PG DEPARTMENT OF COMPUTER SCIENCE				*CLASS: I M.Sc.* Computer Science				
Sem	**Course Type**	**Course Code**	**Course Title**	**Credits**	**Contact Hours/week**	**CIA**	**Ext**	**Total**
I	Elective - 1	21P1DME1(B)	Embedded Systems	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives

1. To provide experience to integrate hardware and software for microcontroller applications systems.
2. To acquire knowledge about Device Drivers and Interrupts programming concepts, and their applications.
3. To acquire knowledge about microcontroller embedded processors and Software Practices.
4. To enhance the knowledge about the Inter process communication and Real Time Operating Systems.
5. Foster ability to understand the internal architecture and interfacing of different peripheral devices with Microcontrollers.

Unit	Content	Hrs	K-Level	CLO
I	**Introduction to embedded systems:** An Embedded System- Processor In The System—Other Hardware Units- Software Embedded Into A System – Embedded System On Chip (Soc) And In VLSI Circuit. **Processor and memory organisation:** Structural Unit In A Processor- Processor Selection For An Embedded System – Memory Devices- Memory Selection for An Embedded System- Allocation Of Memory To Program Segments And Blocks And Memory Map Of A System- Direct Memory Access – Interfacing Processor , Memories And I/O Devices.	15	Up to K2	1
II	**Device drivers and interrupts servicing mechanism:** Device Drivers- Parallel Port Device Drivers In A System – Serial Port Device Drivers In A System- Device Drivers For Internal Programmable Timing Devices – Interrupt Servicing (Handling) Mechanism – Context And Periods For Context Switching , Deadline And Interrupt Latency. **Programming concepts and embedded programming in c and c++:** Software Programming In Assembly Language – C Program Elements: Header And Source File And Pre-Processor Directives- Program Elements: Macros And Functions – Program Elements: Data Types, Data Structures, Modifiers, Statements, Loops And Pointers – Queues- Stacks –Lists And Ordered List – Embedded Programming In C++.	15	Up to K3	2

III	**Program modelling concepts in single and multi processor systems software development process:** Modelling Processes For S/W Analysis Before S/W Implementations – Programming Models For Event Controlled Or Response Time Constrained Real Time Program – Modelling Of Multiprocessor Systems. **Software engineering practices in the embedded s/w development process:** S/W Algorithm Complexity – S/W Development Process Life Cycle and Its Models – S/W Analysis- S/W Designs – S/W Implementation – S/W Testing, Validating and Debugging.	15	Up to K3	3
IV	**Inter process communications and synchronisation of processes, tasks and threads:** Multiple Processes In An Application– Problem Of Sharing Data By Multiple Tasks And Routines – Inter Process Communications. **Real time operating systems:** Operating System Services – I/O Subsystems – Network Operating Systems- Real Time And Embedded System Operating Systems- Interrupt Routines In RTOS Environment: Handling Of Interrupt Source Call By The RTOSs – RTOS Task Scheduling Models, Interrupt Latency And Response Time Of The Tasks As Performance Metrics.	15	Up to K4	4
V	**Real time operating system programming tools:** Need of a Well Tested and debugged Real Time Operating System (RTOS). Use Of µc/Os-II **H/w and s/w co – design in an embedded system:** Embedded System Project Management – Embedded System Design And Co-Design Issues In System Development Process – Design Cycle In The Development Phase For An Embedded System – Uses Of Target System Or Its Emulator And In-Circuit Emulator (Ice) Of An Embedded System – Use Of Scopes And Logic Analyzer For System H/W Tests – Issues In Embedded System Design.	15	Up to K4	5

Book for Study

Embedded Systems Architecture Programming and Design,by Raj Kamal, Tata Mc Graw Hill Publications.

Chapters

Unit I – 1.1 – 1.6, 2.1 – 2.7
Unit II – 4.1 – 4.6, 5.1 – 5.8
Unit III – 6.1 – 6.3, 7.1 – 7.6
Unit IV – 8.1 – 8.3, 9.1 – 9.6
Unit V – 10.1, 10.2, 12.1 – 12.

Books for Reference

1. Embedded Microcomputer Systems: Real-Time Interfacing by Jonathan W. Valvano, Brookes/Cole, Pacific Grove, 2000.
2. Embedded System Design by F. Vahid & T. Givargis, Wiley.
3. Computers as Components: Principles of Embedded Computing System Design by Wolf, W., Morgan Kaufmann, San Francisco, 2001.

Web Resources

1. https://www.mepits.com/tutorial/421/vlsi/system-on-chip#
2. https://www.freertos.org/implementation/a00008.html
3. https://www.ques10.com/p/28414/explain-the-embedded-system-design-life-cycle-deve/

Rationale for Nature of the course

- Knowledge in developing Electronic gadget around us such as digital watches ,mp3 players, washing machines ,security system ,vendor machines, GPS and many more.

Activities on Knowledge and Skill

- Group Discussion
- Quiz
- Seminar

Pedagogy

Chalk and talk, Materials, PPT, Assignment, Seminar, Problem solving, Group discussion, Interaction and Demonstration.

Course Designer(s) Name

1. Mr. M. Ashok Kumar
2. Mrs. S. Saranya

Lesson Plan

UNIT	Topics to be covered	Hours	Mode
I	Introduction to embedded systems. Processor and memory organisation.	7 8	Lecture Lecture, GD
II	Device drivers and interrupts servicing mechanism. Programming concepts and embedded programming in c and C++.	7 8	Lecture Lecture, PPT
III	Program modelling concepts in single and multi processor systems software development process. Software engineering practices in the embedded s/w development process.	7 8	Lecture Lecture
IV	Inter process communications and synchronisation of processes, tasks and threads. Real time operating systems.	7 8	Lecture Lecture
V	Real time operating system programming tools. H/w and s/w co – design in an embedded system.	7 8	Lecture & Assignment

Course Learning Outcomes

On the completion of the course, the students will be able to

CLOs	COURSE LEARNING OUTCOME	K - Levels
CLO 1	Understand the Concept of Embedded System, Micro Controller, Different Components of Micro Controller and their interactions.	**Up to K2**
CLO 2	To analyze the Programming Environment to develop Embedded solutions with C and C++.	**Up to K3**
CLO 3	Get familiarized with Software Algorithm Complexity, Software Design and Software Testing, Validating, Debugging.	**Up to K3**
CLO 4	Understand the key concepts of Embedded Systems such as I/O, Timers, Interrupts and RTOS.	**Up to K4**
CLO 5	Understand the key concepts of Embedded systems with Peripheral devices.	**Up to K4**

Mapping of CLOs with POs

CLOs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	2	2	1	1	1	1
CLO 2	2	3	2	2	2	-
CLO 3	2	3	2	2	2	2
CLO 4	2	2	1	2	1	-
CLO 5	2	2	2	2	3	2

(3– Advanced Application, 2 – Intermediate Level, 1- Basic Level)

Continuous Internal Assessment (CIA): 25 Marks

Components	Marks	K Level
Test (Average of two tests) (Conducted for 40 marks and converted into 10 marks)	10	(Refer Next Table)
Assignment	5	K4
Seminar	5	K4
Quiz	5	K4
Total	25	

Learning Outcome Based Education & Assessment (LOBE)

Formative - Blue Print – Model for Embedded Systems
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

Internal	CLOs	K- Level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	**K- Level**		
CIA I	CLO 1	Up to K2	2	K1	2(K1&K1)	2(K2)
	CLO 2	Up to K3	3	K1	2(K2&K2)	1(K3)
CIA II	CLO 3	Up to K3	2	K2	2(K3&K3)	2(K3)
	CLO 4	Up to K4	3	K2	2(K4&K4)	1(K4)
Question Pattern (CIA I & II)	No. of Questions to be asked		5		4	3
	No. of Questions to be answered		5		2	2
	Marks for each question		2		5	10
	Total Marks for each section		**10**		**10**	**20**

- *CLO5 will be allotted for individual Assignment which carries five marks as part of CIA component.*

Distribution of Section-wise Marks with K Levels *

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	**Total Marks**	% of Marks without choice	Consolidated %
K1	10	10	-	**20**	33.33	**83**
K2	-	10	20	**30**	50	
K3	-	-	10	**10**	16.67	**17**
K4	-	-	-	**-**	-	**-**
Total Marks	**10**	**20**	**30**	**60**	**100**	**100**

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	**Total Marks**	% of Marks without choice	Consolidated
K1	-	-	-	-	-	**17**
K2	10	-	-	**10**	16.67	
K3	-	10	20	**30**	50	**50**
K4	-	10	10	**20**	33.33	**33**
Total Marks	**10**	**20**	**30**	**60**	**100**	**100**

Learning Outcome Based Education & Assessment (LOBE)

Summative - Blue Print – Model for Embedded Systems
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

UNITS	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No of Questions	K - Level	No of Questions	K – Level		
1	CLO1	Up to K2	2	K1& K1	1	K1	2(K1&K1)	1(K2)
2	CLO2	Up to K3	2	K2 & K3	1	K1	2(K2&K2)	1(K3)
3	CLO3	Up to K3	2	K2 & K3	1	K2	2(K3&K3)	1(K3)
4	CLO4	Up to K4	2	K3 & K4	1	K2	2(K4&K4)	1(K4)
5	CLO5	Up to K4	2	K3 & K4	1	K3	2(K4&K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

- K1 – Remembering and recalling facts with specific answers
- K2 – Basic understanding of facts and stating main ideas with general answers
- K3 – Application oriented – Solving Problems
- K4 – Examining, analyzing, presentation and make inferences with evidences

Distribution of Section – wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total Marks	% of Marks without choice	Consolidated
K1	2	4	10	-	**16**	13.33	**13%**
K2	2	4	10	10	**26**	21.67	**22%**
K3	4	2	10	20	**36**	30.00	**30%**
K4	2	-	20	20	**42**	35	**35%**
Total Marks	10	10	50	50	**120**	100	**100%**