|  | Ahsanullah University of Science and Technology Bangladesh |
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COURSE OUTLINE

1. **Title**: **Microcontroller Based System Design**
2. **Code**: **CSE 3215**
3. **Credit hours**: **3**
4. **Level**: **Level 3, Term 2**
5. **Faculty**: **Engineering**
6. **Department**: **Computer Science and Engineering (CSE)**
7. **Programme**: **Bachelor of Science in Computer Science and Engineering (B.Sc. in CSE)**
8. **Synopsis from the Approved Curriculum**:

**Programmable ports and handshaking I/O, Interfacing alphanumeric and power devices, Analog interfacing techniques, Induction and stepper motors, Interfacing with stepper motors, Controlling semiconductor power switches – BJT, MOSFET, SCR and Triac, Bus organization and arbitration, Application of Opto-coupler and relays, Basic differential amplifiers, Logarithmic amplifiers, Frequency and voltage measurement using digital techniques, Data acquisition system and interfacing to microprocessor based systems, Transducers, DMA, Mass storage systems, Serial communication interface; Barcode reader; MIDI interface; Printer interface; ISA, PCI, AGP, PS/2 and USB interfaces, Embedded Processors, Embedded Computing Platform, Real Time Embedded Systems, Embedded Systems Programming, Mapping between languages and hardware, Embedded Communication Systems, Embedded Computer Security.**

1. **Type of course (core/elective)**: **Core**
2. **Prerequisite(s) (if any)**: **CSE3107 (Microprocessors)**
3. **Name of the instructor(s) with contact details and office hours**: **Farzad Ahmed**

**E-mail:** [**farzad.cse@aust.edu**](mailto:farzad.cse@aust.edu)

1. **Semester Offered**: **Spring 2021**
2. **Mapping of Course Outcomes with Bloom’s Taxonomy and Programme Outcomes**

After successful completion of the course, the students will be expected to:

| Sl.  No. | Cos | POs | Bloom’s Taxonomy | | |
| --- | --- | --- | --- | --- | --- |
| C | A | P |
| **1** | **Comprehend the basics of embedded systems, microcontrollers and microprocessors, operational amplifiers and so on.** | **1** | **2** |  |  |
| **2** | **Analyze the process of interfacing and controlling of various external devices and sensors with microcontrollers.** | **2** | **3** |  |  |
| **3** | **Investigate and design possible solution of complex problems related to embedded system.** | **4** | **4** |  |  |

1. **Mapping of COs with Knowledge Profiles, Complex Engineering Problem Solving and Complex Engineering Activities**

| Course Outcome | Knowledge Profile | Complex Problem Solving | Complex Engineering  Activities |
| --- | --- | --- | --- |
| **CO1** | **K4** |  |  |
| **CO2** | **K4** |  |  |
| **CO3** | **K8** |  |  |

1. **Percentages of Assessment Methods**

| Method | Percentage |
| --- | --- |
| **Class Performance** | **10** |
| **Quizzes** | **30** |
| **Final Examination** | **60** |

1. **Week wise distribution of contents and assessment methods**

| **Week** | **Topics** | **Assessment Methods** |
| --- | --- | --- |
| 1 | **Embedded systems**  Common characteristics of embedded systems Microcontroller & Microprocessor  **Microcontrollers** |  |

|  | Characteristics of Microcontroller Types of Microcontroller  Bits Memory  Instruction Set Packaging  Memory Architecture |  |
| --- | --- | --- |
| 2 | **Microcontroller Manufacturers**  Popular Microcontroller Technologies or families 8051 Microcontroller  PIC Microcontroller AVR Microcontroller ARM Microcontroller  Microcontroller Applications Features of a Microcontroller |  |
| 3-4 | **8051 Architecture**  Memory Architecture Register Bank  Stack and Stack Pointer Timer and Timing Diagram Register Organization Program Status Word  Interrupts | **Quiz1** |
| 4-5 | **AVR Core Architecture** Program Counter ALU  Status Register  Stack and Stack Pointer Timer and Timing Diagram |  |
| 6 | **Operational Amplifier**  Internal Circuit of Op-Amp  Op-amp Parameter and Idealized Characteristics Ideal Op-Amp VS Typical Op Amp  Op-Amp Applications |  |
| 6-7 | **Signals**  Analog Signal Digital Signal  Analog to Digital Converter (ADC) Resolution of ADC  LSB of ADC  Digital to Analog Converter (DAC) Resolution of DAC | **Quiz2** |
| 8 | **Data Acquisition System (DAQ/DAS)**  Components  DAQ Block Diagram Transducers  Methodology of DAQ |  |

| 8-9 | **Sensors**  Sensors and Transducers Types of Transducer Characteristics of Transducers Analogue Sensors  Digital Sensors IR Sensor Sonar Sensor  Resistance Temperature Detector (RTD) Temperature Sensor (LM-35)  Light Sensor |  |
| --- | --- | --- |
| 9-10 | **Serial Communication**  Serial and Parallel Communication Types of Serial Communication Synchronous Serial Communication Asynchronous Serial Communication  Universal asynchronous receiver/transmitter (UART) Serial Peripheral Interface (SPI)  Inter Integrated Circuit Protocol (I2C) | **Quiz3** |
| 11 | **Keypad Interfacing LCD Interfacing**  **External Memory Interfacing** Interface Semiconductor Memory  Memory Address Decoding Simple NAND Gate Decoder  The 3 to 8 Line Decoder (74LS138) Programmable Decoders (PLD)  Address Decoding Methods and examples 8085 Memory Interfacing  Demultiplexing Address/Data Lines |  |
| 12-13 | **Introduction to DC Motors**  Common Parts Basic Principles  Performance Calculation Motor Specifications Nominal Voltage  No Load RPM Stall Torque Stall Current Power Rating Torque  Pulse Width Modulation  **Motor Driver Wheel Encoder Relay**  **Multi-copters** | **Quiz4** |
| 14 | **Overview** |  |

1. **References**
   1. Required (if any)
      1. **Microcontroller Principles and Applications by Ajit Pal**
      2. **The 8051 Microcontroller and Embedded systems: using Assembly and C by Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. Mckinla**
      3. ***The AVR Microcontroller and Embedded Systems Using Assembly and C: Using Arduino Uno and Atmel Studio by Sepehr Naimi, Sarmad Naimi, Muhammad Ali Mazidi (2nd ed.)***
      4. ***Microprocessor and Interfacing Programming and Hardware by Douglas V. Hall***

| **Prepared by:**  Signature:    Name: **Afsana Ahmed Munia**  Department: **CSE**  Date: | **Checked by:**  Signature:    Name: **Dr. Mohammad Shafiul Alam**  **OBE Program Coordinator, CSE**  Date: | **Approved by:**  Signature:    Name: **Professor Dr. Kazi A Kalpoma**  HOD, **CSE**  Date: |
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# Annex-1: PEO of CSE

**PEO1 - Professionalism**

Graduates will demonstrate sound professionalism in computer science and engineering or related fields.

**PEO2 – Continuous Personal Development**

Graduates will engage in life-long learning in multi-disciplinary fields for industrial and academic careers.

**PEO3 – Sustainable Development**

Graduates will promote sustainable development at local and international levels.

# Annex-2: Mapping of PEO-PO

|  | PEO1 | PEO2 | PEO3 |
| --- | --- | --- | --- |
| PO1 - Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems. | **√** |  |  |
| PO2 - Problem analysis: Identify, formulate, research and analyze complex engineering problems and reach substantiated conclusions using the principles of mathematics, the natural sciences and the engineering sciences. | **√** |  |  |
| PO3 - Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety as well as cultural, societal and environmental concerns. | **√** |  |  |
| PO4 – Investigation: Conduct investigations of complex problems, considering design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions. | **√** |  |  |
| PO5 - Modern tool usage: Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations. | **√** |  |  |
| PO6 - The engineer and society: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice. | **√** |  | **√** |
| PO7 - Environment and sustainability: Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development. | **√** |  | **√** |
| PO8 – Ethics: Apply ethical principles and commit to professional ethics, responsibilities and the norms of engineering practice. | **√** |  |  |

| PO9 - Individual work and teamwork: Function effectively as an individual and as a member or leader of diverse teams as well as in multidisciplinary settings. | **√** | **√** |  |
| --- | --- | --- | --- |
| PO10 – Communication: Communicate effectively about complex engineering activities with the engineering community and with society at large. Be able to comprehend and write effective reports, design documentation, make effective presentations and give and receive clear instructions. | **√** |  |  |
| PO11 - Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work as a member or a leader of a team to manage projects in multidisciplinary environments. | **√** |  |  |
| PO12 - Life-long learning: Recognize the need for and have the preparation and ability to engage in independent, life-long learning in the broadest context of technological change. |  | **√** |  |

**Annex-3: Blooms Taxonomy – Revised Version\***

| Level | Cognitive Domain (C) | Affective Domain (A) | Psychomotor Domain (P) |
| --- | --- | --- | --- |
| 1 | Remember | Receive | Imitate |
| 2 | Comprehend | Respond | Execute |
| 3 | Apply | Value | Perform |
| 4 | Analyze | Conceptualize Values | Adaption |
| 5 | Evaluate | Intermalize Values | Neturalize |
| 6 | Create |  |  |

\* References: Dyjur, P. (2018). Writing Course Outcomes