Sem: 6 **EE6602-Embedded Systems** **Class: III year EEE**

Two Marks and Answers

Book Reference:

1. G.Prabhakar and Dr.S.Selvaperumal, "**Embedded Systems**", Anuradha Publications 2015.

Unit-1

1. Define Embedded system.

An Embedded system is an Interface between hardware and software, which is designed for specific applications. eg: (1) Adaptive cruise control Mechanism in cars (2) Temperature controlled system (3) Automatic chocolate vending machine.

2. What are the components of Embedded system?

The three main components are

(1) Hardware (2) Application software (Firm ware) (3) RTOS (Real Time Operating System)

3. Difference between CISC & RISC processors.

CISC	RISC
* Complex Instruction set computers.	* Reduced Instruction set computers.
* It provides number of addressing modes.	* It provides very few addressing modes
* Microprogrammed unit with a control memory.	* Hardwired unit without a control memory.
* Easy compiler design.	* Complex compiler design.
* Provide precise and Intensive calculations slower than a RISC.	* Provide Precise and Intensive calculations faster than a CISC.

4. Difference between Microprocessors and Microcontrollers.

Microprocessors	Microcontrollers
* CPU is stand alone. RAM, ROM, I/O, Timer are separate.	* CPU, RAM, ROM, I/O and Timers are all on a single chip.
* Designer can decide on the amount of ROM, RAM & I/O parts.	* Fixed amount of on chip ROM, RAM and I/O ports.
* Expensive, Versatility and general purpose.	* For Applications in which cost, power and space are critical single purpose.
* eg: 8085, 8086	* eg: 8051, PIC, ARM.

5. Compare an Embedded system and non Embedded system with examples.

In personal computer: (Non Embedded system)

* General purpose OS used for any application
* More Memory is needed.
* Non-dedicated functions.

In Embedded Systems:

* Dedicated Real Time OS used for the dedicated applications.
* Application dependent processor.
* Restricted Memory.
* Real Time Operation & Real Time Scheduling.

6. Define System On Chip (SOC) with an example.

Embedded systems are being designed on a single silicon chip called system on chip. SOC is an innovative design for embedded system. eg: Mobile phone.

7. List the important considerations when selecting a processor.

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

8. What are the types of Embedded system?

* Small Scale embedded systems
* Medium Scale embedded systems
* Sophisticated Embedded Systems.

9. Name some DSP used in embedded systems?

* TMS 320 C6000 series
* TMS 320 C5000 series
* Blackfin processor
* Davinci-Ti processor
* OMAP processor.

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

* RAM
* ROM / PROM / EEPROM / Flash
* Cache Memory.

11. What is watch dog Timer?

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

12. What are the 2 essential units of a processor on a embedded system?

* Program Flow Control Unit
* Execution Unit

13. Define Emulator and Simulator.

Emulates your processor on the another target machine. It is a hardware device or a program that pretends to be another particular device or program. It is similar to the Mimicry process.

Simulator simulates all functions of Embedded system circuit and independent of a particular target system. It also simulates the processes of particular processor that will execute.

14. Define compiler and cross compiler.

Compiler – It uses or includes the codes, functions and expressions from the library routines and grates a file called object file.

eg: MPLAB, Keil, Code composer studio, gcc.

Cross Compiler – Compiler in personal computer (PC) is used to write C programming for any Microcontroller and it generates the code will not run in PC. So that code should be flashed on to the IC (PIC Microcontroller) and then the code performs the execution.

15. Define DMA.

A direct memory access (DMA) is an operation in which data is copied from one resource to another resource in a computer system without the involvement of the CPU.

16. 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.

17. Define RTC (Real Time Clock)?

Real Time clock is a clock which once the system starts does not stop and can't be reset and its count value can't be reloaded.

18. Define Timeout or Timer overflow?

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

Unit-2

1. Difference between Synchronous and Asynchronous communication:

Synchronous	Asynchronous
* Constant time Intervals	* Random Time Intervals
* No hand – shaking between Transmitter and Receiver	* Hand – shaking between Transmitter and Receiver.
* Clock is known to the receiver explicitly	* Clock is known to the receiver implicitly.
* Eg: SPI, SCI, SI	* Eg: RS232, UART, HDLC, etc.

2. What is I2C?

I2C (Inter Integrated Circuit) 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. It is a 2 wire communication: SDA and SCL. Addressing is needed for each slave device.

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

CAN (Controller Area Network) 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. CAN protocol is a message based protocol.

4. What is meant by UART?

* UART stands for universal Asynchronous Receiver and 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.

5. What does UART contain?

* A clock generator
* Input and output start Registers
* Buffers
* Transmitter / Receiver Control

6. Define half duplex and full duplex communication.

Half duplex – Transmission occurs in both the direction, but not simultaneously.

Full duplex – Transmission occurs in both the direction simultaneously.

7. Define SPI.

SPI (synchronous peripheral Interface) is a serial bus for inter connecting ICS. It is a full duplex communication. It is a 3 wire communication such as SDI, SDO & SCLK.

* Addressing for each slave device is not needed.
* It allows 8 bit to transmit & Receive.
* It supports full master mode and slave mode.
* Bus Arbitration logic is needed.

8. Why we go for RS-485?

RS-232C standard is a point to point interface. The problem in Rs-232 is, when to communicate with many embedded microprocessor, you need more dedicated RS-232C ports for each embedded processor. So it becomes expensive and also susceptible to noise. In this case, RS-485 Interface has been created to allow multiple processors (up to 32) to communicate with each other on a common line called as partly line or Multidrop Interface.

9. What is meant by Device Driver?

A driver is a software program that allows your computer to communicate with hardware or devices. eg: USB device driver program to communicate with PC.

10. List out the Frames in CAN.

There are four message frames:

1. Data frame, 2. Remote frame, 3. Overload frame & 4. Error frame.

Unit-3

1. What is EDLC?

Embedded product development life cycle (EDLC) is an Analysis – Design – Implementation based standard problem solving approach for Embedded product development.

EDLC defines the interaction and activities among various groups of a product development sector including project management, system design and development, system testing, release management and quality assurance.

2. What is Model?

The Life cycle of a product development is commonly referred as Models and a Model defines the various phases involved in a product's life cycle.

The Embedded product life cycle model contains the phases; Need, Conceptualisation, Analysis, Design, Development and Testing, Deployment, Support, Upgrades and Retirement / Disposal.

3. Define Conceptualisation phase.

Conceptualisation phase is the phase dealing with product concept development. Conceptualisation phase includes activities like product feasibility analysis, cost benefit analysis, product scoping and planning for next phases.

4. Name the 3 Categories of product development.

The 3 categories are

1. New or custom product development
2. Product Re-engineering.
3. Product maintenance.

5. Define Requirement analysis phase.

This phase defines the inputs, processes, outputs and interfaces of the product at a functional level. Analysis and documentation, interface definition and documentation, high level test plan and procedure definition etc. are the activities carried out during requirement analysis phase.

6. Explain the preliminary design and Detailed Design in brief.

* The preliminary design establishes the top level architecture for the product, lists out the various functional blocks required for the product and defines the inputs and outputs for each functional block.

* Detailed design generates a detailed architecture, identifies and lists out the various components for each functional block, the inter-connection among various functional blocks, the control algorithm requirements etc.

7. Define Product design phase and Development phase.

* The design phase deals with the implementation aspects of the required functionalities for the product.

* The development phase transforms the design into a realisable product. The detailed specifications generated during the design phase are translated into hardware and firmware during the development phase.

8. What are the models used in EDLC?

They are:

1. The Linear or Waterfall Models
2. Iterative or incremental or fountain Models
3. Prototyping or Evolutionary Models.
4. Spiral Models

9. Define Linear Model and Proto typing Model.

* The Linear or Waterfall model executes all phases of the EDLC in sequence, one after another. It is the best suited method for product development, where the requirements are fixed.

* Prototyping model is a variation to the Interative model, in which a more refined prototype is produced at the end of each iteration. It is the best suited model for developing embedded products whose requirements are not fully available at the time of starting the project and are subject to change.

10. Define Spiral Model.

Spiral Model is the EDLC model combining linear and prototyping model to give the best possible risk minimisation in product development.

11. Define Deployment phase.

The deployment phase deals with the launching of the product. Product deployment notification, Training plan execution, product installation, product post implementation review, etc. are the activities performed during deployment phase.

12. Explain Data flow Model.

Data flow is a type of process network model. In data flow, a program is specified by a directed graph. The nodes of the graph represent computational functions that map input data into output data. Data is represented by a circle and data flow is represented using arrows.

13. What are the differences between Data flow model and state machine model?

Both Data flow and finite state machine are models of computation. The data flow model of computation is used in signal processing design and modelling of DSP algorithms. On the other hard FSMs have been developed to solve a different class of problems, namely sequential control. FSMs are an appropriate modelling approach for control – dominant applications. Mixing Data flow with FSMs is a good solution for representing a system which requires both signal processing and control. This Integrated method is very useful to eradicate the drawbacks.

Unit-4

1. Difference between Linux and RT Linux.

	Linux	RT Linux
1.	Linux is not a hard real time system	RT Linux supports hard real time applications.
2.	The tasks, which do not have any time constraints	Any task that has real time constraints will run under RTLinux

2. What is meant by Semaphore?

Semaphore is a special variable operated by the OS functions which are used to take note of certain actions to prevent another task or process from proceeding further.

3. Define critical section of a task.

A section in a task the execution of which should block execution of another such section in another task, for example, when a buffer in printer is shared between two or more tasks.

4. Define Deadlock situation.

A task waiting for the release of a semaphore from a task and another a different task waiting for another semaphore release to run. None of there is able to proceed further due to circular dependency. An OS can take care of this by appropriate provisions.

5. Define (a) Mailbox (b) Message queue.

Mailbox: A message from a task that is addressed for another task.

Message queue: A task sending the multiple messages into a queue for use by another task using queue messages as an Input.

6. What is meant by a pipe in OS?

A device for use by the task for sending the messages and another task using the device receives the messages as stream. A pipe is a unidirectional device.

7. Define Priority Inversion and Priority Inheritance.

A problem in which a low priority task inadvertently does not release the process for a higher priority task is called as Priority Inversion.

Priority Inversion problems are eliminated by using a method called priority inheritance. The process priority will be increased to the maximum priority of any process which waits for any resource which has a resource lock. This is the programming methodology of priority inheritance.

8. Define Mutex.

Mutex (Mutually Exclusive) is a program that allows multiple program threads to share the same resource such as file access, but not simultaneously Mutex helps in mutual exclusion of one task with respect to another by a scheduler in the mltitasking operations.

9. What do you mean by shared data problem.

If a variable is used in two different processes and if another task interrupts before the operation on that data is completed, then the shared data problem arises.

10. What is RTOS?

A certain capability within a specified time constraint is guaranteed by an operating system is called real time operating system.

11. Define Process.

A process may consist of multiple threads that define thread as a minimum unit for a scheduler to schedule it to run the CPU and provide other system resources. Unix provides for processes and their threads as light-weight processes. Light weight means functions not dependent on functions like memory management functions. A process is a computational unit that processes on a CPU under the state control of a kernel in OS.

12. Explain in brief about the Remote procedure call.

A method used for connecting two remotely placed methods by first using a protocol for connecting the processes. It is used in the cases of distributed tasks.

13. What is meant by Exception handling.

Exemption handling is defined as executing a function on receiving a signal. Error is also handled by using an exception handling function.

14. What is context switching?

A context switch is the switching of the CPU from one process or task to another. It enables the process of storing and restoring the state of a process or task, so that execution can be resumed from the same point at a later time.

15. Explain in brief about Task Creation and Task deletion.

Task creation – Task is allotted a TCB and an identity. Creation also initiates and schedules on creation in MUCOS.

Task deletion – Task is no longer has the TCB and is ignored till created again.

Unit-5

1. What is Multi-state system?

A system that can exist in multiple states (one-state at a time) and transition from one state to another state is known as Multistate system. There are 3 types of multi state system:

1. Timed Multi state systems, 2. Input – based multistate system, 3. Input – based / Timed Multistate systems.

2. What is a Motor Driver?

A motor driver is a little current amplifier. The function of motor drivers is to take a low current control signal and then turn it into a higher current signal that can drive a motor. eg: Motor driver example L293D IC.

3. Define RTC.

A real time clock is a computer clock that keeps track of the current time even when the computer is turned off. Real time clock (RTC) runs on a special battery that is not connected to the normal power supply.

4. Write in brief about the PIC Microcontroller.

PIC (Peripheral Interface Controller) is a family of Harvard Architecture microcontrollers made by Microchip Technology. It has an in built PWM generator, which is very useful to control the motors.

5. What is Smart Card?

Smart Card stores and process information through Electronic circuits embedded in the silicon in a plastic substrate body. It is portable and tamper resistant computer. It carries both processing power and Information.

6. Define class and objects.

A class is a user defined type or data structure declared with keyword class that has data and functions as its members whose access is governed by the three access specifiers private, protected or public. Class is a collection of data member and member function.

Object is a class type variable, objects are also called instance of the class. Each object contains all members declared in the class.

7. What is synchronization in RTOS?

To let each section of codes, tasks and ISRS run and gain access to the CPU one after the other sequentially or concurrently, following a scheduling strategy, so that there is a predictable operation at any instance.

8. What is PWM?

When a width of the pulse signal is varied, it is pulse width modulation.