

**CURRICULUM FOR
ADVANCE DIPLOMA IN EMBEDDED SYSTEMS (ES)
*SCHEME : C***

DURATION: ONE YEAR

PATTERN: SEMESTER

TYPE: PART TIME

**ELIGIBILITY: Diploma (Electronics / Computer / Mechanical / Electrical Streams), B.Sc. (Physics / IT / Comp Sc. Streams)
OR Higher.**

(To be implemented from the Academic Year 2008 – 2009)



**MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION. MUMBAI
(AUTONOMOUS)**

ISO 9001-2001 Certified

49, Kherwadi, Aliyawer Jung Marg, Mumbai – 400 051

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI																	
TEACHING AND EXAMINATION SCHEME FOR ADVANCE DIPLOMA COURSES.																	
COURSE NAME : ADVANCE DIPLOMA IN EMBEDDED SYSTEMS																	
COURSE CODE : ES																	
DURATION OF COURSE : ONE YEAR / TWO SEMESTER									WITH EFFECT FROM 2008-2009								
YEAR / SEMESTER : FIRST									DURATION : 16 WEEKS								
FULL TIME / PART TIME : PART TIME									SCHEME : C								
SR. NO.	SUBJECT TITLE	SUBJECT CODE	TEACHING SCHEME			EXAMINATION SCHEME											
			TH	TU	PR	PAPER HRS	TH		TEST	TOTAL		PR		OR		TW	
							Max	Min		Max	Min	Max	Min	Max	Min		
1	Embedded 'C' For Microcontroller	10371	3	--	4	3	80	36	20	100	50	50#	25	--	--	50@	25
2	RISC Microcontroller (8 Bit)	10372	3	--	4	3	80	36	20	100	50	50#	25	--	--	50@	25
3	Introduction to Embedded Systems	--	1	1	--	--	--	--	--	--	--	--	--	--	--	50@	25
4	Mini Project	--	--	--	4	--	--	--	--	--	--	--	--	50@	25	50@	25
TOTAL			7	1	12	--	160	--	40	200	--	100	--	50	--	200	--

STUDENT CONTACT HOURS PER WEEK (FORMAL TEACHING) : **20 HRS.**

THEORY AND PRACTICAL PERIODS OF 60 MINUTES EACH.

TOTAL MARKS: **550**

ABBREVIATIONS : TH - THEORY, TU - TUTORIAL, PR - PRACTICALS, OR - ORAL, TW - TERM WORK, # - EXTERNAL, @ - INTERNAL

Assessment of practical, oral and term work are to be done as per the prevailing norms for curriculum implementation and assessment.

Note:- Considering the architectural differences in 8051 & 8 bit RISC Microcontroller it is necessary to complete Embedded 'C' for Microcontroller subject before starting & Risk Microcontroller (8 Bit)

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI																	
TEACHING AND EXAMINATION SCHEME FOR ADVANCE DIPLOMA COURSES.																	
COURSE NAME : ADVANCE DIPLOMA IN EMBEDDED SYSTEMS																	
COURSE CODE : ES																	
DURATION OF COURSE : ONE YEAR / TWO SEMESTER									WITH EFFECT FROM 2008-2009								
YEAR / SEMESTER : SECOND									DURATION : 16 WEEKS								
FULL TIME / PART TIME : PART TIME									SCHEME : C								
SR. NO.	SUBJECT TITLE	SUBJECT CODE	TEACHING SCHEME			EXAMINATION SCHEME											
			TH	TU	PR	PAPER HRS	TH		TEST	TOTAL		PR		OR		TW	
							Max	Min		Max	Min	Max	Min	Max	Min		
1	PC Communication Interfaces	10373	3	--	2	3	80	36	20	100	--	--	--	--	--	50@	25
2	RISC Microcontroller (32 Bit)	10374	3	--	4	3	80	36	20	100	--	50#	25	--	--	50@	25
3	Introduction to Real Time Operating Systems	--	1	1	--	--	--	--	--	--	--	--	--	--	--	50@	25
4	Industrial Project	--	--	1	6	--	--	--	--	--	--	--	--	50#	25	50@	25
TOTAL			7	2	12	--	160	--	40	200	--	50	--	50	--	200	--

STUDENT CONTACT HOURS PER WEEK (FORMAL TEACHING) : **21 HRS.**

THEORY AND PRACTICAL PERIODS OF 60 MINUTES EACH.

TOTAL MARKS: **500**

ABBREVIATIONS : TH - THEORY, TU - TUTORIAL, PR - PRACTICALS, OR - ORAL, TW -TERM WORK, # - EXTERNAL, @ - INTERNAL

Assessment of practical, oral and term work are to be done as per the prevailing norms for curriculum implementation and assessment.

Advance Diploma in Embedded Systems

Admission Criteria:

Diploma (Electronics / Computer / Mechanical / Electrical Streams), B.Sc. (Physics / IT / Comp Sc. Streams) OR Higher.

Staff Qualification:

Lecturer: BE (Electronics/Computer stream) / M.Sc. (IT / Comp Sc), B.Sc. (IT / Comp Sc) Preferably with any supporting course/ Training in Embedded Systems.

List of Equipment: Batch of 20 Students

1. Computer Systems P4 with minimum 512 mb RAM, 40/80 gb HDD, CDROM, KB, Mouse, Network Interface (onboard / external) ----- 10 nos minimum
2. Switch/ Hub to connect all Computer systems in LAN
3. 8051 Microcontroller Trainer Kits: minimum 6 nos.
4. PIC Microcontroller Trainer Kits: minimum 6 nos
5. ARM Microcontroller Trainer Kits: minimum 6 nos
6. Separate Interface Boards (if not available on the Kit)
 - LED Matrix
 - Switches / Push Buttons
 - Keyboard Matrix
 - Relays
 - LCD (Single line / Two lines)
 - Stepper Motor
 - External Memory
 - PC Keyboard
 - ADC / DAC
7. Universal Programmer: 1 nos.
8. Serial Communication cables: minimum 6 nos
9. Multimeters / Oscilloscopes / Probes & Connectors.
10. Power Supply (Short circuit protected)

List of Software:

1. MS Windows XP or Higher
2. MS Office
3. Antivirus program
4. Turbo 'C' / Borland 'C'
5. Keil Compiler (for 8051 & ARM Microcontrollers)
6. MPLAB IDE for PIC Microcontroller
7. Visual Basic 6.0

Audio Visual:

1. LCD Projector.

Course Name : Advance Diploma In Embedded Systems

Course Code : ES

Semester : First

Subject Title : Embedded 'C' for Microcontrollers

Subject Code : 10371

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme						
TH	TU	PR	PAPER HRS	TH	TEST	PR	OR	TW	TOTAL
3	--	4	3	80	20	50#	--	50@	200

Rationale:

Students are expected to have prior knowledge of 'C' Programming and 8051 Assembly Language Programming as these subjects are covered in the qualifying courses. Since now a days embedded systems programming is done in higher level language like 'C' it is necessary for students to be ready for the same. The concepts of embedded 'C' are covered with reference to 8051 Microcontroller with which the students are already familiar and hence can grasp the concepts easily. Keil compiler is one of the popular cross compiler used in the industry. Knowledge of Keil would definitely be beneficial.

Objectives:

The student will be able to:

1. Work with Integrated development Environment like Keil IDE.
2. Write 8051 Microcontroller Programs in 'C'.
3. Understand process, tools and advantages of writing programs in 'C' vs in Assembly.

Contents: Theory

Chapter	Name of the Topic	Hours	Marks
01	8051 Microcontroller 1.1 Architecture 1.2 Timers/Counters 1.3 Interrupts 1.4 Serial Communication	04	10
02	'C' Programming 2.1 Constants, Variables, Data types, Operators and Expressions 2.2 Input/Output, Branching and Looping 2.3 Arrays and Strings 2.4 Functions 2.5 Structures and Unions 2.6 Pointers	06	10
03	Exploring IDE (Keil or Equivalent) 3.1 Memory configurations 3.2 Local Memory Model specifications 3.3 Developing an Application using IDE	04	06
04	Introduction to C Programming for Microcontroller 4.1 Basic C Program Structure 4.2 Differences from ANSI C 4.3 In-System Programming Technologies and Methods	04	02
05	Programming Microcontroller using 'C' – Part I 5.1 I/O Ports 5.2 Interrupts 5.3 Timer / Counter 5.4 Serial Communication	14	30
06	Programming Microcontroller using 'C' – Part II 6.1 Using Functions 6.2 Embedding Assembly Language Statements in 'C' Programs 6.3 LCD Interfacing	06	10
07	Advanced Concepts in Embedded 'C' 7.1 Using Pointers, Structures and Unions 7.2 External Memory and Dynamic Memory Allocation using malloc(), calloc(), realloc() and free()	10	12
TOTAL		48	80

List of Practical:

(Minimum 08 including 4, 5, 6, 7, 8 & 11 mandatory using 8051 Insystem Programming Kit)

- Exercises in ANSI C Programming
- Exercises in Assembly Language Programming on 8051
- Study of IDE (Keil)
- C programming for 8051 – Output Ports.
- C programming for 8051 – Input Ports.

- C programming for 8051 using Timers.
- C programming for 8051 using Counters.
- C programming for 8051 using Interrupts.
- C programming for 8051 using External Memory.
- C programming for 8051 using Serial Port.
- C Programming for 8051 – LCD & Keyboard.
- C programming for 8051 with In-Line Assembly.

Learning Resources:

Books:

Sr. No	Author	Title	Publisher
1	Kenneth Ayala	The 8051 Microcontroller	Thompson Learning
2	Mazidi	The 8051 Microcontrollers and Embedded Systems	Pearson Education Asia
3	Michel Pont	Embedded C	Pearson Education Asia
4	Mike Beach	C51 Primer	Available on Internet

Course Name : Advance Diploma In Embedded Systems

Course Code : ES

Semester : First

Subject Title : RISC Microcontroller (8 Bit)

Subject Code : 10372

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme						
TH	TU	PR	PAPER HRS	TH	TEST	PR	OR	TW	TOTAL
3	-	4	3	80	20	50#	-	50@	200

Rationale:

This subject introduces RISC Architecture based Microcontroller. PIC is again widely deployed for embedded systems development. The programming language used will be 'C' with which the student is already familiar. They will get chance to work with another IDE viz. MPLAB IDE.

Objectives:

The student will be able to:

1. Understand RISC Architecture.
2. Understand Architecture of PIC Microcontroller.
3. Use MPLAB IDE.
4. Develop programs for PIC Microcontroller.

Contents: Theory

Chapter	Name of the Topic	Hours	Marks
01	PIC Microcontroller Hardware 1.1 Architecture 1.2 Memory Organization 1.3 Interrupts 1.4 I/O Ports 1.5 Timers 1.6 Analog to Digital I/O 1.7 Assembly Language	10	20
02	Standard I/O and Preprocessor Directives 2.1 Character Input/Output Functions 2.2 Standard Output Functions 2.3 Standard Input Functions 2.4 Standard Preprocessor Directives	04	10
03	'C' Compiler and IDE 3.1 Study of CCS-PICC 'C' Compiler 3.2 Creating a Source File 3.3 Programming the Target Device 3.4 Study of IDE (MPLAB	04	04
04	PIC Programming 4.1 Interrupt Programming 4.2 Timer Programming 4.3 Serial Port Programming	12	18
05	Interfacing PIC 5.1 PC Keyboard Interfacing 5.2 ADC, DAC, and Sensor Interfacing 5.3 Using Flash and EEPROM Memories for Data Storage 5.4 Watchdog Timer and RTC 5.5 Motor Control: Relay, PWM, DC, and Stepper Motors	16	24
06	Project Development Process 6.1 Definition Phase 6.2 Design Phase 6.3 Test Definition Phase 6.4 Prototyping Phase 6.5 System Integration and Software Development Phase 6.6 System Test Phase	02	04
TOTAL		48	80

List of Practical:

(Any 08 Practicals with PIC Kit)

- Interfacing of LED, relay, Push Button
- Generating a 10 Hz Square Wave.
- Sending and Receive Data Serially to/from PC.
- Interfacing Wireless Module using ASK and FSK.

- Interfacing PC Keyboard.
- Interfacing with EEPROM using I2C BUS.
- Using a Watchdog Timer.
- Using an External RTC.
- Stepper Motor Control.
- DC Motor Control using PWM module.
- Interfacing of temperature sensor.

Learning Resources:

Books:

Sr. No	Author	Title	Publisher
1	Barnett Cox & O'Cull	Embedded C Programming and the Microchip PIC	Thomson Delmar Learning
2	John B Peatman	Design with PIC Microcontroller	Pearson Education
3	Myke Predko	Programming and Customizing PIC Microcontroller	Tata McGraw-Hill
4	Gaonkar	Fundamentals of Microcontrollers and Applications in Embedded Systems	Penram
5	Dr. Ajay Deshmukh	Microcontroller Theory & Application	Tata M/c Graw Hill

Course Name : Advance Diploma In Embedded Systems

Course Code : ES

Semester : First

Subject Title : Introduction to Embedded Systems

Subject Code : --

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme						
TH	TU	PR	PAPER HRS	TH	TEST	PR	OR	TW	TOTAL
1	1	--	--	--	--	--	--	50@	50

Rationale:

This subject enables the student to know about the field of embedded systems from definition to applications to recent trends. Knowing about the widespread applications of embedded systems in every walk of our life will generate interest in the student's mind and he would also get an idea of the career scope the field offers him.

Objectives:

The student will be able to:

1. Understand the definition of Embedded system.
2. Understand what the embedded systems are made up of.
3. Understand the wide spread scope for their applications.
4. Understand the characteristics of and constraints for the embedded systems.
5. Understand the trends in embedded systems field.

Contents: Theory

Chapter	Name of the Topic	Hours
01	What is an Embedded System 1.1 Definition 1.2 Historical milestones 1.3 Application Areas in industry (Automobile, Communication, Home Appliances, Defense, Textile)	02
02	Categories of Embedded Systems 2.1 Standalone 2.2 Real Time 2.3 Networked 2.4 Mobile Devices	02
03	Architecture of Embedded Systems 3.1 Hardware Architecture 3.2 Software Architecture	06
04	Specialties of Embedded Systems 4.1 Reliability 4.2 Performance 4.3 Power consumption 4.4 Cost 4.5 Size 4.6 Limited user interfaces 4.7 Software upgradation capability	04
05	Recent Trends in Embedded Systems 5.1 Processor power 5.2 Memory 5.3 Operating Systems 5.4 Communication interfaces and networking capability 5.5 Programming languages 5.6 Development tools 5.7 Programmable Hardware	02
TOTAL		16

Note:- Minimum 8 Assignments on above topics.

Learning Resources:**Books:**

Sr. No	Author	Title	Publisher
1	Dr. K.V.K.K.Prasad	Embedded/ Real-Time Systems: Concepts, Design & Programming	Dreamtech Press, New Delhi
2	Mr. Gaonkar	Fundamentals of Microcontrollers and Application in Embedded Systems	Penram

Course Name : Advance Diploma in Embedded Systems

Course Code : ES

Semester : First

Subject Title : Mini Project

Subject Code : --

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme						
TH	TU	PR	PAPER HRS	TH	TEST	PR	OR	TW	TOTAL
-	-	4	-	-	-	-	50#	50@	100

Rationale:

This subject enables the students to co-relate the Embedded System's architectural & Software knowledge.

Objectives:

The student will be able to apply knowledge acquired for the development of Hardware & Software based applications of microcontroller.

Guidelines for Mini Project:

1. Should be based on either 8051 Microcontroller or PIC Microcontroller.
2. It should have following Interfaces.
 - a. Input (Keyboard / Sensor)
 - b. Output (LED / LCD / Motor / Relays)
 - c. Communication Interface (Serial / I2C)
3. Institutes must have ready interfaced hardware and Students are expected to carry out required software programming to provide the necessary functionality.

Course Name : PC Communication Interfaces

Course Code : ES

Semester : Second

Subject Title : PC Communication Interfaces

Subject Code : 10373

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme						
TH	TU	PR	PAPER HRS	TH	TEST	PR	OR	TW	TOTAL
3	--	2	3	80	20	--	--	50@	150

Rationale:

Microcontrollers are required to communicate with outside world through various communication interfaces. Also communication between Microcontroller and the front end application sitting on PC is very common. Visual Basic is widely used for developing front end applications. Also students do learn VB application development during their qualifying courses. This subject introduces them with VB tools available for communication between PC and Microcontroller.

Objectives:

The student will be able to:

1. Understand various communication interface standards.
2. Use Hyper Terminal Utility for serial communication to/from PC.
3. Use VB to setup communication between PC and Microcontroller.
4. Handle communication from Microcontroller side.
5. Understand Communication BUS and Protocols commonly used in Industry.

Contents: Theory

Chapter	Name of the Topic	Hours	Marks
01	Serial Communication 1.1 RS232 Standard 1.2 UART 1.3 Serial Communication Support in VB	06	10
02	Parallel Port 2.1 Centronix Interface 2.2 Parallel Port Communication Support in VB	06	10
03	USB 3.1 USB Standards 3.2 USB Support in VB	06	10
04	Ethernet 4.1 Ethernet Standard 4.2 Ethernet Frame Types and Frame Formats 4.2 Ethernet Support in VB	06	12
05	Wireless Communication 5.1 Infrared 5.2 802.11 5.3 Bluetooth	04	08
06	Communication BUS 6.1 RS422/RS485 6.2 MODBUS 6.3 CAN	08	10
07	Communication Protocols – TCP/IP 7.1 TCP/IP Stack 7.2 Data Encapsulation 7.3 IP Addressing 7.4 TCP/IP Support in Microcontrollers 7.5 TCP/IP Support in VB	12	20
TOTAL		48	80

List of Practical:

(Completion of 3 Experiments is mandatory)

- Using Hyper terminal for Serial Communication between PC and Microcontroller.
- Using VB for Serial Communication between PC and Microcontroller.
- Using VB for USB Communication between PC and Microcontroller.
- Study of Ethernet Communication – Encapsulation at various levels using Network Packet Monitoring Utility.
- Using VB for TCP/IP Communication between PC and Microcontroller.

Note: It is proposed that ready VB Programs should provided in the from a manual. Students are expected to run these programs and understand how they work.

Learning Resources:

Books:

Sr. No	Author	Title	Publisher
1	Dr K.V.K.K.Prasad	Embedded/ Real-Time Systems: Concepts, Design & Programming (Chapter 6)	Dreamtech Press, New Delhi
2	Jan Axelson	Serial Port Complete	Penram International
3	Jan Axelson	Parallel Port Complete	Penram International
4	Jan Axelson	USB Port Complete	Penram International
5	Jan Axelson	Embedded Ethernet and Internet Complete	Penram International
6	Douglas Comer	Networking with TCP/IP Vol I, II, II	Prentice Hall (I) Pvt. Ltd.

Course Name : Advance Diploma In Embedded Systems

Course Code : ES

Semester : Second

Subject Title : RISC Microcontroller (32 Bit)

Subject Code : 10374

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme						
TH	TU	PR	PAPER HRS	TH	TEST	PR	OR	TW	TOTAL
3	--	4	3	80	20	50#	--	50@	200

Rationale:

ARM is a 32 bit RISC CPU. It is widely used for advanced embedded systems. Having knowledge of 2 eight bit microcontrollers the students will be certainly in a position to understand 32 bit Microcontroller and it would be beneficial to them.

Objectives:

The student will be able to:

1. Understand 32 bit ARM Microcontroller Architecture.
2. Write simple programs in 'C' for ARM Microcontroller.
3. Get overview of GNU ARM Linux Tool Chain.

Contents: Theory

Chapter	Name of the Topic	Hours	Marks
01	Introduction to 32 Bit RISC Processor (ARM) 1.1 Advantage of 32 Bit Processor 1.2 Comparison of CISC and RISC 1.3 The ARM Family	04	06
02	32 Bit RISC Architecture (ARM) 2.1 The ARM Core 2.2 The ARM Register File 2.3 Memory Organization 2.4 The ARM Bus 2.5 The ARM Pipeline 2.6 Exceptions and Interrupts 2.7 Cache 2.8 MMU	08	20
03	32 Bit RISC Instruction Set (ARM / Thumb) 3.1 Data Processing Instructions 3.2 Load and Store Instructions 3.3 Control Flow Instructions 3.4 Introduction to Thumb Instruction Set	06	10
04	32 Bit RISC Assembly Language Programming (ARM) 4.1 The Assembler (Keil Assembler) 4.2 A Sample Assembly Language Program	02	04
05	Microcontroller Featuring ARM Core 5.1 Block Diagram and Functions 5.2 System Memory Map 5.3 System Control Blocks 5.4 Pin and Register Functions	12	16
06	Microcontroller Programming using 'C' 6.1 Integrated Development Environment (Keil IDE) 6.2 Techniques for higher code efficiency and faster speed 6.3 Techniques for accessing peripherals 6.4 The “startup module” 6.5 Using interrupts	12	20
07	Introduction to GNU ARM Linux Tool Chain 7.1 Tool chain Components 7.2 Compiling a 'C' Program using the Tool Chain	04	04
TOTAL		48	80

List of Practical:

(Minimum 5 Experiments)

- Study of IDE (Keil)

- Blinking LED
- Reading a Switch Bank
- Input and Output
- Interrupts – FIQ
- Interrupts – IRQ
- Interrupts – Non-Vectored
- Measurement of Frequency
- Flashing LED at 1 Hz
- Sending and Receive Data Serially to/from PC
- Stepper Motor Control

Learning Resources:

Books:

Sr. No	Author	Title	Publisher
1	Steven Furber	ARM System-on-Chip Architecture	Pearson Education
2	Sloss, Symes and Wright	ARM System Developer's Guide	Elsevier

Web Site: www.arm.com

Course Name : Advance Diploma In Embedded Systems

Course Code : ES

Semester : Second

Subject Title : Introduction to Real Time Operating Systems

Subject Code : --

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme						
TH	TU	PR	PAPER HRS	TH	TEST	PR	OR	TW	TOTAL
1	1	--	--	--	--	--	--	50@	50

Rationale:

Knowledge of Operating System concepts is essential in developing medium to large size embedded systems. Also Real Time Operating Systems are used for Time Critical Applications. This subject gives introduction to the OS and the Real Time concepts.

Objectives:

The student will be able to:

1. Understand the functionalities offered by today's operating systems.
2. Understand what is a real time OS.
3. Know features of some embedded/real time/handheld operating systems.

Contents: Theory

Chapter	Name of the Topic	Hours
01	OS Responsibilities 1.1 Interrupt Servicing 1.2 Communication and Synchronization 1.3 Memory Management 1.4 Task Management and Scheduling	06
02	Off-the-Shelf Operating Systems 2.1 Common features 2.2 Differences	02
03	Embedded Operating Systems 3.1 Embedded NT 3.2 Windows XP Embedded 3.3 Embedded Linux	02
04	What is Real Time OS 4.1 Categories of Real Time Systems 4.2 Features 4.3 Requirements	02
05	Real Time Operating Systems 5.1 QNX Neutrino 5.2 VxWorks 5.3 MicroC/OSII 5.4 RTLinux	02
06	Handheld Operating Systems 6.1 Palm OS 6.2 Symbian OS 6.3 Windows CE 6.4 Windows CE.NET	02
TOTAL		16

Note: Minimum 8 assignments on above topics

Learning Resources:**Books:**

Sr. No	Author	Title	Publisher
1	Dr K.V.K.K.Prasad	Embedded/ Real-Time Systems: Concepts, Design & Programming (Chapter 8)	Dreamtech Press, New Delhi
2	Dr. A. S. Godbole	Operating System with Case Studies in Unix, Netware, Windows NT	Tata Mc Graw Hill
3	William Stalling	Operating Systems	Prentice Hall (I) Pvt. Ltd.

Course Name : Advance Diploma in Embedded Systems

Course Code : ES

Semester : Second

Subject Title : Industrial Project

Subject Code : --

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme						
TH	TU	PR	PAPER HRS	TH	TEST	PR	OR	TW	TOTAL
-	-	6	-	-	-	-	50#	50@	100

Rationale:

This subject will enable the student to work independently on development of particular concept & its application in industry. It will help the student to exploit all the skills acquired during the course.

Objectives:

- To develop a particular concept used in actual applications of Embedded System.
- To develop the required hardware.
- To acquired the logical & programming Skills for the development of Software.
- To co-relate the acquired skills for development of a dedicated application.

Guidelines for Industrial Project:

1. It will be a group project with minimum 2 and maximum 4 students per group.
2. Project can be based on industrial application of 8051 / PIC / ARM Microcontroller.
3. Programming should be done in 'C' language.