<table>
<thead>
<tr>
<th>COURSE CODE</th>
<th>COURSE NAME</th>
<th>L-T-P-C</th>
<th>YEAR OF INTRODUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC302</td>
<td>Digital Communication</td>
<td>4-0-0-4</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** EC204 Signals and Systems, EC208 Analog Communication

**Course Objectives:**
- To understand the concept of Digital representation of analog source
- To understand the Performance comparison various pulse modulation schemes
- To discuss Inter Symbol Interference (ISI) problem in digital communication and to derive the Nyquist Criteria for zero ISI in data Transmission
- To analyse the need for introducing ISI in controlled manner
- To understand signal space representation of signal using Gram Schmidt orthonormalisation procedure
- To analyse the error probability for different modulation schemes like BPSK, BFSK, QPSK etc.
- To understand the principle of spread spectrum communication and to illustrate the concept of FHSS and DSSS
- To understand various Multiple Access Techniques

**Syllabus:** Overview of Random variables and Random process, Overall picture and relevance of digital communication, Digital Pulse modulation, Signal space concepts, Matched filter receiver, Review of Gaussian random process, Digital band pass modulation schemes, Detection of signals in Gaussian noise, Pseudo–noise sequences, Importance of synchronization, Spread spectrum communication, Diversity techniques, Multiple Access Techniques.

**Expected Outcome**
The students will be able to
- i. Illustrate the Digital representation of analog source
- ii. Compare the performance of various Digital Pulse Modulation Schemes
- iii. Apply the knowledge of ISI problems in Digital communication to derive Nyquist criteria for zero ISI
- iv. Analyse the need for introducing ISI in Digital Communication in a controlled manner
- v. Construct signal space representation of signal using Gram Schmidt orthonormalisation procedure
- vi. Compare the error probability for different digital modulation schemes like BPSK, BFSK, QPSK etc.
- vii. Describe the principle of spread spectrum communication and to illustrate the concept of FHSS and DSSS
- viii. Understand various Diversity Techniques

**Text Books:**
References:

| Course Plan |
|---|---|
| Module | Course content | Hours | End Sem. Exam Marks |
| I | Overview of Random variables and Random process: Random variables–continuous and Discrete, random process-Stationarity, Autocorrelation and power spectral density, Transmission of Random Process through LTI systems, PSD, AWGN | 3 |  |
| | Pulse Code Modulation (PCM): Pulse Modulation, Sampling process, Performance comparison of various sampling techniques Aliasing, Reconstruction, PAM, Quantization, Noise in PCM system | 3 | 15 |
| | Modifications of PCM: Delta modulation, DPCM, ADPCM, ADM, Performance comparison of various pulse modulation schemes, Line codes, PSD of various Line codes | 4 | |
| II | Transmission over baseband channel: Matched filter, Inter Symbol Interference (ISI), Nyquist Criteria for zero ISI, Ideal solution, Raised cosine spectrum, Eye Pattern | 4 | 15 |
| | Correlative Level Coding - Duobinary coding, precoding, Modified duobinary coding, Generalized Partial response signalling. | 3 | |
| **FIRST INTERNAL EXAM** | | | |
| III | Signal Space Analysis: Geometric representation of signals, Gram Schmidt orthogonization procedure. | 3 | 15 |
| | Transmission Over AWGN Channel: Conversion of the continuous AWGN channel into a vector channel, Likelihood function, Maximum Likelihood Decoding, Correlation Receiver | 4 | |
| IV | Digital Modulation Schemes: Pass band transmission model, Coherent Modulation Schemes- BPSK, QPSK, BFSK, Non-Coherent orthogonal modulation schemes, Differential Phase Shift Keying (DPSK) | 4 | 15 |
| | Detection of Binary modulation schemes in the presence of noise, BER for BPSK, QPSK, BFSK | 5 | |
| **SECOND INTERNAL EXAM** | | | |
| V | Pseudo–noise sequences: Properties of PN sequences. Generation of PN Sequences, generator polynomials, Maximal length codes and Gold Codes. | 3 | 20 |
**Importance of synchronization:** Carrier, frame and symbol/chip synchronization techniques.

**Spread spectrum communication:** Direct sequence spread spectrum with coherent binary phase shift keying, Processing gain, Probability of error, Anti-jam Characteristics, Frequency Hop spread spectrum with MFSK, Slow and Fast frequency hopping.

**Multipath channels:** classification, Coherence time, Coherence bandwidth, Statistical characterization of multi path channels, Binary signalling over a Rayleigh fading channel.

**Diversity techniques:** Diversity in time, frequency and space.

**Multiple Access Techniques:** TDMA, FDMA, CDMA and SDMA – RAKE receiver, Introduction to Multicarrier communication- OFDM

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**Question Paper Pattern (End Semester Exam)**

**Maximum Marks:** 100

**Time:** 3 hours

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 30% for theory and 70% for logical/numerical problems, derivation and proof.
### Prerequisite:

### Course Objectives:
- To give the knowledge about IC Fabrication Techniques
- To impart the skill of analysis and design of MOSFET and CMOS logic circuits.

### Syllabus:

### Expected outcome:
The students will be able to design and analyse various MOSFET and CMOS logic circuits.

### Text Books:
1. John P. Uyemura, Introduction to VLSI Circuits and Systems, Wiley India, 2006

### References:

### Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Course content</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Material Preparation- Purification, Crystal growth (CZ and FZ process), wafer preparation</td>
<td>4</td>
<td>15</td>
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<tr>
<td></td>
<td>Thermal Oxidation- Growth mechanisms, Dry and Wet oxidation, Deal Grove model.</td>
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<td></td>
<td>Diffusion- Fick's Laws, Diffusion with constant surface concentration and from a constant source, diffusion techniques.</td>
<td>3</td>
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<tr>
<td></td>
<td>Ion implantation- Technique, Range Theory, annealing.</td>
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<td></td>
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<tr>
<td>II</td>
<td>Epitaxy : Vapour phase epitaxy and molecular beam epitaxy</td>
<td>4</td>
<td>15</td>
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<tr>
<td></td>
<td>Lithography- Photo lithographic sequence, Electron Beam Lithography, Etching and metal deposition</td>
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<tr>
<td></td>
<td>Methods of isolation Circuit component fabrication: transistor, diodes, resistors, capacitors, N-well CMOS IC Fabrication Sequence</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>CMOS inverters- DC characteristics, switching characteristics, power dissipation</td>
<td>4</td>
<td>15</td>
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</table>

**FIRST INTERNAL EXAM**
<table>
<thead>
<tr>
<th></th>
<th>Layout Design rules, Stick Diagram and layout of CMOS Inverter, two input NAND and NOR gates</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
<td>MOSFET Logic Design - Pass transistor logic, Complementary pass transistor logic and transmission gate logic, realization of functions</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td><strong>SECOND INTERNAL EXAM</strong></td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>Read Only Memory - 4x4 MOS ROM Cell Arrays (OR, NOR, NAND)</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Random Access Memory – SRAM – Six transistor CMOS SRAM cell, DRAM – Three transistor and One transistor Dynamic Memory Cell</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sense amplifiers – Differential Voltage Sensing Amplifiers</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Introduction to PLDs and FPGAs, Design of PLAs.</td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>Adders - Static adder, Carry-By pass adder, Linear Carry-Select adder, Square- root carry-select adder</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Multipliers - Array multiplier</td>
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<tr>
<td></td>
<td><strong>END SEMESTER EXAM</strong></td>
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</tr>
</tbody>
</table>

**Question Paper Pattern (End Semester Exam)**

**Maximum Marks : 100**

**Time : 3 hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 70% for theory and 30% for logical/numerical problems, derivation and proof.
<table>
<thead>
<tr>
<th>COURSE CODE</th>
<th>COURSE NAME</th>
<th>L-T-P-C</th>
<th>YEAR OF INTRODUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC306</td>
<td>Antenna &amp; Wave Propagation</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** EC303 Applied Electromagnetic Theory

**Course objectives:**
- To learn the basic working of antennas.
- To study various antennas, arrays and radiation patterns of antennas.
- To understand various techniques involved in various antenna parameter measurements.
- To understand the propagation of radio waves in the atmosphere.

**Syllabus:**

**Expected outcome:**
The student will be able to know:
- The basic working of antennas.
- Various antennas, arrays and radiation patterns of antennas
- Various techniques involved in various antenna parameter measurements.
- The propagation of radio waves in the atmosphere.

**Text Books:**
2. John D. Krauss, Antennas for all Applications, 3/e, TMH.

**References:**
# Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Course content</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Basic antenna parameters - gain, directivity, beam solid angle, beam width and effective aperture calculations. Effective height - wave polarization - antenna temperature - radiation resistance - radiation efficiency - antenna field zones - principles of reciprocity. Duality of antennas.</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>II</td>
<td>Concept of retarded potential. Field, directivity and radiation resistance of a short dipole and half wave dipole. Measurement of radiation pattern, gain, directivity and impedance of antenna</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td><strong>FIRST INTERNAL EXAM</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Arrays of point sources - field of two isotropic point sources - principle of pattern multiplication - linear arrays of ‘n’ isotropic point sources. Grating lobes.</td>
<td>4</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Design of Broadside, Endfire &amp; Binomial arrays. Design of DolphChebyshev arrays.</td>
<td>4</td>
<td></td>
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<tr>
<td></td>
<td><strong>SECOND INTERNAL EXAM</strong></td>
<td></td>
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</tr>
<tr>
<td>V</td>
<td>Principle of Log periodic antenna array and Helical antenna. Antennas for mobile base station and handsets.</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Design of rectangular Patch antennas. Principle of smart antenna.</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>Radio wave propagation, Modes, structure of atmosphere, sky wave propagation, effect of earth’s magnetic field, Ionospheric abnormalities and absorption, space wave propagation, LOS distance</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Field strength of space wave, duct propagation, VHF and UHF Mobile radio propagation, tropospheric scatter propagation, fading and diversity techniques.</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>END SEMESTER EXAM</strong></td>
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</tbody>
</table>

**Question Paper Pattern (End semester exam)**

Max. Marks : 100  
Time : 3 hours

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 50% for theory and 50% for logical/numerical problems, derivation and proof.
<table>
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<tr>
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<th>YEAR OF INTRODUCTION</th>
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<tbody>
<tr>
<td>EC308</td>
<td>Embedded Systems</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

Prerequisite: EC206 Computer Organization, EC305 Microprocessors & Microcontrollers

Course objectives:
- To have a thorough understanding of the basic structure and design of an Embedded System
- To study the different ways of communicating with I/O devices and standard I/O interfaces.
- To study the basics of RTOS for Embedded systems.
- To study the programming concepts of Embedded Systems
- To study the architecture of System-on-Chip and some design examples.

Syllabus: Introduction to Embedded Systems, Embedded system design process, Serial and parallel communication standards and devices, Memory devices and device drivers, Programming concepts of embedded programming - Embedded C++ and embedded java, Real Time Operating Systems Micro C/OS-II.

Expected outcome:
The students will be able to:
  i. Understand the basics of an embedded system
  ii. Develop program for an embedded system.
  iii. Design, implement and test an embedded system.

Text Books:

References:
2. Iyer - Embedded Real time Systems, 1e, McGraw Hill Education New Delhi, 2003
<table>
<thead>
<tr>
<th>Module</th>
<th>Course content</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction to Embedded Systems– Components of embedded system hardware–Software embedded into the system – Embedded Processors - CPU architecture of ARM processor (ARM9) – CPU Bus Organization and Protocol. Design and Development life cycle model - Embedded system design process – Challenges in Embedded system design</td>
<td>4</td>
<td>15</td>
</tr>
<tr>
<td>II</td>
<td>Serial Communication Standards and Devices - UART, HDLC, SCI and SPI. Serial Bus Protocols - I2C Bus, CAN Bus and USB Bus. Parallel communication standards ISA, PCI and PCI-X Bus.</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>III</td>
<td>Memory devices and systems - memory map – DMA - I/O Devices – Interrupts - ISR – Device drivers for handling ISR – Memory Device Drivers – Device Drivers for on-board bus.</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>IV</td>
<td>Programming concepts of Embedded programming – Features of Embedded C++ and Embedded Java (basics only). Software Implementation, Testing, Validation and debugging, system-on-chip. Design Examples: Mobile phones, ATM machine, Set top box</td>
<td>6</td>
<td>15</td>
</tr>
</tbody>
</table>
Question Paper Pattern (End semester exam)

Maximum Marks: 100  Time: 3 hours

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have a maximum of four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 100% for theory.
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<th>YEAR OF INTRODUCTION</th>
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<tbody>
<tr>
<td>EC312</td>
<td>Object Oriented Programming</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

Prerequisite: NIL

Course objectives:
- To introduce the Object Oriented Programming paradigm using C++ and Java as the languages.
- To learn simple Android application development from the fundamentals.

Syllabus:
Object Oriented Programming and basics of C++, Advanced features of C++ programming such as exception handling and templates. Object oriented features of Java and their implementation. Advanced features of Java including packages, multithreading and error management. Introduction to Android application development with a case study.

Expected outcome:
The students will have:
1. A thorough understanding of the features of OOP like class construction, polymorphism and inheritance of C++ and Java.
2. An understanding of advanced features of C++ such as templates, abstract classes and virtual functions.
3. Knowledge of advanced features of Java such as multithreading, packages and error management.
4. Skills in designing android application development.
5. Skills in debugging, deploying and testing mobile applications.

Text Books:

References:
<table>
<thead>
<tr>
<th>Module</th>
<th>Course content</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Concepts of OOP – Introduction to OOP, Procedural Vs. Object Oriented Programming, Principles of OOP, Benefits and applications of OOP. Beginning with C++: Overview and Structure of C++ Program, Classes and Objects, Constructors and Destructors.</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td><strong>FIRST INTERNAL EXAM</strong></td>
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</tr>
<tr>
<td>III</td>
<td>Virtual Functions and Polymorphism – Pointers to objects, this pointer, Pointers to derived classes, Virtual functions, Virtual Constructors and Destructors. Programming with JAVA – Overview of Java Language, Classes Objects and Methods, Method Overloading and Inheritance, Overriding Methods, Final Variables and Methods. Interfaces, Packages, Multithreaded programming, Managing Errors and Exceptions.</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>IV</td>
<td><strong>SECOND INTERNAL EXAM</strong></td>
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</tr>
<tr>
<td>V</td>
<td>Introduction to Android : Setting up Development Environment, Basic Building blocks – Activities, Services, Broadcast Receivers &amp; Content providers, UI Components – Views &amp; notifications, Components for communication – Intents &amp; Intent Filters, Application Structure-Android Manifest.xml, uses-permission &amp; uses-sdk, Layouts &amp; Drawable Resources, First sample Application, Emulator-Android Virtual Device, Basic UI design, Styles &amp; Themes, Content Providers-SQLite Programming, Case study –Develop an App to demonstrate database usage.</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>VI</td>
<td><strong>END SEMESTER EXAM</strong></td>
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</table>

**Assignment:**
1. Assignment for implementing virtual base class in C++ related to some application.
2. Assignment for implementing a simple interactive applet in Java (eg: calculator)
3. A group assignment on simple android mobile app (eg: managing students’ details and rank calculation of a class).
The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 60% for theory and 40% for logical/numerical problems, derivation and proof.
<table>
<thead>
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<th>COURSE NAME</th>
<th>L-T-P-C</th>
<th>YEAR OF INTRODUCTION</th>
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</thead>
<tbody>
<tr>
<td>EC332</td>
<td>Communication Engineering Lab</td>
<td>0-0-3-1</td>
<td>2016</td>
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<tr>
<td></td>
<td>(Analog &amp; Digital)</td>
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</table>

**Prerequisite:** EC204 Analog Integrated Circuit, EC208 Analog Communication Engineering.

**Course objectives:**
- To provide experience on design, testing and analysis of few electronic circuits used in communication engineering.

**List of Experiments:**

**Cycle I (Six experiments are mandatory)**
1. AM generation using discrete components.
2. AM using multiplier IC AD534 or AD633.
3. AM detection using envelope detector.
4. IF tuned amplifier.
5. FM using 555 IC.
6. FM generation and demodulation using PLL.
7. Frequency multiplier using PLL.
8. Pre-emphasis and de-emphasis circuits.

**Cycle II (Six mandatory)**
11. Time Division Multiplexing and Demultiplexing.
12. Generation & Detection of DM/SIGMA DELTA/ ADM.
13. Generation & Detection of PAM/PWM/PPM.
14. Generation & Detection of BPSK/DPSK/DEPSK.
15. Generation & Detection of PCM.
16. 16 QPSK Modulation and Demodulation.

**Expected outcome:**
The students will be able to understand the basic concepts of circuits used in communication systems.
<table>
<thead>
<tr>
<th>COURSE CODE</th>
<th>COURSE NAME</th>
<th>L-T-P-C</th>
<th>YEAR OF INTRODUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC334</td>
<td>Microcontroller Lab</td>
<td>0-0-3-1</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** EC305 Microprocessors & Microcontrollers

**Course objectives:**
1. To understand Assembly Language/embedded C programming of Microcontroller.
2. To interface simple peripheral devices to a Microcontroller.
3. To equip student groups to design and implement simple embedded systems.

**List of Experiments:**

**PART –A (At least 6 experiments are mandatory)**

**Assembly Language Programming experiments using 8051 Trainer kit.**

1. Data transfer/exchange between specified memory locations.
2. Largest/smallest from a series.
3. Sorting (Ascending/Descending) of data.
4. Addition / subtraction / multiplication / division of 8/16 bit data.
5. Sum of a series of 8 bit data.
6. Multiplication by shift and add method.
7. Square / cube / square root of 8 bit data.
8. Matrix addition.
9. LCM and HCF of two 8 bit numbers.
10. Code conversion – Hex to Decimal/ASCII to Decimal and vice versa.

**PART –B (At least 4 experiments are mandatory)**

**Interfacing experiments using 8051 Trainer kit and interfacing modules.**

1. Time delay generation and relay interface.
2. Display (LED/Seven segments/LCD) and keyboard interface.
3. ADC interface.
4. DAC interface with wave form generation.
5. Stepper motor and DC motor interface.
6. Realization of Boolean expression through port.
7. Elevator interfacing.

**PART -C (At least 2 experiments are mandatory)**

**Programming / interfacing experiments with IDE for 8051/PIC/MSP/Arduino/Raspberry Pi based interfacing boards/sensor modules (Direct downloading of the pre-written ALP/C/Python programs can be used).**

1. Relay control
2. Distance measurement.
3. Temperature measurement / Digital Thermometer
4. Txr-Rxr interface.
5. Alphanumeric LCD display interface.
6. Simple project work including multiple interfaces.
Expected outcome:
The students will be able to:
1. Program Micro controllers.
2. Interface various peripheral devices to Micro controller.
3. Function effectively as an individual and in a team to accomplish the given task.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
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<tbody>
<tr>
<td><strong>352</strong></td>
<td>Comprehensive Examination</td>
<td>0-1-1-2</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite : Nil**

**Course Objectives**
- To assess the comprehensive knowledge gained in basic courses relevant to the branch of study
- To comprehend the questions asked and answer them with confidence.

**Assessment**

**Oral examination** – To be conducted by the college (@ three students/hour) covering all the courses up to and including V semester– 50 marks

**Written examination** - To be conducted by the Dept. on the date announced by the University– common to all students of the same branch – objective type (1 hour duration)– 50 multiple choice questions (4 choices) of 1 mark each covering the six common courses of S1&S2 and six branch specific courses listed – questions are set by the University - no negative marks – 50 marks.

*Note: Both oral and written examinations are mandatory. But separate minimum marks is not insisted for pass. If a student does not complete any of the two assessments, grade I shall be awarded and the final grade shall be given only after the completion of both the assessments. The two hours allotted for the course may be used by the students for discussion, practice and for oral assessment.*

**Expected outcome.**
- The students will be confident in discussing the fundamental aspects of any engineering problem/situation and give answers in dealing with them