Department Vision

To be a dynamic contributor to the global community through the development of expertise and dissemination of advance knowledge in the field of Instrumentation and Control and to create an environment that will facilitate the growth of individuals through innovative teaching, research and involvement of industry.

Department Mission

- Toprovide high quality education, which allows the students to realize their aspiration and potential in order to encourage Professional education, and to create innovative projects to become industry-ready or pursue higher studies of their choice.
- To contribute towards the betterment of society through workshops by imparting practical skills for better employability in global arena.
- To hold ourselves to high standards of moral and ethical conduct to work on socially relevant issues of national importance.

COURSE PLAN – PART I

Name of the programme and specialization	**B. E (ICE)**		
Course Title	**EMBEDDED SYSTEMS AND IoT**		
UniversityCourse Code / NBA Code	**IC3402 / C214**	**No. of Credits**	**04**
Teaching Scheme (L: T: P)	**3 : 0 : 2**	**Total Periods required**	**75**
Course Year / Semester	**II Year / IV Semester**		
Academic Year / Semester	**2023-24/ EVEN**		
Name of Faculty	**J.SHARMILA DEVI**	**Department**	**ICE**
Email	**sharmiladeviice@avccengg.net**		
Course Type (please tick appropriately**)**	√ **Core course**		**Elective course**

COURSE OBJECTIVES

Upon completion of this course the students would be able to:

- To get familiarized with the embedded hardware architecture.
- To understand the basics of RTOS and the attributes of various communication protocols.
- To build knowledge on Embedded C programming and realize the concept of peripheral interfacing.
- To get introduced with the concept of IoT and architecture of IoT systems.
- To acquire knowledge over IoT implementation tools and the core elements of IIoT.

SYLLABUS (Anna University, Regulations 2021)

UNIT I EMBEDDED HARDWARE ARCHITECTURE 9

CISC Architecture:- Introduction to MCS51 Family - 8051 Microcontroller - Architecture - Timers - Interrupts - Serial Data Communication - RISC Architecture:- overview of PIC 16F87x family - PIC16F877A - Architecture - Timers - Interrupts - Serial ports - Introduction to ARM - LPC4088 Architecture.

UNIT II REAL TIME OPERATING SYSTEM & COMMUNICATION INTERFACES 9

Types of RTOS - Functions of RTOS - Task, Process and Threads, Interrupt handling, Multiprocessing & Multitasking and Task scheduling - Serial communication interfaces - RS232, RS485, I2C SPI and USB.

UNIT III EMBEDDED PROGRAMMING AND PERIPHERAL INTERFACING 9

Embedded C Programming for Embedded Applications - Input and output devices Interface, ADC Interface - DAC Interface - PWM Generation - sensor Interface.

UNIT IV INTRODUCTION TO INTERNET OF THINGS 9

IoT Definition and Characteristics - Physical Design of IoT - Logical Design of IoT - IoT Enabling Technologies - Levels of IoT Deployment - IoT Device Management- Domain specific IoTs.

UNIT V IoT IMPLEMENTATION TOOLS AND IIoT 9

IoT gateways - IoT analytics platforms - IoTapplication development using Raspberry Pi - Introduction to IIoT - IIoT Middleware Platforms - Industrial Internet Security.

TOTAL: 45PERIODS

PRACTICAL EXERCISES:

1. Implementation of specific tasks using Embedded C/Python programming
2. Interfacing input devices with 8051/PIC16F877A/LPC4088.
3. Interfacing ADC & DAC with 8051 microcontroller.
4. PWM generation using PIC16F877A/LPC4088.
5. Interfacing input and output devices with Raspberry Pi using Python.
6. IoT enabled field sensing using Raspberry Pi.

TOTAL: 30 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5

1. Interpretation of Embedded systems architecture.
2. Familiarization of any one relevant software tool (MATLAB/ SCILAB/ LABVIEW/ Proteus/ Equivalent open source software).
3. Design and verification of embedded systems and rtos applications in any of the software.
4. Realization of embedded and rtos in hardware.
5. Able to gather and process data from IOT devices, and perform data analysis and prediction.

TEXT BOOKS:

1. Rajkamal, 'Embedded system-Architecture, Programming, Design', TataMcgraw Hill, 2011.
2. Peckol, "Embedded System Design", John Wiley,2010.
3. Industrial IoT Challenges, Design Principles, Applications, and Security by Ismail Butun(editor)
4. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)

REFERENCES:

1. Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2006.
2. Han-Way Huang, "Embedded system Design using C8051", Cengage Learning,2009.
3. Rajib Mall "Real-Time systems Theory and Practice" Pearson Education, 2007.
4. Shibu.k.v, "Introduction to Embedded Systems", TataMcgraw Hill, 2009
5. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat , Industrial Internet of Things: Cybermanufacturing Systems, Springer, 2017

Web References: WR1

List of Open Source Software/ Learning website:

WR1 :https://nptel.ac.in/courses

PROGRAM SPECIFIC OBJECTIVES (PSOs)

Bachelor of Instrumentation and Control Engineering curriculum is designed to prepare the graduates having attitude and knowledge to

PSO1: Have successful technical and professional careers in their chosen fields such as Process Control, Electronics & Information Technology.

PSO2: Engross in life long process of learning to keep themselves abreast of new developments in the field of Electronics & Instrumentation.

PSO3: To promote students to work collaboratively on multi-disciplinary projects and make them engage throughout their professional life.

Course Outcome –After the successful completion of the course, the students are able to,

Course	Course Outcome Statement
C214.1	Understand the concept of embedded system and its architectural features.
C214.2	Develop embedded software using Embedded C and Python.
C214.3	Integrate/Interface real world field devices with microcontrollers.
C214.4	Utilize the power of RTOS for embedded applications.
C214.5	Acquire real world signals and perform remote process monitoring utilizing the concept of IoT.
C214.6	Design and implement IoT enabled embedded control strategy for a given application.

MAPPING OF COs with Pos/PSOs

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C214.1	2	2	2	1	1	1	1	1	1	1	1	2	2	2	1
C214.2	3	3	3	1	1	1	1	1	1	1	1	1	2	2	1
C214.3	3	3	3	1	1	1	1	1	1	1	1	1	2	2	1
C214.4	3	3	3	1	1	1	1	1	1	1	1	1	2	2	1
C214.5	3	2	2	1	1	1	1	1	1	1	1	1	2	2	1
C214.6	3	3	3	1	1	1	1	1	1	1	1	1	2	2	1
	2.83	2.6	2.6	1	1	1	1	1	1	1	1	1	2	2	1

Correlation levels - Low:1 Medium:2 High:3"-": no correlation

TEACHING METHODS

Conventional: Chalk and Talk	**Collaborative Learning: Problem analysis, Coding**
Technology Enabled: Video Lectures, LCD Presentation, MOOCs	**Participative Learning : Group Presentation, Inplant Training**

UNIT-WISE LESSON PLAN

UNIT I - EMBEDDED HARDWARE ARCHITECTURE

COs COVERED: CO1

TOPICS & SUB TOPICS	PAGE NO	REF BOOK NO	PERIODS REQ/.	PO/PSO	Teaching Methods
CISC Architecture:- Introduction to MCS51 Family	38	R2	1	PO2,PO3/ PSO1,PSO3	Conventional
8051 Microcontroller - Architecture	39	R2	1	PO2.PO3/ PSO1,PSO3	Conventional
Timers – Interrupts - Serial Data Communication	52,223	R2	2	PO2, PO3/ PSO3	Conventional
RISC Architecture:- overview of PIC 16F87x family	-	WR1	1	PO2,PO3/ PSO3	Technology Enabled
PIC16F877A - Architecture	-	WR1	1	PO2,PO3/ PS01	Conventional
Timers - Interrupts - Serial ports	-	WR1	1	PO2, PO3/ PSO3	Technology Enabled
Introduction to ARM - LPC4088 Architecture.	84,124	T1	2	PO2.PO3/ PSO1,PSO3	Technology Enabled
					Total Periods Required: 09

UNIT IIREAL TIME OPERATING SYSTEM & COMMUNICATION INTERFACES

COs COVERED: CO2

TOPICS & SUB TOPICS	PAGE NO	REF BOOK NO	PERIODS REQ/.	PO/PSO	Teaching Methods
Types of RTOS - Functions of RTOS	1-22	R3	1	PO2, PO9, PO3/ PSO3	Conventional& Technology Enabled
Task, Process and Threads,	22-27	R3	1	PO2,PO12/ PSO1, PSO3	
Interrupt handling,	85-105,125	R3	1	PO2/ PSO1	
Multiprocessing & Multitasking and Task scheduling	112,40	R3	1	PO9, PO12/ PSO3	
Serial communication interfaces - RS232,	150	T1	1	PO9, PO12/ PSO3	
RS485, I2C	-	WR1	2	PO9, PO12/ PSO3	
SPI and USB	156	T1	2	PO9, PO12/ PSO3	
					Total Periods Required: 09

UNIT III EMBEDDED PROGRAMMING AND PERIPHERAL INTERFACING

COs COVERED: CO3 & CO4

TOPICS & SUB TOPICS	PAGE NO	REF BOOK NO	PERIODS REQ/.	CO	PO/PSO	Teaching Methods
Embedded C Programming for Embedded Applications -	178-218	R2	2	CO4	PO9, PO12/ PSO3	Conventional &Technology Enabled
Input and output devices Interface,	248	R2	2	CO3	PO9, PO12/ PSO3	
ADC Interface - DAC Interface -	374-395	R2	2	CO3	PO3,PO4/ PSO1	
PWM Generation	-	WRI	1	CO3	PO2, PO3/ PSO3	
Sensor Interface.	401-410	R2	2	CO4	PO12/ PSO3	
Total Periods Required: 09						

UNIT IV INTRODUCTION TO INTERNET OF THINGS

COs COVERED: CO5

TOPICS & SUB TOPICS	PAGE NO	REF BOOK NO	PERIODS REQ/.	PO/PSO	Teaching Methods
IoT Definition and Characteristics -	1-12	T4	2	PO2, PO9, / PSO1,PSO2	Conventionaland Technology Enabled
Physical Design of IoT - Logical Design of IoT -	-	WR1	2	PO9,PO12/ PSO3	
IoT Enabling Technologies -	15-36,125	T4	2	PO9/ PSO3	
Levels of IoT Deployment -	-	WR1	1	PO12/ PSO1,PSO3	
IoT Device Management-	241	T4	1	PO9, PO12/ PSO2,PSO3	
Domain specific IoTs.	127	T4	1	PO9, PO12/ PSO3	
Total Periods Required: 09					

UNIT VIoT IMPLEMENTATION TOOLS AND IIoT

COs COVERED: CO6

TOPICS & SUB TOPICS	PAGE NO	REF BOOK NO	PERIODS REQ/.	PO/PSO	Teaching Methods
IoT gateways	104	T4	1	PO9,PO12/ PSO3	Conventional, Participative Learning&Technology Enabled
IoT analytics platforms	140	T4	2	PO9,PO12/ PSO2,PSO3	
IoTapplication development using Raspberry Pi	144	T4	1	PO9,PO12/ PSO3	
Introduction to IIoT	3,57	T3	1	PO9/ PSO3	
IIoT Middleware Platforms	324	T4	1	PO9/ PSO3	
Industrial Internet Security	204	T3	1	PO9/ PSO2,PSO3	

Total Periods Required: 09

PRACTICAL LESSON PLAN

S. No.	Name of the Experiment	No. of. Periods	Lab manual	Page No.	PO/PSO	CO
1.	Implementation of specific tasks using Embedded C/Python programming	5	1	1	PO2,PO9, PO12, / PSO3	CO3, CO4
2.	Interfacing input devices with 8051/PIC16F877A/LPC4088	5	1	4,6	PO2,PO3, PO9, / PSO1,PSO2	CO1
3.	Interfacing ADC & DAC with 8051 microcontroller.	5	1	8,10	PO2,PO3, PO9, / PSO1,PSO2	CO1
4.	PWM generation using PIC16F877A/LPC4088.	5	1	12,14	PO2,PO9, PO12/ PSO1,PSO2	CO1, CO2
5.	Interfacing input and output devices with Raspberry Pi using Python.	5	1	16,19, 22,25	PO2,PO3, PO9, PO12/ PSO3	CO5
6.	IoT enabled field sensing using Raspberry Pi.	5	1	28,31, 34,37	PO2, PO3,PO9, PO12/ PSO3	CO6

CONSOLIDATED PLAN FOR THEORY AND PRACTICAL

For Theory		
S. No.	**Units**	**No. of periods**
1	Unit - I	9
2	Unit - II	9
3	Unit - III	9
4	Unit - IV	9
5	Unit - V	9
For Lab		
1	Exp.No.1	5
2	Exp.No.2	5
3	Exp.No.3	5
4	Exp.No.4	5
5	Exp.No.5	5
6	Exp.No.6	5
Total no. of periods		**75**

COURSE PLAN – PART II

COURSE ASSESSMENT METHODS

Internal Assessment (IA) Methods:

- Class Test (CT) and MCQ/Case study- For Theory (Two Cycles)
- Continuous Internal Assessment (CIA) - For Theory (Two Cycles)
- End Semester University Examinations (UE)

Theory:

S.No	Assessment Component	Portion	Pattern	Marks	Weightage
1.	Unit Test	1 Unit	Part A- 2 X 5 =10 Marks Part B-10 X 1 =10 Marks	20	40
2.	Assignment	-	Creative Assignment	20	
3	CIA test	2.5 Units	Part A- 10 X 2 = 20 Marks Part B- 5X 13 = 60 Marks Part C- 1X15 = 15 Marks	100	60

For Theory with Lab Component: Internal (50) + External (50)
Internal – 50 Marks

Assessment I (40% Weightage) Theory Component		Assessment II (60% Weightage) Laboratory Component				Total Internal Assessment
Individual Assignment / Case Study / Seminar / Mini Project	Written Test	Evaluation of Laboratory, Observation, Record			CIA Test 2 100	
		Lab work 65	Record 10	Model 25		
40	60	100 converted to 75			25	*50

*50 - Total 200 - Weighted average will be converted to 50

External: End Semester University Examinations – 50 Marks

S. No	Mode of Assessment	Duration	% Weightage
1.	Theory	3 Hours	35
2.	LAB	3 Hours	15

CURRICULAR GAPS

In order to achieve the course objectives, the following topics are planned.

S. No	Contents beyond the Syllabus	Action Plan	Date	PO/PSO Mapping
1.	Interpretation of Embedded systems architecture.	SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/ Assignment/ Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc.)	I Week of February 2024	PO3,PO9/ PSO2
2.	Familiarization of any one relevant software tool (MATLAB/ SCILAB/ LABVIEW/ Proteus/ Equivalent open source software).		III Week of February 2024	PO9/ PSO3
3.	Design and verification of embedded systems and rtos applications in any of the software.		III Week of March 2024	PO2,PO3/ PSO1
4.	Realization of embedded and rtos in hardware.		IV Week of March 2024	PO12/ PSO2
5.	Able to gather and process data from IOT devices, and perform data analysis and prediction.		I Week of April 2024	PO9,12/ PSO3

12/1/2024

Signature of the Faculty
(J. Sharmila Devi)

12/1/24

HoD
(Dr. S. Vadivazhagi)

Dean (Academics)
(Dr. G. Pradeep)

Principal
(Dr. C. Sundar Raj)

After the end of the course, the course shall be assessed by Google Forms / forms based on the course outcomes described.

COURSE EXIT SURVEY

To be collected from the Students and Analyze the CO Attainment by the Subject Faculty

Number of Students : 7/11

CO Attained Level :

(in %)	CO1	CO2	CO3	CO4	CO5	CO6
Strongly Agree	85.7	85.7	100	85.7	85.7	85.7
Agree	—	14.3	—	14.3	—	14.3
Partially Agree	14.3	—	—	—	14.3	—
Disagree	—	—	—	—	—	—

16/7/24

Faculty Member
(J. Sharmila Devi)

16/7/24

Remarks of the HoD & Sign
(Dr. S. Vadivazhagi)

Principal
(Dr. C. Sundar Raj)