 - (a) Princeton
 - (b) Harvard
 - (c) Yale
 - (d) All of these
- (v) USB mode of transfer is
 - (a) serial transmission
 - (b) parallel transmission
 - (c) analog transmission
 - (d) wireless transmission

- (vi) A thread is defined as a
 - (a) Double sequential flow of control within a process
 - (b) Multiple sequential flow of control within a process
 - (c) Single sequential flow of control within a process
 - (d) Multiple parallel flow of control within a process
- (vii) The functions of real-time kernel are
 - (a) Task/Process management
 - (b) Memory management
 - (c) Interrupt handling
 - (d) All of the above
- (viii) RISC processors have instructions of
 - (a) Fixed length
 - (b) Variable length
 - (c) Either of (a) & (b) depending on requirement
 - (d) None of the above
- (ix) A microcontroller contains
 - (a) CPU
 - (b) Timer and interrupt control units
 - (c) Dedicated I/O ports
 - (d) All of the above
- (x) A Digital Signal Processor (DSP) is a chip for the applications
 - (a) Filtering
 - (b) Noise Cancellation
 - (c) Compression
 - (d) All of the Above

Fill in the blanks with the correct word

- (xi) The 2,000,000 Mega Byte is _____ Peta Byte.
- (xii) In _____ scheduling, each process in the 'Ready' queue is executed for a pre-defined time slot.
- (xiii) An embedded system embeds _____ operating system.
- (xiv) A Photo diode is an (actuator or a sensor) _____.
- (xv) _____ is a processor with an instruction set designed for specific application areas on a VLSI chip or core.

Group - B

2. (a) Distinguish between general purpose computing system and embedded system.
[[C01](Understand/LOCQ)]
- (b) Design the process steps of a smart card and show the abstraction of hardware and software architecture in the card before the design with proper diagram.
[[C01](Apply/IOCQ)]

- (c) Does overlapped register window reduce hardware budget of RISC architecture? Justify your answer. [[CO1](Evaluate/HOCQ)]
4 + 5 + 3 = 12
3. (a) Distinguish between a microprocessor and a microcontroller. [[CO1](Understand/LOCQ)]
- (b) Is Smartphone an example of embedded system? Justify your answer with suitable block diagram. Briefly discuss the key features of DSP chip. [[CO1](Apply/IOCQ)]
- (c) Justify which component OS and RTOS is suitable for computer and embedded system individually and why? [[CO1](Evaluate/HOCQ)]
4 + 5 + 3 = 12

Group - C

4. (a) Briefly discuss the three modes of communication for transmitting data frames used by serial communication devices. [[CO2](Understand/LOCQ)]
- (b) Design a parallel port interfacing of 8051 microcontroller or an IO controller with LCD controller? [[CO2](Apply/IOCQ)]
- (c) Is PCI widely used synchronous parallel bus in the computer system for interfacing PC-based devices? Justify your answer. [[CO2](Apply/IOCQ)]
4 + 5 + 3 = 12
5. (a) What is an instruction cycle, micro instruction, and micro-operation? What are main components of a micro-programmed control unit? Are all machine instruction cycle of same duration? [[CO4](Remember/IOCQ)]
- (b) Show how a 9 bit micro-operation field in a microinstruction can be divided into subfields to specify 46 microoperations. How many microoperations can be specified in one microinstruction? [[CO4](Analyse/HOCQ)]
6 + 6 = 12

Group - D

6. (a) Briefly discuss about SRAM and DRAM. [[CO3](Understand/LOCQ)]
- (b) Compare the three different caches direct, fully associative, and set associative mapping techniques with proper diagrams. [[CO3](Apply/IOCQ)]
- (c) Design the steps for reading port bytes received from the external system *i.e.* a touch screen controller after reading ADC inputs, issues interrupt for the processor in computer or mobile. [[CO4](Create/HOCQ)]
4 + 5 + 3 = 12
7. (a) Mark which of the following devices are a sensor or an actuator. (i) Thermistor, (ii) Light emitting diodes, (iii) Photo diode, (iv) Motor (v) Accelerometer (vi) Solenoid, (vii) Hard drive (viii) Light dependent resistor, (ix) electric buzzer (x) IR sensor. [[CO3](Apply/LOCQ)]
- (b) A computer has 16 registers, an ALU(arithmetic logic unit) with 32 operations, and a shifter with eight operations, all connected to a common bus system.

(i)Formulate a control word for a micro-operation. (ii)Specify the number of bits in each field of the control word and give a general encoding scheme, (iii)Show the bits of the control word that specify the micro operator $R4 <- R5 + R6$.

[[CO4] (Analyze/IOCQ)]

5 + 7 = 12

Group - E

8. (a) Briefly discuss the role of the kernel in the operating system (OS).
[[CO5](Understand/HOCQ)]
- (b) Is Anti-Lock Brake System (ABS) a Hard Real-Time System? Justify your answer.
[[CO5] (Apply/IOCQ)]
- (c) Justify the necessity of hardware and firmware debugging in embedded systems.
[[CO6](Apply/IOCQ)]
- 4 + 5 + 3 = 12**
9. (a) Describe ARM register organization. Describe all the processor modes for ARM?
[[CO4](Remember/IOCQ)]
- (b) The content of the top of a memory stack is 5320, the content of stack pointer is SP is 3560. A two word call subroutine is located in memory address 1120 followed by the address field of 6720 at location 1121. What are the contents of PC, SP, and top of the stack? (i) Before the call instruction is fetched from memory, (ii) After the call instruction is executed, (iii) After the return from subroutine.
[[CO4] (Remember/IOCQ)]

6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	21.88	58.33	19.79

Course Outcome (CO):

After the completion of the course students will be able to

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1.Explain the differences between embedded systems and general computing systems and compare different embedded architectures.

2. Explain the operations of different buses and their uses.

3. Select memory devices as per requirement and design memory and I/O interfacing.

4. Determine the suitable processors/controllers for a design.

5. Design RTOS for an application and assess the performance.

6. Create and fault find embedded systems.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.