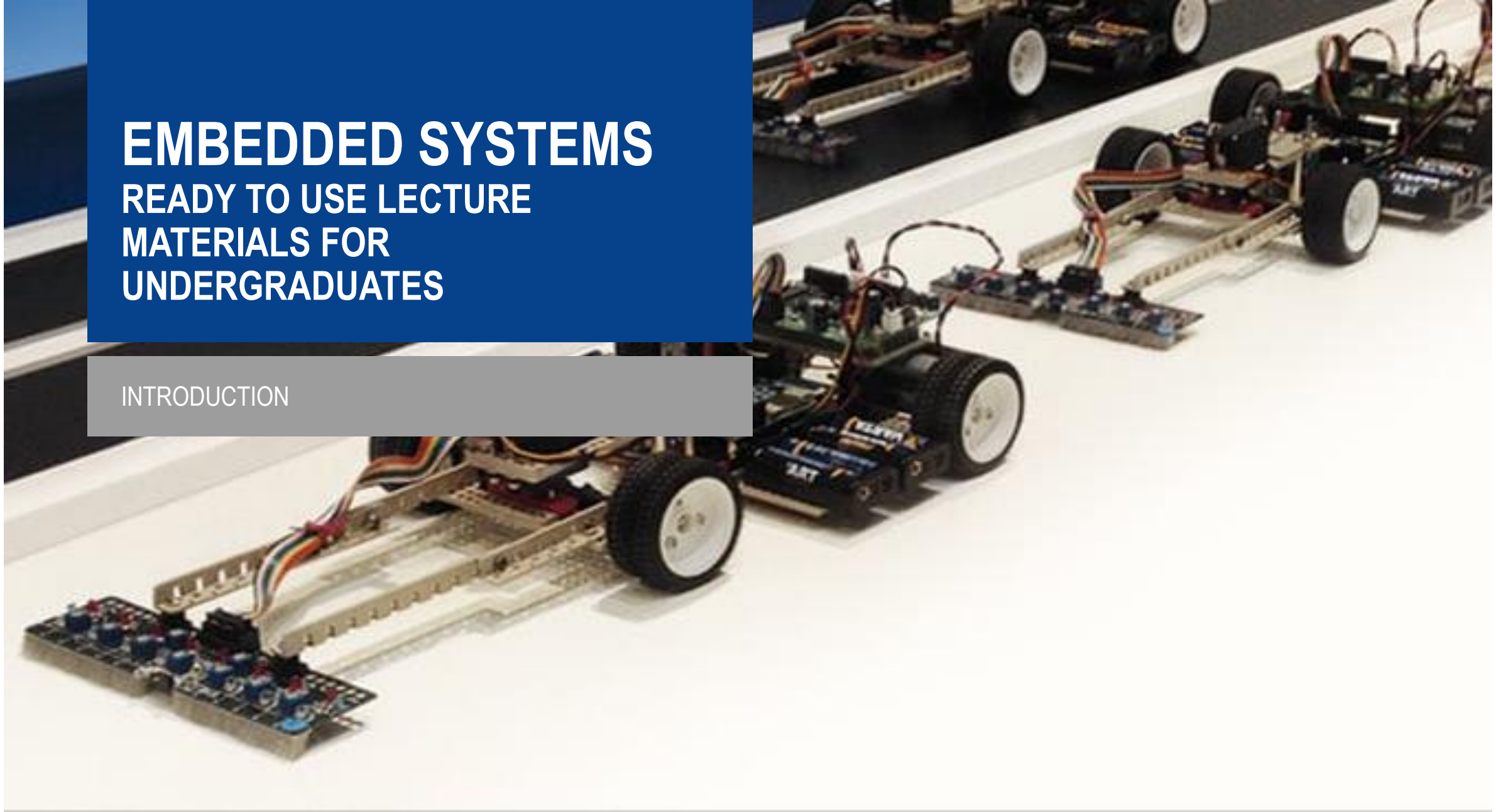
EMBEDDED SYSTEMS

READY TO USE LECTURE MATERIALS FOR UNDERGRADUATES

INTRODUCTION



12 WEEK COURSE OUTLINE (1/2)

1.) Introduction
- What are embedded systems
- Characteristics
- Sample Market Segments
- The IoT Era

2.) Computer Architecture
- RISC vs CISC

3.) ARM Cortex-M Architecture
- Block Diagram
- Registers
- Instruction set
- Memory access
- Exception handling

4.) Memory
- SRAM
- DRAM (SDRAM, DDR)
- ROM/EEPROM/Flash

5.) Timer and GPIO
- Timer
- PWM
- GPIO
- Simple drivers (e.g LED, Relay)
- Power drivers (motors)

6.) Interrupt Controller

(Based on Cortex-M4 and the Renesas Synergy Platform)

12 WEEK COURSE OUTLINE (2/2)

7.) Analog Interfacing
- ADC / DAC

8.) Serial Communication
- UART
- SPI
- I2C

9.) CAN
- Physical interface
- Stack

10.) USB
- Physical interface
- Stack

11.) Ethernet
- Physical interface
- Stack

12.) Software Development
- Software Process
- UML Class Diagram
- UML State Machine Diagram

13.) Concurrent Programming
- Tasks / Context Switching, Scheduling
- Semaphores, Signals / Messages
- Common problems to avoid: deadlock, priority inversion

14.) RTOS
- Thread Management
- Inter-thread communication and synchronization
- Timing Services
- Memory Management

(Based on Cortex-M4 and the Renesas Synergy Platform)

LIST OF LABS – BASED ON SK-S7G2

Lab1 – Synergy Installation – try demo program on the S7G2 board

Lab2 – Sample C program – means to access hardware peripherals; memory organization of a C program

Lab3 – Assembly Programming ATPCS – access from C a function written in assembly

Lab4 – Peripheral Sample device driver

Lab5 – Serial Communication

Lab6 – Display and Touch

Lab7 – RTOS

Lab8 – USB Device

Lab9 – IoT

DISCLAIMER

This course material was developed to contribute to the several forms of training in the area of Embedded Systems, but particularly with undergraduate courses such as Electrical Engineering, Computer Engineering and Computer Science.

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OVERVIEW AND PREREQUISITES

This Embedded Systems course is organized into theory and practice parts. There are 12 theory sections and 9 labs. The labs solutions can be made available to instructors. All labs are conceived to be developed on the Renesas SK-S7G2 board, based on an ARM Cortex-M4F MCU.

The course assumes that the students have previous knowledge on:

- C programming for embedded systems
- Microcontrollers and assembly programming (on an architecture other than ARM)
- Digital Systems
- Digital communications and networks