

UNIT-1

EMBEDDED COMPUTING

TWO MARKS

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
It provides number of addressing modes	It provides very few addressing modes
It has a micro programmed unit with a control memory	It has a hardwired unit without a control memory
An easy compiler design	Complex compiler design
Provide precise and intensive calculations slower than a RISC	Provide precise and intensive calculations faster than a CISC

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?

1. General purpose processor

Microprocessor

Microcontroller

Embedded processor

Digital signal processor

Media processor

2. Application specific system processor

3. Multiprocessor system using GPP and ASSP GPP core or ASIP core

integrated into either an ASIC or a VLSI circuit or an FPGA core integrated with processor unit in a VLSI chip.

8. What are the important embedded processor chips?

- ❖ ARM 7 and ARM 9
- ❖ i 960
- ❖ AMD 29050

9. Name some DSP used in embedded systems?

- ❖ TMS320Cxx
- ❖ SHARC
- ❖ 5600xx

10. 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

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

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

12. What are the points to be considered while connecting power supply rails with embedded system?

- A processor may have more than two pins of Vdd and Vss
- Supply should separately power the external I/O driving ports, timers, and clock and
- From the supply there should be separate interconnections for pairs of Vdd and Vss pins analog ground analog reference and analog input voltage lines.

13. What is watch dog timer?

Watch dog timer is a timing device that resets after a predefined timeout.

14. What are the two essential units of a processor on a embedded system?

Program Flow control Unit

Execution Unit

15. What does the execution unit of a processor in an embedded system do?

The EU includes the ALU and also the circuits that execute instructions for a program control task. The EU has circuits that implement the instructions pertaining to data transfer operations and data conversion from one form to another.

16. Give examples for general purpose processor.

- Microcontroller
- Microprocessor

17. Define microprocessor.

A microprocessor is a single VLSI chip that has a CPU and may also have some other units for example floating point processing arithmetic unit pipelining and super scaling units for faster processing of instruction.

18. When is Application Specific System processors ASSPs) used in an embedded system?

An ASSP is used as an additional processing unit for running the application specific tasks in place of processing using embedded software.

19. Define ROM image.

Final stage software is also called as ROM image .The final implement able software for a product embeds in the ROM as an image at a frame. Bytes at each address must be defined for creating the image.

20. Define device driver.

A device driver is software for controlling, receiving and sending byte or a stream of bytes from or to a device.

21. Name some of the software's used for the detailed designing of an embedded system.

- Final machine implement able software for a product
- Assembly language
- High level language
- Machine codes
- Software for device drivers and device management.
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22. What are the various models used in the design of an embedded system?

- Finite state machine
- Petri net
- Control and dataflow graph
- Activity diagram based UML model
- Synchronous data flow graph
- Timed Petri net and extended predicate/transition net
- Multithreaded graph
-

22. Give some examples for small scale embedded systems.

- ACVM
- Stepper motor controllers for a robotic system
- Washing or cooking system
- Multitasking toys
-

23. Give some examples for medium scale embedded systems

- Router, a hub and a gateway
- Entertainment systems
- Banking systems
- Signal tracking systems
-

24. Give some examples for sophisticated embedded systems

- Embedded system for wireless LAN
- Embedded systems for real time video
- Security products
- ES for space lifeboat.

25. What are the requirements of embedded system?

- Reliability
- Low power consumption
- Cost effectiveness
- Efficient use of processing power

26. Give the characteristics of embedded system?

- a Single-functioned
- b Tightly constrained
- c Reactive and real time

27. What are the design metrics?

- Power
- Size
- NRE cost
- Performance

28. What are the challenges of embedded systems?

- Hardware needed
- Meeting the deadlines
- Minimizing the power consumption
- Design for upgradeability

29. Give the steps in embedded system design?

- Requirements
- Specifications
- Architecture
- Components
- System integration

30. What are the requirements?

Before designing a system, it must to understand what has to be designed. This can be known from the starting steps of a design process.

31. Give the types of requirements?

Functional requirements
Non functional requirements

32. Define functional requirements?

It says the fundamental functions of an embedded system.

33. Give some examples of functional requirements?

1. Performance
2. Cost
3. physical size and weight
4. power

34. What is the use of requirements form?

It is used as a checklist in the requirements analysis. From this the fundamental properties of a system came to be known.

35. What are the entries of a requirement form?

- Name
- Purpose
- Inputs and outputs
- Functions
- Performance
- Manufacturing cost
- Power
- Physical size and weight

36. What is meant by specification?

This is a bridge between Customer and Architect. It conveys the customer's needs. These needs are properly used in the design process.

37. What is architecture design?

It says the way of implementing functions by a system. Actually architecture is a plan for whole structure of a system. While will bring the design of components later.

38. Define system integration?

It is a processor of combining the components into one system.

39. What are the functions of memory?

The memory functions are

- To provide storage for the software that it will run.
- To store program variables and the intermediate results
- Used for storage of information

40. Define RAM?

RAM refers Random Access Memory. It is a memory location that can be accessed without touching the other locations.

41. What is data memory?

When the program is executing, to save the variable and program stack, this type of memory is used

42. What is code memory?

The program code can be stored by using this area. The ROM is used for this purpose.

43. What are the uses of timers?

The time intervals can be completed
Precise hardware delays can be
calculated The timeout facilities are
generated

44. Give short notes on ARM processor?

It is said to be the family of RISC architecture. The ARM instructions are written one per line, starting after the first column.

45. What are the data types supported by ARM?

Standard ARM word is 32 bit long
Word is splitted into 4 8 bit bytes

46. What are the 3 types of operating modes?

- Normal mode
- Idle mode
- Power down mode

UNIT-II

COMPUTING PLATFORM AND DESIGN ANALYSIS

TWO MARKS

1. Differentiate synchronous communication and iso-synchronous communication.

Synchronous communication

When a byte or a frame of the data is received or transmitted at constant time intervals with uniform phase difference, the communication is called synchronous communication.

Iso-synchronous communication

Iso-synchronous communication is a special case when the maximum time interval can be varied.

2. What are the two characteristics of synchronous communication?

Bytes maintain a constant phase difference

The clock is not always implicit to the synchronous data receiver.

3. What are the three ways of communication for a device?

- Iso-synchronous communication
- synchronous communication
- Asynchronous communication

4. Expand a) SPI b) SCI

SPI—serial Peripheral Interface

SCI—Serial Communication Interface

5. Define software timer.

This is software that executes and increases or decreases a count variable on an interrupt from a timer output or from a real time clock interrupt. A software timer can also generate interrupt on overflow of count value or on finishing value of the count variable.

6. What is I2C?

I2C is a serial bus for interconnecting ICs .It has a start bit and a stop bit like an UART. It has seven fields for start,7 bit address, defining a read or a write, defining byte as acknowledging byte, data byte, NACK and end.

7. What are the bits in I2C corresponding to?

It has seven fields for start,7 bit address, defining a read or a write, defining byte as acknowledging byte, data byte, NACK and end

8. What is a CAN bus? Where is it used?

CAN is a serial bus for interconnecting a central Control network. It is mostly used in automobiles. It has fields for bus arbitration bits, control bits for address and data length data bits, CRC check bits, acknowledgement bits and ending bits.

9. What is USB? Where is it used?

USB is a serial bus for interconnecting a system. It attaches and detaches a device from the network. It uses a root hub. Nodes containing the devices can be organized like a tree structure. It is mostly used in networking the IO devices like scanner in a computer system.

10. What are the features of the USB protocol?

A device can be attached, configured and used, reset, reconfigured and used, share the bandwidth with other devices, detached and reattached.

11. Explain briefly about PCI and PCI/X buses.

PCI and PCI/X buses are independent from the IBM architecture .PCI/X is an extension of PCI and support 64/100 MHZ transfers. Lately, new versions have been introduced for the PCI bus architecture.

12. Why are SPCI parallel buses important?

SPCI serial buses are important for distributed devices. The latest high speed sophisticated systems use new sophisticated buses.

13. What is meant by UART?

UART stands for universal Asynchronous Receiver/Transmitter.

- UART is a hardware component for translating the data between parallel and serial interfaces.
- UART does convert bytes of data to and from asynchronous start stop bit.
- UART is normally used in MODEM.

14. What does UART contain?

- A clock generator.
- Input and Output start Registers
- Buffers.
- Transmitter/Receiver control.

15. What is meant by HDLC?

- HDLC stands for “High Level Data Link Control”.
- HDLC is a bit oriented protocol.
- HDLC is a synchronous data Link layer.

16. Name the HDLC’s frame structure?

Flag	Address	Control	Data	FCS	Flag
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17. List out the states of timer?

There are eleven states as follows

- Reset state
- Idle state
- Present state
- Over flow state
- Over run state
- Running state
- Reset enabled state / disabled
- Finished state
- Load enabled / disabled
- Auto reload enabled / disabled
- Service routine execution enabled / disabled

18. Name some control bit of timer?

- Timer Enable
- Timer start
- Up count Enable
- Timer Interrupt Enable

19. What is meant by status flag?

Status flag is the hardware signal to be set when the timer reaches zeros.

20. List out some applications of timer devices?

- Real Time clock
- Watchdog timer
- Input pulse counting
- TDM
- Scheduling of various tasks

21. State the special features on I²C?

- Low cost
- Easy implementation
- Moderate speed upto 100 kbps).

22. What are disadvantages of I²C?

- Slave hardware does not provide much support
- Open collector drivers at the master leads to be confused

23. What are the two standards of USB?

- USB 1.1
- USB 2.0

24. Draw the data frame format of CAN?

Start	Arbitration field	Control field	Data field	CRC field	Acknowledgement field	End of frame
1	12	6	0-64	16 2	7	

25. What is the need of Advanced Serial High Speed Buses?

If the speed in the rate of ‘Gigabits per second’ then there is a need of Advanced Serial High Speed Buses.

26. What is meant by ISA?

- ISA stands for Industry standard Architecture.
- Used for connecting devices following IO addresses and interrupts vectors as per IBM pc architecture.

27. What is meant by PCI-X?

- PCI X offers more speed over PCI.
- 30 times more speed than PCI.

28. Define CPCI?

- CPCI stands for Compact peripheral component Interfaces.
- CPCI is to be connected via a PCI.
- CPCI is used in the areas of Telecommunication Instrumentation and data communication applications.

29. Define half-duplex communication.

Transmission occurs in both the direction, but not simultaneously.

30. Define full duplex communication.

Transmission occurs in both the direction, simultaneously

31. Define Real Time Clock RTC?

Real time clock is a clock which once the system starts does not stop and cannot be reset and its count value cannot be reloaded.

32. Define Time-out or Time Overflow?

A state in which the number of count inputs exceeded the last acquirable value and on reaching that state, an interrupt can be generated.

33. Why do we need at least one timer in an ES?

The embedded system needs at least one timer device. It is used as a system clock.

PROCESS AND OPERATING SYSTEMS

TWO MARKS

1. What are the states of a process?

- a. Running
- b. Ready
- c. Waiting

2. What is the function in steady state?

Processes which are ready to run but are not currently using the processor are in the 'ready' state.

3. 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.

4. What is scheduling policy?

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

5. Define hyper period?

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

6. What is schedulability?

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

7. What are the types of scheduling?

- 1. Time division multiple access scheduling.
- 2. Round robin scheduling.

8. 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.

9. Define round robin scheduling?

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

10. What is scheduling overhead?

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

11. What is meant by context switching?

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

12. Define priority scheduling?

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

13. What is rate monotonic scheduling?

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

preemptive system.

14. What is critical instant?

It is the situation in which the process or task possesses highest response time.

15. What is critical instant analysis?

It is used to know about the schedule of a system. It says that based on the periods given, the priorities to the processes has to be assigned.

16. Define earliest deadline first scheduling?

This type of scheduling is another task priority policy that uses the nearest deadline as the criterion for assigning the task priority.

17. What is IDC mechanism?

It is necessary for a 'process to get communicate with other process' in order to attain a specific application in an operating system.

18. What are the two types of communication?

1. Blocking communication
2. Non blocking communication

19. Give the different styles of inter process communication?

1. Shared memory.
2. Message passing.

UNIT 1V

HARDWARE ACCELERATES AND

NETWORKS 2 MARKS

1. Name the important terms of RTOS?

Task
State
Scheduler
Shared data
Reentrancy

2. Define process.

Process is a computational unit that processes on a CPU under the control of a scheduling kernel of an OS. It has a process structure, called Process control block. A process defines a sequentially executing program and its state.

3. What is meant by PCB?

Process Control Block' is abbreviated as PCB.PCB is a data structure which contains all the information and components regarding with the process.

5. 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

6. 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.

7. 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: waiting, running, blocked and finished.

8. 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.

9. What is shared data problem?

If a variable is used in two different processes and another task 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 is known as a shared data problem.

10. 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.

11. Define Mutex.

A phenomenon for solving the shared data problem is known as semaphore. Mutex is a semaphore that gives at an instance two tasks mutually exclusive access to resources.

12. Differentiate counting semaphore and binary semaphore.

Binary semaphore

When the value of binary semaphore is one it is assumed that no task has taken it and that it has been released. When the value is 0 it is assumed that it has been taken.

Counting semaphore

Counting semaphore is a semaphore which can be taken and given number of times. Counting semaphores are unsigned integers.

13. What is Priority inversion?

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

14. 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.

15. 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.

16. Define Mailbox and Pipe.

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

17. Define Socket.

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

18. 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.

19. 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
- Interoperability
- Providing common set of interfaces.

20. What is RTOS?

An RTOS is an OS for response time controlled and event controlled processes. RTOS is an OS for embedded systems, as these have real time programming issues to solve.

21. List the functions of a kernel.

- Process management
- Process creation to deletion
- Processing resource requests
- Scheduling
- IPC
- Memory management
- I/O management
- Device management

22. What are the two methods by which a running requests resources?

- Message
- System call

23. What are the functions of device manager?

- Device detection and addition
- Device deletion
- Device allocation and registration
- Detaching and deregistration
- Device sharing

24. List the set of OS command functions for a device

- Create and open
- Write
- Read
- Close and delete

25. List the set of command functions of POSIX file system

Open
Write
Read
Seek
Close

26. What are the three methods by which an RTOS responds to a hardware source call on interrupt?

- Direct call to ISR by an interrupt source
- Direct call to RTOS by an interrupt source and temporary suspension of a scheduled task.
- Direct call to RTOS by an interrupt source and scheduling of tasks as well as ISRs by the RTOS.

27. Name any two important RTOS.

- MUCOS
- VxWorks

28. Write short notes on Vxworks?

- Vxworks is a popular Real-time multi-tasking operating system for embedded microprocessors and systems.
- Vxworks can run on many target processors.
- It is a UNIX like Real time operating system.

- More Reliable
- More faster

29. What is meant by well tested and debugged RTOS?

An RTOS which is thoroughly tested and debugged in a number of situations.

30. What is sophisticated multitasking embedded system?

A system that has multitasking needs with multiple features and in which the tasks have deadlines that must be adhered to.

31. What are the features of UC/OS II?

- Preemptive
- Portable
- Scalable
- Multitasking

32. What is MICRO C/OS II?

- It stands for micro-controller operating system UC/OS II.
- It is a real time kernel
- The other names of MICRO C/OS II are MUCOS and UCOS.
- The codes are in 'C' and Assembly language.

33. What are the real time system level functions in UC/OS II? State some?

- 1 Initiating the OS before starting the use of the RTOS functions.
- 2 Starting the use of RTOS multi-tasking functions and running the states.
- 3 Starting the use of RTOS system clock.

34. Write the interrupt handling functions?

int connect is the function for handling the Interrupt.
int Lock -> Disable Interrupts.
int unlock -> Enable functions.

35. Write down the seven task priorities in embedded 'C++'?

```
define Task_Read ports priority
define Task_Excess Refund priority
define Task_Deliver priority
define Task_Refund priority
define Task_Collect priority
define Task_Display priority
define Task_Time Date Display priority
```

36. Name any two mailbox related functions.

- OS_Event *OSMboxCreate(void *mboxMsg)
- Void *OSMboxAccept(OS_EVENT *mboxMsg)

37. Name any two queue related functions for the inter task communications.

- OS_Event OSQCreate(void **QTop, unsigned byte qSize)
- Unsigned byte OSQPostFront(OS_EVENT *QMsgPointer, void *qmsg)

38. How is Vx Works TCB helpful for tasks?

- Provide control information for the OS that includes priority, stack size, state and options.
- CPU context of the task that includes PC, SP, CPU registers and task variables.

39. What are the various features of Vx Works?

- VxWorks is a scalable OS
- RTOS hierarchy includes timers, signals, TCP/IP sockets, queuing functions library, Berkeley ports and sockets, pipes, UNIX compatible loader, language interpreter, shell, debugging tools, linking loader for UNIX.

40. What is an active task in the context of Vx Works?

Active task means that it is in one of the three states, ready, running, or waiting.

41. What are the task service functions supported by Vx Works?

- taskSpawn
- taskResume
- taskSuspend
- taskDelay
- taskSuspend
- taskInit()
- exit()
- taskDelete

42. Name any four interrupt service functions supported by Vx Works?

- intLock
- intVectSet()
- intVectGet()
- intContext()

43. Name some of the inter process communication function.

- semBCreate
- semMCreate
- semCCreate
- semTake
- semDelete

44. Name some of the inter process communication function used for messaging.

- msgQCreate
- msgQDelete
- msgQSend
- msgQReceive

45. What are Vx Works pipes?

VxWorks pipes are thec queues that can be opened and closed like a pipe.pipes are like virtual IO devices that store the messages as FIFO.

46. What are the different types of scheduling supported by Vx Works?

- Preemptive priority
- Time slicing

UNIT V

CASE STUDY
2 MARKS

1. What is a PIC?

PIC refers to Programmable Intelligent Computer. PIC is microprocessor lies inside a personal computer but significantly simpler, smaller and cheaper. It can be used for operating relays, measuring sensors etc.

2. What are the main elements inside a PIC?

Processing engine, Program memory, data memory and Input/Output.

3. What are the types of program memory in a PIC?

Read-only, EPROM and EEPROM, Flash

4. What is MBasic Compiler Software?

From version 5.3.0.0 onward, Basic Micro offers one version of its MBasic compiler, the “Professional” version. MBasic runs under Microsoft’s Windows operating system in any version from Windows 95 to Windows XP. The computer requires an RS-232 port for connection to the ISP-PRO programmer board.

5. 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

6. 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.

7. 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.

8. 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.

9. 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.

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

Process or memory

Connectivity

Power management unit

User interface.

11. 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.

12. 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 metrological condition upon comparison of which at certain office, predictions concerning the weather are telegraphed to various sections also known as signal publicity display.

13. Give the steps to destroy a message queue.

- (i) First delete all the element in a message queue.
- (ii) Check if $\text{Front} = \text{rear} = -1$, then queue is empty.
- (iii) Otherwise, now call a delete routine to destroy a message queue.