ST.ANNE'S

COLLEGE OF ENGINEERING AND TECHNOLOGY

(Approved by AICTE, New Delhi. Affiliated to Anna University, Chennai)
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QUESTION BANK

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BRANCH : ECE **YEAR/SEM:** IV/VII

SUB CODE/NAME: EC6703- EMBEDDED AND REAL TIME SYSTEMS

UNIT – I - INTRODUCTION TO EMBEDDED COMPUTING AND ARM PROCESSORS

PART – A

1. ***Enumerate some embedded computers that are exists from origin of the embedded systems. [ID][Nov/Dec-2016]***
   - Microprocessor
   - Computer peripherals
   - Printers

2. ***In what way Interrupts differ from Exceptions? [ID][Nov/Dec-2016]***
   Interrupts and exceptions both alter the program flow.
   - Interrupts are used to handle external events (serial port, keyboard)
   - Exceptions are used to handle instruction fault (division by zero, undefined opcode).

3. ***What is bus protocol? [D][Apr/May-2017]***
   Bus Protocols are the set of rules and conditions for the data communication. It is a communication system that transfers data between components inside a computer or between computers.

4. ***Mention the various methods for reading from or writing to an I/O port? [ID][Apr/May-2017]***
   - Programmed I/O
   - Interrupts
   - Direct Memory Access(DMA)

5. ***What is the role of Microprocessor in embedded computing? [D][Nov/Dec-2017]***
   Processor is the central processing unit which does the application specific processing and controlling of all the sub-system. Processor along with peripherals together constitutes embedded system

6. ***How traps are handled in ARM processor? [ID][Nov/Dec-2017]***
   A trap also known as a software interrupt, is an instruction that explicitly generates an exception condition. The most common use of a trap is to enter supervisor mode. The ARM provides the **SWI** interrupt for software interrupts. This instruction causes the CPU to enter supervisor mode.

7. ***What are the basic sources of CMOS power consumption? [ID][Apr/May-2018]***
   - Power supply voltage
   - Capacitive toggling
   - Leakage

8. ***List the functions of ARM processor in supervisory mode. [D][Apr/May-2018] (Or)***
   Enumerate the functions of ARM processor in supervisor mode. [D][Nov/Dec-2018]
   The ARM instruction that puts the CPU in supervisor mode is called SWI: SWI CODE_1
   - It can be executed conditionally with any ARM instruction.
   - SWI causes the CPU to go into supervisor mode and sets the PC to 0x08.

- ❖ The argument to SWI is a 24-bit immediate value that is passed on to the supervisor mode code
- ❖ It allows the program to request various services from the supervisor mode.

9. Determine the average memory access time of a machine whose hit rate is 90% with a cache access time of 3ns and main memory access time of 70ns. [D][Nov/Dec-2018]

Hit rate = 90%

H_{cache} = Hit rate/100 = 90/100 = 0.9

T_{cache} = 3ns

T_{memory} = 70ns

$CPU_{access\ time} = H_{cache} * T_{cache} + (1 - H_{cache})(T_{cache} + T_{memory})$

$= 0.9 * 3 + 0.1 * (3 + 70) = 2.7+7.3 = 10ns$

10. Compare the functions of CPU and Co-processor. [ID][Apr/May-2019]

CPU	Co-Processor
✓ CPU is the main processing unit of the computer ✓ Operations performed by the CPU are arithmetic, logic and control operations according to the instruction	✓ Co-processor is a computer processor used to support the main processor. ✓ Operations performed by the co-processor are floating point arithmetic, graphics, signal processing, string processing, I/O interfacing with peripheral devices

11. Define assembler. [ID][Apr/May-2019]

When translating assembly code into object code, the assembler must translate opcodes and format the bits in each instruction, and translate labels into addresses.

(Or)

The assembler is used to translate symbolic assembly language statements into bit-level representations of instructions known as object code.

12. Define deadline. [D]

Deadline is the time at which a computation must be finished. If the program does not produce the required output within deadline then the program does not work.

13. What is meant by streaming data? [D]

Data sets that arrive continuously and periodically in the CPU is called streaming data.

14. What are the steps in embedded system design process? [D]

- ❖ Requirements
- ❖ Specification
- ❖ Architecture
- ❖ Architecture
- ❖ System integration

15. Define UML? [D]

The Unified Modeling Language (UML) is a visual / object-oriented modeling language to represent design tasks such as creating requirements, specifications, architecting the system, designing code and designing tests.

16. Define MMU? [D]

Memory management units (MMUs) perform address translations between CPU and physical memory.

17. Define CPSR. [D]

Current Program Status Register (CPSR) is set automatically during every arithmetic, logical, or shifting operation. The top four bits of the CPSR hold the following useful information about the results of that arithmetic/logical operation:

- ❖ **Negative (N)** bit is set when the result is negative in two's complement arithmetic.

- **Zero (Z)** bit is set when every bit of the result is zero.
- **Carry (C)** bit is set when there is a carry out of the operation.
- **Overflow (V)** bit is set when an arithmetic operation results in an overflow

18. What is meant by baud rate? [D]

The data bits are sent as high and low voltages at a uniform rate, that rate is known as the baud rate.

19. What is meant by interrupt? [D]

The interrupt mechanism allows devices to signal the CPU and to force execution of a particular piece of code.

20. What is meant by masking? [D]

The priority mechanism must ensure that a lower-priority interrupt does not occur when a higher-priority interrupt is being handled this decision processing is known as masking.

21. Define cache hit? [D]

The cache controller sends a memory request to the cache and main memory. If the requested location is in the cache, the cache controller forwards the location's contents to the CPU and aborts the main memory request, this condition is known as a cache hit.

22. Define cache miss. [D]

The cache controller sends a memory request to the cache and main memory. If the location is not in the cache, the controller waits for the value from main memory and forwards it to the CPU, this situation is known as a cache miss.

23. List the types of cache misses? [D]

- Compulsory miss (or) Cold miss
- Capacity miss
- Conflict miss

24. Define exception? [D]

Exception is an internally detected error. A simple example is division by zero. One way to handle this problem would be to check every divisor before division to be sure it is not zero, but this would both substantially increase the size of numerical programs and cost a great deal of CPU time evaluating the divisor's value. The CPU can more efficiently check the divisor's value during execution. Because the time at which a zero divisor will be found is not known in advance, this event is similar to an interrupt except that it is generated inside the CPU. The exception mechanism provides a way for the program to react to such unexpected events.

Resets, undefined instructions, and illegal memory accesses are other typical examples of exceptions.

25. Define trap? [D]

A trap also known as a software interrupt, is an instruction that explicitly generates an exception condition. The most common use of a trap is to enter supervisor mode.

26. ***Define interrupt priorities? [D]***

Interrupt priorities allow the CPU to recognize some interrupts as more important than other interrrupts.

27. Define interrupt vectors? [D]

Interrupt vectors allow the interrupting device to specify its handler.

28. Define Data registers. [D]

Data registers hold values that are treated as data by the device, such as the data read or written by a disk.

29. Define Status registers. [D]

Status registers provide information about the device's operation, such as whether the current transaction has completed.

30. Define stack and frame pointer? [D]

- **Stack pointer (SP)** defines the end of the current frame.
- **Frame pointer (FP)** defines the end of the last frame.

31. Define Interrupts in ARM [D]

ARM supports two types of interrupts,

- Fast interrupt requests (FIQs)
- Interrupt requests (IRQs).

PART – B
[First Half]

[Complex systems and micro processors]

1. Demonstrate the challenges and performance of embedded processes for real time system design.(13)**[D][Apr/May -2019]**
2. Explain in detail about microprocessors. (8) **[D]**

[Embedded system design process]

1. What are the several requirements of an embedded computing system design.(8) **[D][Apr/May-2017]**
2. Analyze the requirements for designing a GPS moving map in embedded system design process. (8) **[D][Nov/Dec-2016]**
3. Describe the different factors involved in embedded system design process. (16) **[ID][Apr/May-2018]**

[Design example: Model train controller]

1. How are the conceptual specifications and detailed specifications written in UML language to design the Model train controller? (8)**[D][Nov/Dec-2016]**
2. Explain model train controller with the frame format of DCC. (16) **[D][Apr/May-2018]**
3. Explain in detail the embedded system design process with an illustrative example of Model Train controller. (16) **[D][Nov/Dec-2017]**
4. Design a Model Train Controller with suitable diagrams, and explain.(7)**[D][Nov/Dec-2018]**

[Instruction sets preliminaries -ARM Processor]

1. Explain the function of ARM processor instructions. (8) **[D][Nov/Dec-2017]**
2. How does branching and procedural has been performed in ARM processor? (8) **[D][Apr/May-2017]**
3. Draw and explain ARM architecture in detail.(13)**[D][Nov/Dec-2018]**
4. Analyze the performance of ARM processor Instruction set over CISC processes.(13)**[D][Apr/May-2019]**
5. Write short note on Assembly language.(8) **[D]**
6. What is ARM? Also elaborate the memory and instructions of ARM. (10) **[D]**
7. Brief about Instruction sets preliminaries in embedded system environment.(8) **[D]**

[Second Half]

[CPU: programming input and output]

1. What are the ways of programming the input and output devices in an embedded system design? (8) **[D][Apr/May-2017]**
2.

[Supervisor mode, exceptions and traps]

1. Explain about supervisor mode, exceptions and traps.(8) **[D]**

[Co-processors]

1. Discuss on the operation of Coprocessor used with ARM processor. (8) **[D][Nov/Dec-2017]**

[Memory system mechanisms]

1. How memory management is done for an embedded system processor in order to manage multiple programs in a single physical memory?(8) **[D][Nov/Dec-2016]**
2. Explain the memory system mechanisms to increase the performance in an embedded system.(16) **[D]**

[CPU performance]

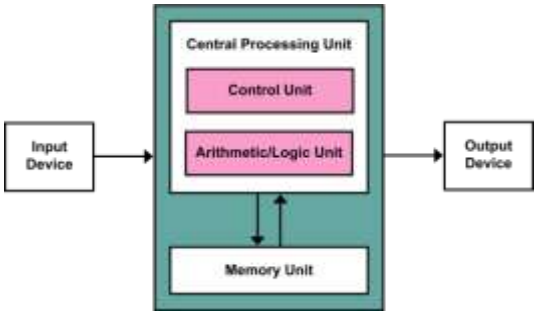
1. How CPU performance is affected? Explain them with example instructions. (8) **[D][Nov/Dec-2016]**
2. Explain in detail about CPU performance.(8) **[D]**
3. What is co-processors? How it s used in embedded application? (4) **[D]**

[CPU power consumption]

1. Name three mechanism by which a CMOS microprocessor consumes power and also specify several power saving strategies are used in CMOS CPU's. (8) **[D][Apr/May-2017]**
2. Give an account on CPU power consumption.(6)**[D][Nov/Dec-2018]**

UNIT-II - EMBEDDED COMPUTING PLATFORM DESIGN
PART A

1. ***Differentiate Harvard and Von Neumann architecture. [D][Apr/May-2018]***

Harvard architecture	Von Neumann architecture
Harvard machine has separate memories for data and program. The program counter points to program memory, not data memory. 	A computer whose memory holds both data and instructions is known as a von Neumann machine 

2. ***What is the basic building block of most bus control? [D][Apr/May-2018]***
   - ❖ Data bus
   - ❖ Address Bus
   - ❖ Control bus
   - ❖ System bus

3. ***Compare Static and Dynamic RAM. [D][Nov/Dec-2016]***

Static RAM	Dynamic RAM
• SRAM uses transistor to store a single bit of data • SRAM does not need periodic refreshment to maintain data • SRAM's structure is complex than DRAM • SRAM are expensive as compared to DRAM • SRAM are faster than DRAM • SRAM are used in Cache memory	• DRAM uses a separate capacitor to store each bit of data • DRAM needs periodic refreshment to maintain the charge in the capacitors for data • DRAM's structure is simplex than SRAM • DRAM's are less expensive as compared to SRAM • DRAM's are slower than SRAM • DRAM are used in Main memory

4. ***What are Data Flow Graph and Control/Data Flow Graph (CDFG)? [D][Nov/Dec-2016]***
   A data flow graph is a model of a program with no conditionals. In a high-level programming language, a code segment with no conditionals and with only one entry and exit point. Control/data flow graph is a fundamental model for programs. The CDFG has contracts that model both data operations and control operations.

5. ***What is the disadvantage of nested loops in embedded programs? [ID][Apr/May-2017]***
   - ❖ More number of iterations
   - ❖ More complexity

6. ***List the types of Co-verification techniques? [D][Apr/May-2017]***
   - ❖ Instruction Level Simulator
   - ❖ Cycle level simulator
   - ❖ Hardware/Software Co-simulator

7. ***How power can be optimized at the program level? [ID][Nov/Dec-2017]***
   The main step towards optimizing power consumption is to understand the source of energy consumption at different levels. Various energy models have been developed and integrated with

existing simulators OS measuring tools to provide accurate power estimation, which can be used to optimize the system design.

8. ***List the memory devices used in the design of embedded System? [D][Nov/Dec-2017]***
   What is the memory devices used in the design of embedded System? [D][Nov/Dec-2018]
   - RAM(DRAM,SRAM)
   - ROM(Flash, EEPROM)
   - Hybrid (PROM, Masked)

9. ***Outline the significance of CDFG. [D][Nov/Dec-2018]***
   Control/data flow graph (CDFG) constructs model for both data operations (arithmetic and other computations) and control operations (conditionals).

10. ***What is meant by linking and loading? [ID][Apr/May-2019]***
    Linker (or) Linking: A linker allows a program to be stitched together out of several smaller pieces. The linker operates on the object files created by the assembler and modifies the assembled code to make the necessary links between files
    Loader (or) Loading: The program that brings the program into memory for execution

11. ***Define embedded programming? [ID][Apr/May-2019]***
    Embedded programming is a type of programming that supports the creation of consumer facing or business facing devices that don't operate on traditional operating systems the way that full-scale laptop computers and mobile devices do.

12. ***Define aspect ratio.[D]***
    In a memory, the ratio of the number of addressable units to the number of bits read per request is called as aspect ratio.

13. ***Define DMA? [D]***
    Direct memory access (DMA) is a bus operation that allows reads and writes not controlled by the CPU.

14. ***Define compilation? [D]***
    Compilation combines translation and optimization which converts the high level language program into the low level form of instructions.

    Compilation = Translation + Optimization

15. ***Define bus request and bus grant? [D]***
    - **Bus request** is an input to the CPU through which DMA controllers ask for ownership of the bus.
    - **Bus grant** signals that the bus has been granted to the DMA controller.

16. ***What do mean by control bus in CPU? [D]***
    A control bus is a computer bus used by CPUs for communicating with other devices within the computer. The control bus carries commands from the CPU and returns states signal from the devices

17. ***Define host and target? [D]***
    - The software development for an embedded system is done on a PC or workstation known as a **host**
    - The hardware on which the code will finally run is known as the **target**.

18. ***Define elastic buffer. [D]***
    Queues are used whenever data may arrive and depart at somewhat unpredictable times or when variable amounts of data may arrive. This queue is often called as an elastic buffer

19. Define: cross compiler. [D]

A cross-compiler is a compiler that runs on one type of machine but generates code for another.

20. Define induction variable? [D]

An induction variable is a variable whose value is derived from the loop iteration variable's value.

21. What are the important techniques in optimizing loops? [D]

There are three important techniques in optimizing loops they are

- Code motion
- Induction variable elimination
- Strength reduction

22. Mention the types of performance measures on programs? [D]

- Average-case execution time
- Worst-case execution time
- Best-case execution time

23. Mention two major types of testing strategies? [D]

- Clear Box Testing
- Black-box Testing

24. State Black-box testing strategy. [D]

Black-box methods generate tests without looking at the internal structure of the program.

25. State clear-box testing strategy? [D]

Clear-box (also known as white-box) methods generate tests based on the program structure.

26. What are test used in Black-box Testing. [D]

- Random tests
- Regression tests

27. What is In-Circuit Emulator? [D]

In-Circuit Emulator (ICE) is a specialized hardware tool that can help debug software in a working embedded system.

28. Define profiler.

A profiler does not measure execution time instead, it counts the number of times that procedures or basic blocks in the program are executed.

29. Define profiling. [D]

Profiling is a simple method for analyzing software performance.

30. Mention the I/O devices used in embedded system? [D]

- Timers and counters
- A/D and D/A converters
- Keyboards
- LEDs
- Display
- Touch Screen

PART – B
[FIRST HALF]

[The CPU Bus-Memory devices and systems]

1. Explain about various CPU BUS configurations in embedded systems.(8) **[D]**
2. Explain the different I/O devices used in embedded system. (16) **[D]**
3. Describe about the basic types of memory components that are commonly used in embedded systems. (8) **[D][Apr/May-2018]**

[Designing with computing platforms]

1. Describe how embedded system is useful in competing with computing platform. (8) **[D][Nov/Dec-2016]**
2. Compare and contrast the debugging techniques used in embedded system.(6)**[D][Nov/Dec-2018]**
3. Illustrate how of embedded system design is done using IDE- (Integrated Development Environment).(13)[D] **[Apr/May-2019]**

[Consumer electronics architecture]

1. With an example in consumer electronics, explain the embedded system design with computing Platform. (8) **[D][Nov/Dec-2017]**

[Platform-level performance analysis]

1. Analyze the platform level performance in an embedded system. (8) **[D]**

[Components for embedded programs]

1. Discuss the basic types of memory components, that are commonly used in embedded systems.(7)**[D][Nov/Dec-2018]**
2. Explain the various components and programming models used for developing embedded Programs.(8) **[D][Nov/Dec-2017]**

[Models of programs- Assembly, linking and loading]

1. Explain the following design tools used in embedded system design. Assembly, linking and loading. (10) **[D]**
2. Discuss in detail various programming models. (8) **[D] [Apr/May-2017]**
3. Explain models of the program with no conditionals.(8) **[D][Apr/May-2018]**

[SECOND HALF]

[Compilation techniques]

1. Outline the role of assemblers and linkers in the compilation process.(16) **[D][Apr/May-2018]**
2. Explain in detail about the compilation process in high level languages.(8) **[D][Apr/May-2017]**
3. Explain the principle of various compilation techniques.(8) **[D][Nov/Dec-2017]**

[Program level performance analysis]

1. What are the program level performance analysis of embedded system design.(8) **[D][Apr/May-2017]**

[Software performance optimization]

1. Discuss about the embedded system software performance analysis and optimization.(8)**[D] [Nov/Dec-2017]**

[Program level energy and power analysis and optimization]

1. Discuss in detail the optimization of energy and power of an embedded system.(8) **[D][Nov/Dec-2016]**

[Analysis and optimization of program size]

1. Explain in detail the testing process involved in developing an embedded system. (8) **[D][Nov/Dec-2016]**
2. Explain the various debugging techniques in the development of embedded system. (8) **[D][Nov/Dec-2016]**
3. Explain energy, power and program size optimization in detail.(13)**[D][Nov/Dec-2018]**

[Program validation and testing]

1. Discuss in detail the optimization of program size of an embedded system.(8) **[D][Apr/May-2017]**
2. Compare various program validation and testing methods done for system design.(13)[D]**[Apr/May-2019]**

UNIT-III - PROCESSES AND OPERATING SYSTEMS
PART A

1. ***Define context switching in RTOS. [D][Apr/May-2018]***
   When the task is resumed, its saved context is restored by the operating system kernel prior to its execution. The process of saving the context of a task being suspended and restoring the context of a task being resumed is called context switching.

2. ***Illustrate the interconnect network developed for distributed embedded systems. [ID][Apr/May-2018]***
   - **Inter-Integrated Circuit (I^2C)** bus is used in microcontroller-based systems.
   - **Controller Area Network (CAN)** bus was developed for automotive electronics. It provides megabit rates and can handle large numbers of devices.
   - **Ethernet** and variations of standard Ethernet are used for a variety of control applications.

3. ***Define tasks and processes. [D][Nov/Dec-2016]***
   - **Task**: We generally run several programs simultaneously on a CPU, creating a multitasking system. The tasks interact with each other in ways that have profound implications for performance
   - **Process** is a single execution of a program. If we run the same program two different times, we have created two different processes. Each process has its own state that includes not only its registers but all of its memory.

4. ***Write about scheduling states present in the embedded system design. [D][Nov/Dec-2016]***
   There are three basic scheduling states present in the embedded system design, they are
   - Waiting,
   - Ready
   - Executing.

5. ***Define Semaphore. [D][Apr/May-2017]***
   Semaphore is a variable. This variable is used to solve the critical section problem and to achieve process synchronization in the multiprocessing environment. The two most common kinds of semaphores are counting semaphores and binary semaphores.

6. ***What is Priority Inversion? [D][Apr/May-2017]***
   A low-priority process blocks execution of a higher-priority process by keeping hold of its resource, a phenomenon known as priority inversion.

7. ***List the advantages and limitations of Priority based process scheduling. [D][Nov/Dec-2017]***

Advantages	Limitations
❖ Simplicity ❖ Reasonable support for priority ❖ Suitable for applications with varying time and resource requirements	❖ Indefinite blocking ❖ A priority schedule scheduling leave some low priority waiting process indefinitely for CPU ❖ If the system eventually crashes then all unfinished low priority processes gets lost

8. ***State the major functions of POSIX RTOS. [D][Nov/Dec-2017]***
   - Process management
   - Thread management
   - Timer management
   - Asymmetric I/O
   - Synchronization /communication between tasks.

9. ***What is the concept of multitasking? What does it signify? [D][Nov/Dec-2018]***
   Multitasking, in an operating system, is allowing a user to perform more than one computer task at a time.

10. ***What is Rate Monotonic Scheduling? [D][Nov/Dec-2018]***
    Rate-monotonic is a priority based scheduling, the task with the shortest periodicity executes with the highest priority.

11. ***What is priority inheritance and priority inversion? [ID][Apr/May-2019]***
    Priority inversion: A low-priority process blocks execution of a higher-priority process by keeping hold of its resource.
    Priority inheritance: promote the priority of any process when it requests a resource from the operating system. The priority of the process temporarily becomes higher than that of any other process that may use the resource

12. ***How does priority scheduling improve multitask execution? [ID][Apr/May-2019]***
    Priority scheduling in which a task can be stopped or suspended in order to allow a task of higher priority to run. In the case of two tasks of the same high priority each is given an equal time slice.

13. ***Define: Multitasking. [D]***
    Multitasking is defined as running of two or more programs in one computer at the same time. Multitasking is used to keep all of a computer's resources at work as much of the time as possible. It is controlled by the operating system, which loads programs into the computer for processing and oversees their execution until they are finished.

14. ***List out the major styles of interprocess communication? [D]***
    Two major styles of interprocess communication:
    - ❖ Shared memory
    - ❖ Message passing

15. ***What are the ways of communication in process? [D]***
    A process can send a communication in one of two ways: **blocking or nonblocking**.
    Blocking communication, the process goes into the waiting state until it receives a response.
    Non-blocking communication allows the process to continue execution after sending the communication.

16. ***Define processes. [D]***
    A process is a single execution of a program. If we run the same program at two different times, we have created two different processes. Each process has its own state that includes not only its register but also all of its memory.

17. ***Define: scheduling policy. [D]***
    A scheduling policy defines how processes are selected for promotion from the ready state to the running state

18. ***What is "Kernel"? [D]***
    The kernel is the part of the operating system that determines what process is running. The kernel is activated periodically by the timer.

19. ***Define response time? [D]***
    The response time of a process as the time at which the process finishes.

20. ***Define critical instant? [D]***
    The critical instant for a process is defined as the instant during execution at which the task has the largest response time.

21. **Define active class.** ***[D]***
    UML often refers to processes as active objects, that is, objects that have independent threads of control. The class that defines an active object is known as an active class.

22. Define CPU usage metrics? [D]
In addition to the application characteristics, we need to have a basic measure of the efficiency with which we use the CPU. The simplest and most direct measure is utilization:

$$U = \frac{\text{CPU time for useful work}}{\text{total available CPU time}}$$

23. List out the two important requirements on processes? [D]
- ❖ Initiation time
- ❖ Deadline

24. Define initiation time? [D]
The initiation time is the time at which the process goes from the waiting to the ready state

25. Define deadline? [D]
A deadline specifies when a computation must be finished

26. Define threads. [D]
Thread is a light weight process, Processes that share the same address space are called threads.It will reduce the program execution speed

27. Define record. [D]
The data structure that holds the state of the process is known as the record.

28. Define context switching. [D]
Switching from one process's register set to another is known as context switching.

29. Define mailbox. [D]
The mailbox is a simple mechanism for asynchronous communication. Some architectures define mailbox registers. These mailboxes have a fixed number of bits and can be used for small messages

30. Define context. [D]
The set of registers that defines a process is known as its context.

PART – B
[FIRST HALF]

[Multiple tasks and multiple processes]
1. Discuss in detail multitasking and multiprocessing. (8) **[D][Nov/Dec-2016]**
2. Summarize the services of operating system in handling multiple task and multiple processes. (8) **[D][Apr/May-2018]**
3. Explain the services of operating system in handling multiprocessor scheduling and communication. (16) **[ID]**

[Multirate systems]
1. Describe why automobile engines require a multi -rate control. (8) **[D][Nov/Dec-2016]**

[Preemptive real-time operating systems]
1. Explain how multiple processes are handled by Preemptive real time operating system.(6) **[D][Nov/Dec-2017]**
2. Discuss why preemptive scheduling is preferred in real time operating systems.(13)[D] **[Apr/May-2019]**

[Priority based scheduling]

1. Explain in detail rate monotonic scheduling with an example. (8) **[D][Nov/Dec-2016]**
2. Elucidate on scheduling policies with suitable examples. (8) **[D][Apr/May-2018]**
3. Explain in detail about Earliest-deadline-first scheduling. (8) **[D][Apr/May-2017]**
4. Compare RMS versus EDF. (7)**[D][Nov/Dec-2018]**

[SECOND HALF]

[Interprocess communication mechanisms]

1. Explain with a neat diagram inter process Communication.(8) **[D][Apr/May-2017]**
2. With neat sketch explain the interprocess communication mechanism. (16) **[D][Apr/May-2018]**
3. Compare the principle, merits and limitations of Inter-process communication mechanism. (10) **[D][Nov/Dec-2017]**
4. Explain inter process communication Mechanisms and evaluating operating system performance in detail.(13)**[D][Nov/Dec-2018]**
5. Demonstrate about inter process communication mechanisms.(13)[D] **[Apr/May-2019]**

[Evaluating operating system performance]

[Power optimization strategies for processes]

1. Write short note on the power optimization strategies for processes in real time operating system environment. (6) **[D][Nov/Dec-2017]**
2. Explain in detail about power optimization strategies in embedded system. (8) **[D][Apr/May-2017]**

[Example Real time operating systems-POSIX-Windows CE]

3. Explain the example real time operating system called windows CE in detail. (8) **[D][Nov/Dec-2016]**
4. Explain the example real time operating system called POSIX in detail. (8) **[D][Apr/May-2017]**
5. Discuss about the features and services of Windows CE real time operating system. (10) **[D][Nov/Dec-2017]**
6. Explain about Windows CE with a neat diagram.(6)**[D][Nov/Dec-2018]**

UNIT-IV - SYSTEM DESIGN TECHNIQUES AND NETWORKS
PART A

1. ***What do you mean by accelerators in embedded multiprocessor? [D][Apr/May-2018]***
   An accelerator is one important part of processing element for embedded multiprocessor. It is attached to CPU buses to quickly execute certain key functions. It provides large performance for many applications with computational kernels. Accelerators can also provide critical speedups for low-latency I/O functions.

2. ***Mention the goals of design process in embedded computing systems. [D][Apr/May-2018]***
   The goals of design process in embedded computing systems
   - Functionality
   - Manufacturing cost
   - Performance
   - Power consumption
   - Time-to-market
   - Design cost
   - Quality

3. ***What is the role of CRC bit in CAN Bus? [D][Apr/May-2017]***
   A cyclic redundancy check (CRC) is sent after the data field for error detection.

4. ***List out some of the verification requirements and specifications related to the design flow? [D][Apr/May-2017]***
   - Functionality
   - Manufacturing cost
   - Performance
   - Power consumption
   - Time to market
   - Design cost
   - Quality

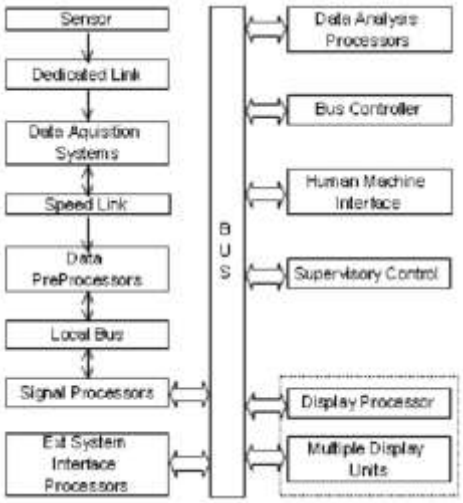
5. ***What do you mean by quality and quality assurance related to embedded systems? [D][Nov/Dec-2016]***
   - **Quality** of a product or service can be judged by how well it satisfies its intended function.
   - **Quality assurance (QA)** is a way of preventing mistakes or defects in manufactured products and avoiding problems when delivering solutions or services to customers.

6. ***Give examples of internet enabled system. [D][Nov/Dec-2016]***
   - *L*aser printer
   - Portable internet devices
   - Home control system
   - Personal digital Assistant

7. ***Give the design flow used in embedded system design. [D][Nov/Dec-2017]***
   A design flow is a sequence of steps to be followed during a design.
   - waterfall model
   - spiral model
   - successive refinement
   - hardware/software design

8. ***Write the special characteristics of a card. [D][Nov/Dec-2018]***
   - **Classes** define the logical groupings of data and functionality.
   - **Responsibilities** describe what the classes do.
   - **Collaborators** are the other classes with which a given class works.

9. Draw the block diagram of Distributed embedded system. [D][Nov/Dec-2017]



10. List the difference between multistage network and direct network? [D][Nov/Dec-2018]

Multistage Network	Direct Network
✓ A multistage network consists of multiple stages of switches. ✓ The number of stages determines the delay of the network. By choosing different interstage connection patterns, various types of multistage network can be created. ✓ Some examples of multistage networks are Omega network, Clos network, Benes Network	✓ Direct networks have point-to-point connections between neighboring nodes. ✓ These networks are static, which means that the point-to-point connections are fixed. ✓ Some examples of direct networks are rings, meshes and cubes.

11. Mention a power saving strategy adopted for real time systems. [ID][Apr/May-2019]

Multiprocessors is a power saving strategy adopted for real time systems. Several processors running at slower clock rates consume less power than a single large processor

12. Why is Benchmark Comparison done for new design? [ID][Apr/May-2019]

Benchmark Comparison is used to compared themselves to competitors and to introduce a new product than their best competitors

13. What is meant by processing element? [D]

Processing element is a unit which is responsible for performing computation. It may be programmable or not. Accelerator is one kind of processing element.

14. List the OSI layers from lowest to highest level of abstraction. [D]

The OSI layers from lowest to highest level of abstraction are described below:

- ❖ Physical layer
- ❖ Data link layer
- ❖ Network layer
- ❖ Transport layer
- ❖ Session layer
- ❖ Presentation layer
- ❖ Application layer

15. What is CMM? [D]

Capability Maturity Model (CMM) is used for measuring the quality of an organization's software development process.

16. Who are all the members present in design review process? [D]

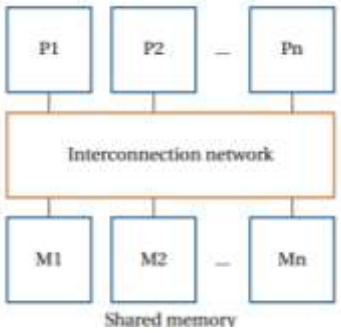
- Designers
- Review Leader
- Review Scribe
- Review Audience

17. What is meant by avionics? [D]

Aircraft electronics are known as avionics. Avionics are the electronic systems used on aircraft, artificial satellites, and spacecraft.

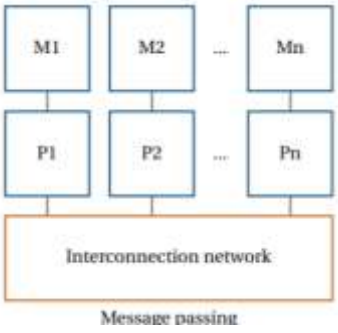
18. Define Shared memory?

Shared memory systems have a pool of processors (P1, P2, etc.) that can read and write a collection of memories (M1, M2, etc.).



19. Define message passing. [D]

Message passing systems have a pool of processors that can send messages to each other. Each processor has its own local memory.



20. What is the use of attaching accelerator to CPU? [D]

An accelerator is one important part of processing element for embedded multiprocessor. It is attached to CPU buses to quickly execute certain key functions. It provides large performance for many applications with computational kernels. It provides critical speedups for low latency I/O functions.

21. What is the arbitration scheme types used in Distributed embedded systems? [ID]

- Carrier Sense Multiple Access with Collision Detection (CSMA/CD)
- Carrier Sense Multiple Access with Arbitration on Message Priority (CSMA/AMP)

22. Define multiprocessor.

A multiprocessor is, in general, any computer system with two or more processors coupled together. Multiprocessors used for scientific or business applications tend to have regular architectures: several identical processors that can access a uniform memory space.

23. Define packets.

In networks data can be transmitted in the form of packets only. A packet is one unit of binary data capable of being routed through a network. Packets are improved communication performance and reliability. Each packet sends a message between two network devices.

24. Define internet protocol.

The Internet Protocol (IP) is the fundamental protocol on the internet and it provides connectionless packet based communication. Industrial automation is a good application area for internet based embedded system.

25. List the various design process goals?

- Time-to-market.
- Design cost
- Quality.

26. Define Requirements & specifications.

- **Requirements** are informal descriptions of what the customer wants.
- **Specifications** are more detailed, precise, and consistent descriptions of the system that can be used to create the architecture.

27. What are the types of requirements in system design techniques?

There are two types of requirements in system design techniques, they are

- **Functional** requirement states what the system must do, such as compute an FFT.
- **Non-functional** requirement can be any number of other attributes, including physical size, cost, power consumption, design time, reliability etc.

28. State some of the network dedicated for embedded system.

- I^2C
- CAN bus
- Ethernet
- Internet

29. What is a distributed embedded architecture?

In a distributed embedded architecture several processing elements are connected by a network that allows them to communicate. More than one compute or group of computer and PCs are connected via network that forms distributed embedded architecture.

30. Expand CRC, CMM.

CRC – **C**lasses, **R**esponsibilities, **C**ollaborators

CMM – **C**apability **M**aturity **M**odel

PART – B
[FIRST HALF]

[Design methodologies - Design flows -Requirement Analysis -Specifications]

1. Briefly discuss about the design methodologies for an embedded computing system. (16) **[D][Nov/Dec-2016]**
2. Discuss about the embedded system design methods and explain the importance of Requirement Analysis. (8) **[D][Nov/Dec-2017]**
3. Explain the various design methodologies and design flows in system design.(13)**[D][Nov/Dec-2018]**
4. Explain in detail about various Design flows in System Design Techniques.(16) **[D]**

[System analysis and architecture design]

1. Explain the type of Specifications in System Design Techniques.(16) **[D]**
2. With a neat diagram explain about CRC cards.(16) **[D]**
3. Analyze system design technique by giving specifications for a case study like a digital camera.(13)[D] **[Apr/May-2019]**

[Quality Assurance techniques]

1. Observe in detail about quality Assurance process using the following:
   i) Quality Assurance Techniques (8) **[D] [Apr/May-2018]**
   ii) Verifying the specifications. (8) **[D] [Apr/May-2018]**
2. Briefly explain the quality assurance process taken place in the embedded computing system design. (16) **[D][Apr/May-2017]**
3. Explain the principle of Quality Assurance techniques used in embedded system design. (8) **[D][Nov/Dec-2017]**
4. Explain about CMM's five levels of maturity.(8) **[D]**

[SECOND HALF]

[Distributed embedded systems]

1. Discuss about the distributed embedded architecture. (16) **[D][Apr/May-2018]**
2. Discuss in detail about the network based embedded system design. (8) **[D][Nov/Dec-2016]**
3. Explain in detail about The OSI model layers. (8) **[D]**
4. With neat diagram explain the working of CAN Bus. (8) **[D][Apr/May-2017]**
5. With neat diagram explain the working of I^2C. (8) **[D][Apr/May-2017]**
6. With neat diagram explain the working of Internet Protocol. (16) **[D]**
7. Write notes on internet enabled systems. (8) **[D][Nov/Dec-2016]**
8. Explain in detail about CAN architecture. (16) **[D]**
9. With a neat diagram, describe the typical bus transactions on the I^2C Protocol.(7)**[D][Nov/Dec-2018]**
10. Discuss the role of distributed embedded architecture available for embedded systems.(6) **[D][Nov/Dec-2018]**

[MPSoCs - shared memory multiprocessors]

1. Explain how the concepts of Multiprocessor System-On-Chip MPSoC and shared memory multiprocessors are used in embedded application. (**16) [D][Nov/Dec-2017]**
2. Illustrate why MPSoCs are preferred over general purpose microprocessor.(13)[D] **[Apr/May-2019]**

UNIT-V - CASE STUDY

PART A

1. ***Determine the requirements of block motion estimator. [ID][Apr/May-2018]***

Name	Block motion estimator
Purpose	Perform block motion estimation within a PC system
Inputs	Macro blocks and search areas Outputs Motion vectors
Functions	Compute motion vectors using full search algorithms
Performance	As fast as we can get
Manufacturing cost	Hundreds of dollars
Power	Powered by PC power supply
Physical size and weight	Packaged as PCI card for PC

2. ***What are data compressors? [D][Apr/May-2018]***

Data compressor is a process of reducing the amount of data needed for storage or transmission of a given piece of information using encoding techniques

3. ***Write the requirement form for an alarm clock. [D][Apr/May-2017]***

Name	Alarm Clock
Purpose	A 24-hour digital clock with a single alarm.
Inputs	Six pushbuttons: set time, set alarm, hour, minute, alarm on, alarm off.
Outputs	Four-digit, clock-style output. PM indicator light. Alarm ready light. Buzzer.
Functions	Alarm on, Alarm off, Default mode
Performance	Displays hours and minutes but not seconds. Should be accurate within the accuracy of a typical microprocessor clock signal
Manufacturing cost	Consumer product range. Cost will be dominated by the microprocessor system, not the buttons or display
Power	Powered by AC through a standard power supply.
Physical size and weight	Small enough to fit on a nightstand with expected weight for an alarm clock.

4. ***What is the advantage of video accelerator? [D][Apr/May-2017]***

A video accelerator is a video card with integrated processor and memory. It is used to,

- To increase the overall capabilities of video graphics.
- To provides critical speedups for low-latency I/O functions.

5. ***Specify the MPEG layer 1 data frame format set for the audio player application. [ID][Nov/Dec-2016]***

Header	CRC	Bit allocation	Scale Factors	Sub band Samples	AUX data

6. ***What are the classes in data compressor? [D][Nov/Dec-2016]***

- Data Compressor
- Data buffer
- Symbol table

7. ***Write the main functions performed by Video accelerator[D][Nov/Dec-2017]***

A video accelerator significantly speeds up the updating of images on a screen which also frees CPU to take care of other tasks.

8. ***What are the major components used in the design of Alarm clock? [D][Nov/Dec-2017]***

- Lights/ Display
- Buttons
- Speaker

9. State the features of FSK detection Scheme in MODEM. [D][Nov/Dec-2018]

- Frequency Shift Keying (FSK) is the digital modulation technique in which the frequency of the carrier signal varies according to the digital signal changes.
- FSK is a scheme of frequency modulation used in 1200 baud modems
- The output of a FSK modulated wave is high in frequency for a binary High input and is low in frequency for a binary Low input. The binary 1s and 0s are called Mark and Space frequencies.

10. Which compression technique is used for telephone answering machine? [D][Nov/Dec-2018]

Adaptive Differential pulse code modulation (ADPCM) is used in is used telephone answering machine

11. List out the major components of audio player. [ID][Apr/May-2019]

- RISC processor
- DSP
- Audio interface
- CD interface
- Memory controller (flash, DRAM, SRAM)
- SRAM
- ROM
- I/O interface

12. What is the need for video accelerator? [ID][Apr/May-2019]

A video accelerator significantly speeds up the updating of images on a screen which also frees CPU to take care of other tasks. It is a video card with integrated processor and memory. It is used to,

- To increase the overall capabilities of video graphics.
- To provides critical speedups for low-latency I/O functions.

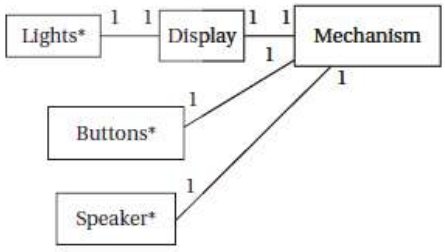
13. What type of technique used in Data compressor? [D]

Huffman coding technique is used in Data compressor

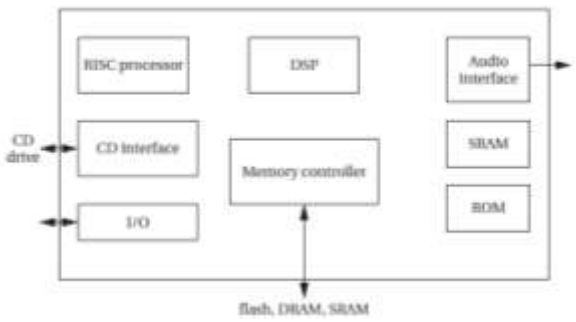
14. What is the code require to test the Data compressor internals? [D]

Scaffolding code is the code used to test the Data compressor internals.

15. Draw the class diagram for alarm clock. [D]



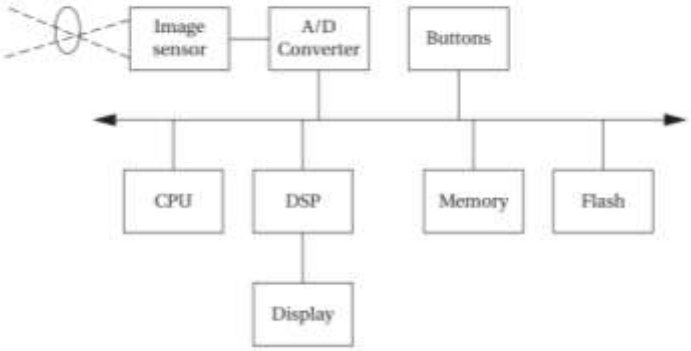
16. Draw the architecture for Audio player. [D]



17. List the functions of Digital Still Cameras. [D]

- Determine exposure and focus
- Capture image
- Perform Bayer pattern interpolation
- JPEG compression
- Store in flash file system

18. Draw the hardware architecture for Digital Stills Camera. [D]



19. What do you mean by Block Motion Estimation? [D]

JPEG-style compression alone does not reduce video bandwidth enough for many applications. MPEG uses motion to encode one frame in terms of another. Rather than send each frame separately, as in motion JPEG, some frames are sent as modified forms of other frames using a technique known as block motion estimation.

20. What is the basic function of audio player?

Audio player performs three basic functions,

- Audio decompression
- User Interface
- Audio Storage

21. List out the layers of audio compression.

- **Layer 1 (MP1)** uses a lossless compression of subbands and an optional, simple masking model.
- **Layer 2 (MP2)** uses a more advanced masking model.
- **Layer 3 (MP3)** performs additional processing to provide lower bit rates.

22. Define: Motion Vectors. [D]

The macro block position relative to the search area gives us the smallest value for this metric. The offset at this chosen position describes a vector from the search area center to the macro block's center called as the motion vector.

23. Define: Loop back testing. [D]

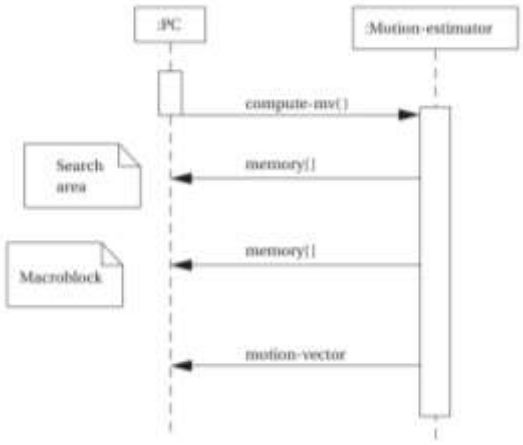
Loop-back testing is a simpler testing tool in the telecommunications industry. Loop-back can be performed in two ways,

- A shared variable can be used to directly pass data from the transmitter to the receiver.
- A audio cable can be used to plug the analog output to the analog input.

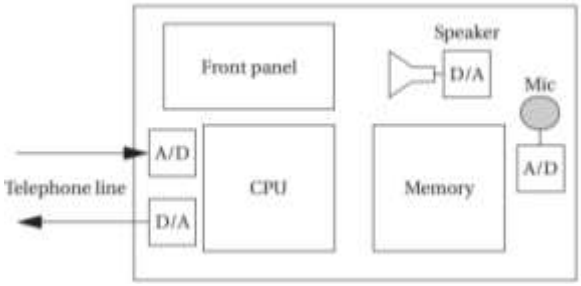
24. List the software modules in Telephone Answering Machine. [D]

- Front panel module
- Speaker module
- Telephone line module
- Telephone input and output modules
- Compression module
- Decompression module

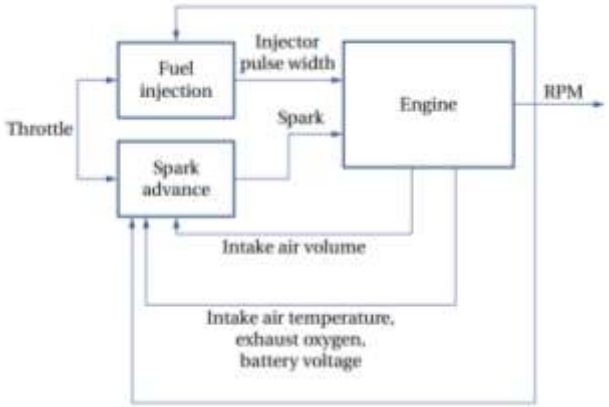
25. Draw the sequence diagram for video accelerators. [D]



26. Draw the Hardware structure of Telephone Answering Machine. [D]



27. Draw the Hardware Structure of Engine control. [D]



28. **List the compression process used for JPEG images**

- JPEG images has five main steps:
- Color space conversion.
- Color down sampling.
- Block-based discrete cosine transform (DCT).
- Quantization.
- Entropy coding.

29. What are the types of data compression? [D]

Data compression is classified into two types

- Lossy Compression
- Lossless Compression

30. Define luminance and chrominance. [D]

- A pixel's brightness is often referred to as its luminance
- A color pixel's brightness in a particular color is known as chrominance.

PART – B

[Data compressor]

1. Write in detail about the embedded concepts in the design of data compressor. (8) **[D][Nov/Dec-2016]**
2. Design data compressor using UML methodology. Analyse its design flow, requirements, Specification with architectural design.(15)**[D][Nov/Dec-2018]**

[Alarm Clock]

1. Design an alarm clock using embedded systems design techniques. (15)[D] **[Apr/May-2019]** Explain operation of Audio Player. (5) **[D][Nov/Dec-2017]**
2. Demonstrate in detail about design example of audio player. (8) **[D][Apr/May-2018]**

[Software modem]

1. Explain the hardware and software design of software modem and telephone answering machine. (16)**[ID][Nov/Dec-2016]**
2. Summarize the principle and operation of software MODEM. (8) **[D][Apr/May-2018]**
3. Explain operation of Software modem (5) **[D][Nov/Dec-2017]**

[Digital still camera]

1. Explain the hardware and software design of digital still-camera designed with automation of camera functions. (16) **[D][Apr/May-2017]**
2. Demonstrate the sequence diagram of taking a picture with digital still camera. (16) **[D][Apr/May-2018]**
3. Explain operation of Digital still camera. (6) **[D][Nov/Dec-2017]**
4. Write technical notes on "Applications of Embedded systems in software modem and digital still camera".(13)**[D][Nov/Dec-2018]**

[Telephone answering machine]

1. Outline the design example telephone answering machine. (13)[D] **[Apr/May-2019]**

[Engine control unit]

1. Justify that Engine Control Unit is an embedded system. Explain in detail the hardware and software components of Engine Control Unit. (16) **[D][Nov/Dec-2017]**
2. Write in detail about the embedded concepts in the design of engine control unit. **[D][Apr/May-2017]**
3. Outline the design example of embedded control of Engine Control Unit. (13)[D]**[Apr/May-2019]**
4. Illustrate the working of engine control unit with a diagram.(7)**[D][Nov/Dec-2018]**

[Video accelerator]

1. Write in detail about the embedded concepts in the design of video accelerator. (16) **[D][Nov/Dec-2016]**
2. From design flow analysis to architectural design, illustrate video accelerator using UML methodology.(15)**[D][Nov/Dec-2018]**
3. Evaluate the system design technique for large data analysis using video accelerator.(15)**[D] [Apr/May-2019]**
4. Illustrate the working of Video player.(6) **[D][Nov/Dec-2018]**