Unit I   INTRODUCTION TO EMBEDDED COMPUTING AND ARM PROCESSORS

Part - A Questions

1. Define Embedded System. What are the components of embedded system?

An Embedded system is one that has computer hardware with software embedded in it as one of its most important component.

The three main components of an embedded system are

1. Hardware
2. Main application software
3. RTOS

2. In what ways CISC and RISC processors differ?

CISC	RISC
1. It provides number of addressing modes	It provides very few number of addressing modes
2. It has a micro programmed unit with a control memory	It has a hard wired unit without a control memory
3. An easy compiler design	Complex compiler design
4. Provides precise and intensive calculations slower than a RISC	Provides precise and intensive calculations faster than a RISC

3. Define system on chip (SOC) with an example.

Embedded systems are being designed on a single silicon chip called system on chip. SOC is a new design innovation for embedded system

Ex. Mobile phone.

4. Give any two uses of VLSI designed circuits

A VLSI chip can embed IPs for the specific application besides the ASIP or a GPP core. A system on a VLSI chip that has all of needed analog as well as digital circuits.

Eg. Mobile phone.

5. List the important considerations when selecting a processor.

- Instruction set
- Maximum bits in an operand
- Clock frequency
- Processor ability

6. What are the types of embedded system?

- Small scale embedded systems
- Medium scale embedded systems
- Sophisticated embedded systems

7. Classify the processors in embedded system?

a). General purpose processor

- Microprocessor
- Microcontroller
- Embedded processor
- Digital signal processor

8. What are the advantages and disadvantages of embedded system?

Advantages: Customization yields lower area, power, cost.

Disadvantages: Higher HW/software development overhead design, compilers, debuggers, etc., may result in delayed time to market.

9. What are the applications of an embedded system? Embedded Systems: Applications:

- Consumer electronics, e.g., cameras, camcorders, etc.,
- Consumer products, e.g., washers, microwave ovens, etc.,
- Automobiles (anti-lock braking, engine control, etc.,)
- Industrial process controllers & avionics/defense applications
- Computer/Communication products, e.g., printers, FAX machines, etc.,

Emerging multimedia applications & consumer electronics

10. Name some DSP used in embedded systems?

- TMS320Cxx
- SHARC
- 5600xx

11. Name some of the hardware parts of embedded systems?

- Power source
- Clock oscillator circuit
- Timers
- Memory units
- DAC and ADC
- LCD and LED displays
- Keyboard/Keypad

12. What are the various types of memory in embedded systems?

- RAM (internal External)
- ROM/PROM/EEPROM/Flash
- Cache memory

13. What are the functional requirements of embedded system?

- Data Collection
- Sensor requirements
- Signal conditioning
- Alarm monitoring
- Direct Digital Control
- Actuators
- Man-Machine Interaction informs the operator of the current state of the controlled object assists the operator in controlling the system.

14. How is ARM processor different from other processors?
ARM is a RISC (Reduced Instruction Set Computing) architecture while other processor being a CISC (Complex Instruction Set Computing) one. In the ARM processor, arithmetic and logical operations cannot be perform directly on memory locations, while other processors allow such operations to directly reference main memory.

15. When is application specific system processor (ASSPs) used in a embedded systems?
ASSP is a processing unit for specific task and for specific application. In embedded system for example image compression and that is integrated through the buses with the main processor in an embedded system.

16. What are the various in embedded system designs modelling refining (or) partitioning?
Structural modelling⌉ Behaviour modelling⌉ State machine modelling⌉ Process algebra modelling⌉ Logic based modelling⌉ Petri-nets modelling.⌉

Part-B

1. (i)Analyze in detail about the challenges in embedded computing system design.(8)

    (ii)Find out how characters are copied from input to output using interrupts and buffers with the help of a program segment. (8)

2. (i)What are the parameters to be considered while designing an Embedded System Process? (8)

    (ii) State the importance of Structural and Behavioral description in detail. (8)

3. i) Draw the architecture and instruction set of ARM processor. (8)

    (ii)List the various blocks of an Embedded System in detail (8)

4. i) Mention the major levels of abstraction in design process for GPS moving map.(8)

    ii) Write down the major operations and data flows of a GPS moving map and draw its Architecture. (8)

5. (i)Explain in detail about the characteristics of embedded computing applications.(8)

    (ii)Explain in detail about supervisor mode, exception and traps. (8)

6. Discuss with a simple system namely, a model train controller, how will you use the UML to model systems? (13)

7. i) Discuss about the CPU performance . (4)

    ii)Discuss in detail about Coprocessors. (12)

Unit II   EMBEDDED COMPUTING PLATFORM DESIGN

Part - A Questions

1. What is the bus protocols especially, the four-cycle handshake?

Protocols are the set of rules and conditions for the data communication. The basic building block of most bus protocols is the four-cycle handshake. Handshake ensures that when two devices want to communicate. One is ready to transmit and other is ready to receive. The handshake uses a pair of wires dedicated to the handshake; such as enq(meaning enquiry) and ack (meaning acknowledge). Extra wires are used for the data transmitted during handshake.

2. What is a data flow graph?

A data flow graph is a model of a program with no conditions. In a high level programming language, a code segment with no conditions and one entry point and exit point.

3. What are CPU buses?

Data bus⌉ Address bus⌉ Control bus⌉ System bus.⌉

4. List out the various compilation techniques.

There are three types of compilation techniques: Analysis and optimization of execution time.⌉ Power energy and program size⌉ Program validation and testing.⌉

5. State the basic principles of basic compilation techniques.

Compilation combines translation and optimization.⌉ The high level language program is translated in to lower level form of⌉ instructions; optimizations try to generate better instruction sequences. Compilation = Translation + optimization⌉

6. Define BUS.

A bus is a connection of wires. The bus defines a protocol by which the CPU communicates with memory and I/O devices.

7. Define memory mapped I/O?

Memory-Mapped I/O (MMIO) and Port-Mapped I/O (PMIO) (which is also called isolated i/o) are two complementary methods of performing input/output between the cpu and peripheral devices in a computer. Memory-mapped I/O, uses the same address bus to address both memory and i/o devices – the memory and registers of the i/o devices are mapped to (associated with) address values. So when an address is accessed by the cpu, it may refer to a portion of physical ram, but it can also refer to memory of the i/o device.

8. Define RAM?

RAM is an acronym for random access memory, a type of computer memory that can be accessed randomly; that is, any byte of memory can be accessed without touching the preceding bytes. RAM is the most common type of memory found in computers and other devices, such as printers.

9. What is dynamic RAM?

Dynamic Random-Access Memory (DRAM) is a type of random-access memory that stores each bit of data in a separate capacitor within an integrated circuit. The capacitor can be either charged or discharged; these two states are taken to represent the two values of a bit, conventionally called 0 and 1.

10. What is ROM?

Read-Only memory (ROM) is a class of storage medium used in computers and other electronic devices. Data stored in ROM can only be modified slowly, with difficulty, or not at all, so it is mainly used to distribute firmware (software that is very closely tied to specific hardware, and unlikely to need frequent updates).

11. What is the bus protocols especially, the four-cycle handshake?

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13. What are CPU buses?

i)Data bus
ii)Address bus
iii) Control bus
iv)System bus.

14. List out the various compilation techniques.

There are three types of compilation techniques:
i)Analysis and optimization of execution time.
ii)Power energy and program size
iii) Program validation and testing.

15. Give the limitation of polling techniques.

i)It is wasteful of the processors time, as it needlessly checks the status of all devices all the time.
ii)It is inherently slow, as it checks the status of all input/output devices before it comes back to check any given one again.
iii)Priority of the device cannot be determined frequently.

Part B

1. Describe about Memory devices with suitable examples. (13)
2. i)List any two factors which may be the cause for delay in peripheral interface. (4)
   ii) Briefly explain with neat diagrams on how DMA based processor can remove delay for higher speed process. (12)
3. i) Discuss how component interfacing is done in embedded system in detail. (6)
   ii) Describe the development environment of an embedded system with suitable diagram? (10)
4. With a suitable example, explain how debugging is carried out using debuggers & compliers? (13)

5. (i)Evaluate how Logic analyzer, In circuit Emulator and Co simulator are used as debugging tools with examples.(12)
   ii) Justify the need of model of programs and Program design? (4)
6. (i)Elaborate briefly about Assembly and Linking. (10)
   (ii)Investigate the importance of program Validation and testing? (6)
7. (i)Write about Basic compilation techniques. (8)
   (ii) List the various compiler optimization techniques. (8)

Unit III   PROCESSES AND OPERATING SYSTEMS

Part - A Questions

1.Define scheduling.

This is defined as a process of selection which says that a process has the right to use the processor at given time.

2. What is scheduling policy?

It says the way in which processes are chosen to get promotion from ready state to running state.

3. Define hyper period?

It refers the duration of time considered and also it is the least common multiple of all the process.

4. What is schedulability?

It indicates any execution schedule is there for a collection of process in the system's functionality.

5. What are the types of scheduling?

1. Time division multiple access scheduling.

2. Round robin scheduling.

6. What is cyclostatic scheduling?

In this type of scheduling, interval is the length of hyper period 'H'. For this interval, a cyclostatic schedule is separated into equal sized time slots.

7. Define round robin scheduling?

This type of scheduling also employs the hyperperiod as an interval. The processes are run in the given order.

8. What is scheduling overhead?

It is defined as time of execution needed to select the next execution process.

09. What is meant by context switching?

The actual process of changing from one task to another is called a context switch.

10. Define priority scheduling?

A simple scheduler maintains a priority queue of processes that are in the runnable state.

11. What is rate monotonic scheduling?

Rate monotonic scheduling is an approach that is used to assign task priority for a preemptive system.

12.Define task and Task state.

A task is a set of computations or actions that processes on a CPU under the control of a scheduling kernel. It also has a process control structure called a task control block that saves at the memory. It has a unique ID. It has states in the system as follows: idle, ready, running, blocked and finished.

13. Define Task Control Block (TCB)

A memory block that holds information of program counter, memory map, the signal dispatch table, signal mask, task ID, CPU state and a kernel stack.

14. What is a thread?

Thread is a concept in Java and UNIX and it is a light weight sub process or process in an application program. It is controlled by the OS kernel. It has a process structure, called thread stack, at

the memory. It has a unique ID .It have states in the system as follows: stating, running, blocked and finished.

15. Define Inter process communication.

An output from one task passed to another task through the scheduler and use of signals, exception, semaphore, queues, mailbox, pipes, sockets, and RPC.

16. What is shared data problem?

If a variable is used in two different processes and another task if interrupts before the operation on that data is completed then the value of the variable may differ from the one expected if the earlier operation had been completed .This ids known as shared data problem.

17. Define Semaphore.

Semaphore provides a mechanism to let a task wait till another finishes. It is a way of synchronizing concurrent processing operations. When a semaphore is taken by a task then that task has access to the necessary resources. When given the resources unlock. Semaphore can be used as an event flag or as a resource key.

18. What is Priority inversion?

A problem in which a low priority task inadvertently does not release the process for a higher priority task.

19. What is Deadlock situation?

A set of processes or threads is deadlocked when each process or thread is waiting for a resource to be freed which is controlled by another process.

20. Define Message Queue.

A task sending the multiple FIFO or priority messages into a queue for use by another task using queue messages as an input.

21. Define Mailbox and Pipe.

A message or message pointer from a task that is addressed to another task.

22. Define Socket.

It provides the logical link using a protocol between the tasks in a client server or peer to peer environment.

23. Define Remote Procedure Call.

A method used for connecting two remotely placed methods by using a protocol. Both systems work in the peer to peer communication mode and not in the client server mode.

24. What are the goals of RTOS?

- Facilitating easy sharing of resources
- Facilitating easy implantation of the application software
- Maximizing system performance
- Providing management functions for the processes, memory, and I/Os and for other functions for which it is designed.
- Providing management and organization functions for the devices and files and file like devices.
- Portability

25.List the functions of a kernel.
- Process management
- Process creation to deletion
- Processing resource requests
- Scheduling
- IPC
- Memory management
- I/O management
- Device management

26.What is priority inheritance?

Priority inheritance is a method for eliminating priority inversion problems. Using this programming method, a process scheduling algorithm will increase the priority of a process to the maximum priority of any process waiting for any resource on which the process has a resource lock.

27. Define Message Queue.

A message queue is a buffer managed by the operating system. Message queues allow a variable number of messages, each of variable length, to be queued. Tasks and ISRs can
send messages to a message queue, and tasks can receive messages from a message queue (if it is nonempty). Queues can use a FIFO (First In, First Out) policy or it can be based on priorities. Message queues provide an asynchronous communications protocol.

28. Define Mailbox and Pipe.

A mailboxes are software-engineering components used for interprocess communication, or for inter-thread communication within the same process. A mailbox is a combination of a semaphore and a message queue (or pipe).
Message queue is same as pipe with the only difference that pipe is byte oriented while queue can be of any size.

29.Define throughput?

Throughput in CPU scheduling is the number of processes that are completed per unit time. For long processes, this rate may be one process per hour; for short transactions, throughput might be 10 processes per second.

30. What is turnaround time?

Turnaround time is the interval from the time of submission to the time of completion of a process. It is the sum of the periods spent waiting to get into memory, waiting in the ready queue, executing on the CPU, and doing I/O.

Part B

1. i)Compare RMS versus EDF. (8)
   ii) Explain about Windows CE with a neat diagram. (8)
2. Explain preemptive real time operating systems in detail. (8)
3. i) Outline about priority based scheduling in detail. (8)
   ii) Explain with the help of an example that the knowledge of data dependencies can help use the CPU more efficiently. (8)
4. Describe in detail about the inter process communication mechanism
   (i) Shared Memory communication (4)
   (ii) Message passing (4)
   (iii)Signals (4)
   (iv)Mailboxes (4)
5. i) Demonstrate in detail about power optimization strategies for CPU operation. (8)
    ii) Illustrate how the Predictive shut down technique proved itself as more sophisticated. (8)
6. (i)Enumerate why an automobile engine requires multirate control (4)
   (ii) Recall the performance of the Earliest – Deadline – First scheduling with other scheduling algorithms with suitable example. (12)
7. (i)What is Real time operating system? (4)
   (ii) Mention the special features of POSIX with neat diagram. (12)

Unit IV   SYSTEM DESIGN TECHNIQUES AND NETWORKS

Part - A Questions

1. Define pseudo-code.

Pseudo-code is a useful tool when developing an idea before writing a line of true code or when explaining how a particular procedure or function or even an entire program

2. What is design technology?

Design technology involves the manner in which we convert our concept of desired system functionality into an implementation. Design methodologies are used in taking the decisions at the time of designing the large systems with multiple design team members.

3. What are the goals of design process? (Apr/May 2011)

A design process has several important goals beyond function, performance, and power. They are time to market, design cost and quality

4. What does the acronym CRC stands for?

CRC stands for Classes, Responsibilities and Collaborators.

- 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.

5. What are the steps to be followed in a CRC card methodology?

- Develop an initial list of classes:, Write an initial list of responsibilities and collaborators
- Create some usage scenarios, Walk through the scenarios Refine the classes, responsibilities, and collaborators

What are the five levels of maturity in capability maturity model?

- Initial, Repeatable, Defined, Managed and Optimizing are the five levels of maturity in CMM.

6. What is a design review?

Design review is a simple, low-cost way to catch bugs early in the design process. A design review is simply a meeting in which team members discuss a design, reviewing how a component of the system works.

7. Give the members of the design review team.

Designers, Review leader, Review scribe and Review audience are the members of the design review team.

8. What is the role of a review scribe in a design review?

The review scribe records the minutes of the meeting so that designers and others know which problems need to be fixed.

9. Give the role of the review leader in a design review team.

The review leader coordinates the pre-meeting activities, the design review itself, and the post-meeting follow-up. During the meeting, the leader is responsible for ensuring that the meeting runs smoothly.

10. What are the potential problems to be looked for by the audience of a design review meeting?

Is the design team's view of the component's specification consistent with the overall system specification, or has the team misinterpreted something? Is the interface specification correct?

Does the component's internal architecture work well?

Are there coding errors in the component?

Is the testing strategy adequate?

11. What is a design flow?

A design flow is a sequence of steps to be followed during a design.

12. Define successive refinement design methodology.

In successive refinement design methodology, the system is built several times. A first system is used as a rough prototype, and successive models of the system are further refined. This methodology makes sense when you are relatively unfamiliar with the application domain for which you are building the system

13. What are the phases in water fall development model?

The waterfall development model consists of five major phases; they are requirements analysis, architecture, coding, testing and maintenance.

14. What are the elements of concurrent engineering?

Cross-functional teams, Concurrent product realization, Incremental information sharing and use, Integrated project management & Early and continual supplier involvement.

15.What are the advantages of Assembly language?

It gives the precise control of the processor internal devices and full use of processor specific features in its instruction sets and addressing modes.

The machine codes are compact, which requires only small memory.

Device drivers need only few assembly instructions.

16. What are advantages of high level languages?

o Data type declaration
- Type checking
- Control structures
- Probability of non-processor specific codes
- Define In -line assembly
- Inserting an assembly code in between is said to be in-line assembly.

17. What is the use of MACRO function?

A macro function executes a named small collection of codes, with the values passed by the calling function through its arguments. It has constant saving and retrieving overheads.

18. What is the use of interrupt service routines or device drivers?

It is used for the declaration of functions and datatypes, typedef and executes named set of codes. ISR must be small (short), reentrant or must have solution for shared data problem.

Part B

1. Explain in detail about i) MPSoCs (8) ii) Shared memory multiprocessor. (8)

2. i) Explain the design methodology of an embedded computing system in detail. (8)

    ii) Analyze the features of SDL Specification language with suitable diagrams. (8)

3. Discuss in detail about i) CAN Bus. (8) ii)I2C Bus. (8)

4. Discuss the role of distributed embedded architecture available for embedded systems. (8)

5. Observe in detail about Quality Assurance Process using the following

    i)Quality Assurance Techniques (8)

    ii) Verifying the Specifications (8)

6. Propose a method for understanding the architectural design of a complex systems by using CRC Cards. (12)

Unit V   CASE STUDY

Part - A Questions

1. What is a PDA?

PDA (Personal Digital Assistant) is a device that can be used to receive, display and transcribe information. PDA can run a wide variety of applications.

2. What is a set-top box or STB or STU?

A set top box (STB) or set top unit (STU) is an information appliance device that generally contains a tuner and connects to a television set and an external source of signal, turning the source signal into content in a form that can then be displayed on the television screen or other display device. USES : a) Cable television and satellite television system.

3. Write short notes on H/W and S/W co-design.

Embedded systems architecture design is the task of selecting and programming a suitable configuration of components for a required system application. Building an embedded system is not an easy task. Every embedded system consist of an embedded hardware and embedded software. So software and hardware plays a main role in design of embedded system architecture. Need For Co-Design : Co-design refers to parallel or concurrent development of hardware and software for an embedded system. Co-design reduces the overall design and development cycle of the embedded system. It helps the designer to find the bugs at early stage. It also reduces the number of errors, particularly at the hardware-software interface level.

4. What are FOSS tools for embedded systems?

GNU Compiler Collection (GCC) and GNU debugger (GDB) are the most popular FOSS (Free and open source) tools used in embedded systems.

5. List the major components in the Personal Digital Assistant System?

Process or memory

Connectivity

Power management unit

User interface.

6. Define Data Compression.

Reducing the 'electronic space' (data bits) used in representing a piece of information, by eliminating the repetition of identical sets of data bits (redundancy) in an audio/video, graphic, or text data file.

7. Why most designers use FOSS tools in embedded system development?

Because, It makes software portable.

It speeds up the development process

It provides good foundation for system development activities.

8. What is signal servicing function?

The signal service is a bureau of the government organized to collect from the whole country simultaneously report to local metrologicalcondition upon comparison of which at certain office, predictions concerning the weather are telegraphed to various sections also known as signal publicity display.

9. Give the steps to destroy a message queue.

First delete all the element in a message queue.⌉ Check if Front = rear = -1, then queue is empty.⌉ Otherwise, now call a delete routine to destroy a message queue.⌉

10. Define SOC?

Embedded systems are being designed on a single silicon chip called system on chip. SOC is a new design innovation for embedded system Ex. Mobile phone.

11. Define PDA?

A personal digital assistant (PDA), also known as a palmtop computer, or personal data assistant, is a mobile device that functions as a personal information manager. The term evolved from Personal Desktop Assistant, a software term for an application that prompts or prods the user of a computer with suggestions or provides quick reference to contacts and other lists. PDAs were discontinued in early 2010s after the widespread adoption of smart phones.

12. Define software MODEM.

A software modem is a low-cost alternative to a standard hardware-based modem. While hardware modems contain all the parts necessary to connect to the internet, the software version transfers some of that work to the computer's processor.

Part B

1. Evaluate in detail the principle operation of software modem. (16)

2. List the features of PDA and data compressor in detail. (12)

3. Demonstrate in detail about Design Example of Alarm Clock? (13)

4. Briefly Explain the working of audio player in detail. (8)

5. Explain the working of video accelerator in detail.

    i)System Architecture (8)

    ii)Component designing and testing (4)

    iii)System integration and testing (4)

6. Explain the working of telephone answering machine in detail. (13)

7. Develop the working of Engine control unit in detail.

    i)Theory of operations and requirements. (4)

    ii)Specification (4)

    iii)System Architecture (4)

    iv)Component designing and testing (2)

    v)System integration and testing (2)

8. Discuss about the design of digital still camera. (15)