DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

EE6602- EMBEDDED SYSTEMS

QUESTION BANK

UNIT I - INTRODUCTION TO EMBEDDED SYSTEMS

PART A

1. **Define system.**
   A system is a way of working, organizing or doing one or series of tasks by following a fixed plan, program and set of rules.

2. **What do you meant by real time ?**
   A time that always increments at constant intervals without stopping or resetting and that is used as a reference by the system at all times.

3. **Define ROM image.**
   An embedded system processor executes software that is specific to a given applications of that system. The instruction codes and data in the final phases are placed in the ROM or flash memory for all the tasks that are executed when the system runs.

4. **What is the role of processor reset and system reset?**
   The role of processor reset is it begins the processing of instructions from a starting address. System reset will reset the system after a predefined timeout.

5. **What is the need of watchdog timer?**
   Watchdog timer is a timer that resets the processor in case the program gets stuck for an unexpected length of time.

6. **What are the challenges faced in designing an embedded system?**
   ✓ Amount and type of hardware needed.
   ✓ Clock rate reduction
   ✓ Voltage reduction
   ✓ Process deadlines'
   ✓ Flexibility and upgrade ability
   ✓ Wait, stop and cache disable instructions.

7. **Define design metrics in ES.**

Design metrics is a parameters that define design requirements and must be kept in view during each stage of design process.

8. **When do we need an RTOS?**

RTOS has a basic function of the OS plus functions for real time task scheduling and interrupt latency control. It uses the timers and system clocks, time allocation and de-allocation to attain best utilization of the CPU time under the given timing constraint for the task.

9. **Name some processor in complex embedded system.**
   - ✓ General purpose microprocessor
   - ✓ Microcontroller
   - ✓ Single purpose
   - ✓ Dual core processor

10. **What are the abstractions steps in design process?**
    - ✓ Requirements
    - ✓ Specifications
    - ✓ Architecture
    - ✓ Components
    - ✓ System integration

11. **What are the classification of ES?**
    - ✓ Small scale embedded system
    - ✓ Medium scale embedded system
    - ✓ Sophisticated embedded system

12. **What are the tools used for programming tools are used in a complex software design?**
    - ✓ RTOS
    - ✓ Source code engineering tool
    - ✓ Simulator
    - ✓ Debugger
    - ✓ Assembler
    - ✓ Integrated development environment

13. **Define processor.**

A processor is a basic functional unit in computer system and using that unit only all the components are take places. A processor is a heart of the embedded system.

14. Name some hardware components used in embedded system.
- ✓ Power source
- ✓ Clock oscillator circuit
- ✓ Crystal resonator
- ✓ External oscillator IC
- ✓ Real time clock
- ✓ Memories

15. What is meant by glue circuit?

Glue circuit is a circuit that is placed for all the bus logic actions between circuits and all chips. The glue logic circuit of an embedded system may be a circuit for interconnecting the processor does external memories.

16. What are the device used for designing ES?
- ✓ Physical device
- ✓ Virtual device

17. Define Co-processor.

It is a computer processor used to supplement the functions of primary processor. Operations performed by the co-processor may be floating point arithmetic, graphics, signal processing, string processing.

18. What is meant by interrupt?

The interrupt is the process of switching the CPU execution from current process into new other process. The interrupt mechanism allows devices to signal the CPU and to force execution of a particular piece of code.

19. Define device driver.

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

20. Name some models for software design.
- ✓ Finite state machine
- ✓ Petri net model
- ✓ Control and data flow graphs
- ✓ Activity diagrams based UML model

1. Explain in detail about the build process for embedded systems. (16)

2. Describe the structural units in embedded processor. (16)

3. How to select the processor based upon its architecture and applications. (16)

4. Explain the concept of DMA. (16)

5. Discuss the methods in memory management. (16)

6. Discuss in detail about the timer and counter. (16)

7. Explain the classification of embedded systems with examples. (16)

8. Describe the working principle of in-circuit emulator. (16)

9. Illustrate the concept of watch dog timer. (16)

10. Discuss in detail about target hardware debugging. (16)

UNIT II - EMBEDDED NETWORKING

PART A

1. **What is CAN bus?**

   It is a standard bus used at the control area network generally in automotive and industrial electronics.

2. **What is COM port?**

   It is a port at the computer where a mouse, modem, serial printer or mobile serial printer connects for serial I/O in UART mode and there are handshaking signals for exchange of signals before UART mode communications.

3. **What is meant by device?**

   Device is a unit that has a processing element and that connects to the processor of embedded system internally or through the port or bus. It has fixed pre assigned port addresses according to its interfacing or bus controller circuit.

4. **what is device decoder?**

It is a circuit to take the system address bus signal as the input and generate a device select signals CS, for the port address selection during the device read or write instruction of the system processor.

5. **What is half duplex?**

It is serial port having one common I/O line or channel. For examples, in a telephone line, message flows one way at an instance.

6. **What is an I/O port?**

It is port for input or output operations at an instance. Handshake input and handshake output also known as I/O ports. For examples, a keypad is said to connect to an I/O port.

7. **Define protocol.**

Protocol is a way of transmitting messages on a network by using software for adding the additional bit such as starting bits, header, addresses of source and destination, error control bit and ending bits.

8. **What is status register?**

A register for bits, which reflects the status at the port buffer. It is for a read operation only. the status register bit or bits may or may not auto reset on device servicing after the read.

9. **Define UART.**

It is standard Asynchronous serial input and output port for serial bits. Its usually sends byte in 10-bits format or 11-bit format.

10. **Define bus.**

Bus is a set of parallel lines which carry signals from one to another unit. Bus enables interconnecting among many units in a simple way. The signal specific sequences according to a method or protocol.

11. **List some ways to performing bus arbitration process.**
   - ✓ Daisy chain method
   - ✓ Independent bus request
   - ✓ Polling method

12. what is the purpose of input port?

  Input port is a subsystem where a byte received from an external device or system for processing.

13. Define address bus.

  Address bus carries the address of a memory location pr I/O device that the CPU wants to access. It is an unidirectional bus and shortly it is called A-bus.

14. What is the need of timing diagram?

  Timing diagram reflects the relative time intervals of the signals on the external buses with respect to the processor clock pulses.

15. What are the types of architecture model?
- ✓ Single level architecture
- ✓ Two-level architecture
- ✓ Multi-level architecture

16. Mention some metrics of a bus.
- ✓ Simplifies number of interconnections compared to direct connections between one another.
- ✓ Provides a common way of interconnecting different or same type of I/O devices.
- ✓ Can add a new device or system interface that is compatible with a system I/O bus.

17. Define data bus.

  The data bus is used to transfer data between the processor, memory and I/O devices. It is a bidirectional bus.

18. What is meant by output port?

  Output port is a subsystem where a byte is sent from the processor for an external device or system.

19. What is meant by port?

  Port is a subsystem where byte receives from an external devices or system for processing or where a byte is sent from the processor for an external device or system.

20. What is meant by bus master?

Bus master is a processor, device or system which synchronously or asynchronously controls the input and outputs to the bus at selected instants.

<h2 align="center">PART B</h2>

1. Illustrate the synchronous and asynchronous communications from serial devices. (16)

2. Describe the functions of a typical parallel I/O interface with a neat diagram.(16)

3. Discuss the types of serial port devices. (16)

4. (i) Compare the advantages and disadvantages of data transfer using serial and parallel port/devices. (8) (ii) Discuss the RS-232C interface standard protocol. (8)

5. Compare the various standards of communication protocol, UART, RS232, RS422 & RS485(16)

6. (i) Demonstrate the signal using a transfer of byte when using the I2C bus and also the format of bits at the I2C bus with diagram. (8) (ii) Explain CAN bus. (8)

7. Why we need device driver? How do you write a device driver? List the steps involved in writing a device driver. (16)

8. Describe SPI protocol and its interface. (16)

9. Justify the types and need for various bus communication standards.(16)

10. Describe one type of serial communication bus with its communication protocol. (16)

<h2 align="center">UNIT III - EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT</h2>

<h2 align="center">PART A</h2>

1. **What is EDLC?**
        Embedded produce development life cycle is an analysis design implementation based standard problem solving approach for embedded product development.

2. **What are the objective of EDLC?**
        ✓ Ensure that high quality products are delivered to end user.

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- ✓ Risk minimization
- ✓ Maximize the productivity

3. What are the different phases of EDLC?
- ✓ Need
- ✓ Conceptualization
- ✓ Analysis
- ✓ Design
- ✓ Development and testing
- ✓ Deployment
- ✓ Support
- ✓ Upgrades
- ✓ Retirement

4. What are the different product development needs?
- ✓ New or custom product development
- ✓ Product re-engineering
- ✓ Product maintenance

5. What is meant by conceptualization?
It is the product concept development phase and it defines the scope of the concept, performs cost benefits analysis and feasibility study and prepare project management and risk management.

6. What is requirement analysis?
It is a product life cycle stage which deals with the activities for developing a detailed function model of the product under consideration.

7. What is unit testing?
Unit testing is a test carried out to verify the functioning of the individual modules of the firmware and hardware.

8. What is system testing?
System testing is testing the functional aspects/product requirements of the product after integration. system testing refers to a set of different tests for functional; and non-functional requirements.

9. **What is user acceptance testing?**

User acceptance testing can be performed by the user against the acceptance values for each requirements.

10. **What is upgrade phase?**

The upgrade phase of product development deals with the development of upgrades for the product which is already present in the market.

11. **What is waterfall model?**

In waterfall model, the various phases of EDLC are executed in sequence and the flow is unidirectional with output of one phase serving as then input to the next phase.

12. **What is iterative model?**

Iterative model is a EDLC model which follows the sequence so some analysis, follow some design, then some implementation.

13. **What is prototyping model?**

Prototyping model is a EDLC model which is the variation of the iterative model in which a more refined prototype is produced at the end of each iteration.

14. **What is spiral model?**

It combines the elements of linear and prototyping models to give the best possible risk minimized EDLC model. The product development starts with project definition and traverse through all phases of EDLC through multiple phases.

15. **What is CISC?**

The complex instruction set computing architecture uses an instruction set representing complex operations. It is possible for a CISC instruction set to perform a large complex operation with a single instruction.

16. **What is RISC?**

The reduced instruction set computing architecture uses instruction set representing simple operations and it requires the execution of multiple RISC instructions to perform a complex operation.

17. **What is DFG model?**

The data flow graph model translates the data processing requirements into a flow graph. It is data driven model in which the program execution is determined by data.

18. What is sequential program model?

In sequential programming model, the functions or processing requirements are executed in sequence. It is same as the conventional procedural programming.

19. What is object oriented model?

It is an object based model for modeling system requirements. It divides complex software requirements into simple well defined pieces called objects.

20. What is state machine model?

The state machine model contain a number of states are finite. In other words the system is described using a finite number of possible states.

PART B

1. Explain the embedded software development process. (16)

2. Discuss in detail about the different phases of EDLC. (16)

3. Generalize the various computational models in embedded design. (16)

4. Discuss the issues in hardware – software codesign of embedded system.(16)

5. Compare the various modeling of EDLC. (16)

6. (i) Illustrate sequential flow model with example. (16)

   (ii) Illustrate Concurrent process model with example. (16)

7. (i) Describe object oriented model with example. (8) (ii) Differences between Data flow

   model and state machine model. (8)

8. (i) Describe Data Flow Graph model with example. (8) (ii) Describe State Machine model

   with example. (8)

9. (i) Describe in detail the Waterfall or Linear model. (8) (ii) Describe in detail the Iterative/

Incremental or Fountain Model. (8)

10. (i) Explain in detail the Prototyping Model. (8) (ii) Explain in detail the Spiral Model

UNIT IV - RTOS BASED EMBEDDED SYSTEM DESIGN

PART A

1. **What is an operating system?**
   The operating system acts as a bridge between the user applications and the underlying system resources through a set of system functionalities and services.

2. **What is kernel?**
   The kernel is the core of the operating system which is responsible for managing the system resources and the communication among the hardware and other system services.

3. **What is kernel space and user space?**
   Kernel space is the primary memory area where the kernel applications are confined to run. User space is the primary memory area where the user applications are confined to run.

4. **What is TCB?**
   A process control block also called task block. It is data structure in the operating system kernel containing the information needed to manage a particular process.

5. **What are the different functions handled by a general purpose kernel?**
   - ✓ Process management
   - ✓ Primary memory management
   - ✓ File system management
   - ✓ I/O system management
   - ✓ Protection system
   - ✓ Interrupt handler

6. **What is process life cycle?**

The process traverses through a series of states during its transition from the newly created state to the terminated state. The cycle through which a process changes its state from newly created to execution completed is known as process life cycle.

7. What is thread in the operating system context?

A thread is the primitive that can execute code. A thread is a single sequential flow of control within a process. Thread is also known as light weight process.

8. Why thread creation faster than process creation?

Thread needs only a stack storage for register so they is fast to create. Thread needs a common data to use inter process communication.

9. What is multiprocessing system?

It contain multiple CPU and are capable of executing multiple processes simultaneously.

10. What are the various multi tasking models?
- ✓ Co-operative multitasking
- ✓ Preemptive multitasking
- ✓ Non-preemptive multitasking

11. What is co-operative multitasking?

It is a multitasking model in which a task/process gets a chance when the currently executing task relinquishes the CPU voluntarily.

12. What is preemptive multitasking?

It is a multi tasking model in which a currently running task/ process is preempted to execute another task/ process.

13. What are the different queues associated with process scheduling?
- ✓ Job queues
- ✓ Ready queues
- ✓ Device queues

14. What are the types of non-preemptive scheduling?
- ✓ First come first served
- ✓ Last come last served
- ✓ Shortest job first

✓ Priority based

15. What is priority scheduling?

It is scheduling policy which sorts the ready queue based on priority and schedules the process with highest priority from the ready queue for execution.

16. What is pipe?

Pipe is a selection of the shared memory used by processes for communicating. Pipes follow the client server architecture.

17. What is IPC?

The mechanism through which processes/task communicate each other is known as inter process communications.
It is essential for process co-ordination.

18. What is deadlock?

Deadlock is a situation where non of the processes are able to make any progress in their execution. It is the condition in which a process is waiting for a resources held by another process which is waiting for a resource held by the first process.

19. What is racing?

Racing is the situation in which multiple processes complete each other to access and manipulate shared data concurrently.

20. What is livelock?

Livelock is a condition where a process always does something but is unable tp make any progress in the execution completion.

PART B

1. Describe the services of UNIX based real time operating systems. Compare its features with window based real time operating systems. (16)

2. Discuss about the contemporary real time operating systems VxWorks, Linux and RT Linux. (16)

3. (i) Summarize Preemptive and Non-preemptive multitasking.(8) (ii) Describe the three

alternative systems in three RTOS for responding a hardware source call with the diagram.

3. (i) List out the goals of operating system services. (8) (ii) Generalize the scheduler in which RTOS insert into the list and the ready task for sequential execution in a co-operative round robin model. (8)

5. (i)Analyze the fifteen point strategy for synchronization between the processes, ISRs, OS functions and tasks for resource management. (8) (ii) Discuss the critical section service by a preemptive scheduler. (8)

6. (i) Summarize the Rate Monotonic Co-operative scheduling. (8) (ii) Explain the features of Vx Works. (8)

7. (i) List out the RTOS programming tool MicroC/OS-II (8) (ii) Explain the use of Semaphores for a Task or for the Critical Sections of a Task. (8)

8. Show the appropriate diagrams explain multiple tasks and multiple processes. (16)

9. Generalize the various scheduling policies with example. (16)

10. Describe the following (i) Inter process communication (8) (ii) Context Switching (8)

UNIT V - EMBEDDED SYSTEM APPLICATION DEVELOPMENT

PART A

1. **Define MUCOS.**
    MUCOS is a portable, ROMable, Scalable , real time and multitasking kernel. It is used over thousands of applications including automotive , avionics, consumer electronics, medical devices, military aerospace networking.

2. **What is the use of MUCOS-II?**
    It is one of the popular RTOS for the embedded system development. It is well development for number of applications. It is real time kernel.

3. **What are the applications of MUCOS?**
    - ✓ Cameras
    - ✓ Automotive
    - ✓ Medical devices
    - ✓ Aerospace

✓ Networking

4. **What is AVCM?**
   Automatic chocolate vending machine is a machine using which the children can automatically purchase the chocolates. The payment is made by inserting the coins of appropriate amount into a win slot.

5. **What are the classifications of ES?**
   ✓ Application specific embedded system
   ✓ Domain specific embedded system

6. **What are the three phases of washing machine?**
   ✓ Wash phase
   ✓ Spin phase
   ✓ Rinse phase

7. **What is meant by ECU?**
   Automotive embedded system are normally built around microcontroller or DSP or a hybrid of the two and are generally known as electronic control units.

8. **What are the classifications of ESU?**
   ✓ High speed electronic control unit
   ✓ Low speed electronic control unit

9. **What is the use of HECU?**
   High speed electronic control unit are deployed in critical control units requiring fast response like fuel injection system, antilock brake system.

10. **What is the use of LEC?**
    Low speed electronic control unit are deployed in applications where response time is not so critical. They are generally built around low cost microprocessor and DSP. Audio controller , passenger and driver door lock are the examples of LEC.

11. **Name some serial buses used in automotive communication.**
    ✓ Controller area network
    ✓ Local interconnect network
    ✓ Media oriented system transport bus

12. **Define CAN.**

CAN is an event driven serial protocol interface with support for error handling in data transmission. It is generally employed in safety system like airbag control, power train system.

13. What is meant by LIN?

Lin is a single master multiple slave communication interface. It is s low speed, single wire communication interface with support for data rate upto 20kpbs.

14. What is meant by MOST?

The media oriented system transport bus is targeted for automotive audio video equipment interfacing. MOST bus is a multimedia fiber-optic point to point network implemented in a star, ring or daisy topology.

15. What are the key players of the automotive embedded marker?
- ✓ Silicon providers
- ✓ Tools and platform providers
- ✓ Solution providers

PART B

1. Design architectural hardware and software units needed in an automatic chocolate vending machine (16)

2. Design architectural hardware and software units needed in smart card. (16)

3. Tabulate hardware units needed in each of the systems: Camera, Smart card, Automatic chocolate vending machine, Washing machine.(16)

4. Demonstrate the hardware and software units that must be present in automatic Chocolate vending machines (16)

5. List various types of memories and the application of each in the following systems: Robot, Digital camera, Smart card, Washing machine. (16)

6. Show and explain basic system of an Automatic chocolate vending system (16)

7. Apply suitable hardware and software to develop the embedded system for a smart card. List the various steps needed to design a smartcard (16)

8. Examine the components of embedded system in automatic chocolate vending machines and smartcard(16)

9. Identify the tasks for an ACVM. Explain the various inter process communication Methods required in implementing the application. (16)