CURRICULUM
for the batch 2018 – 2020

DEPARTMENT OF ELECTRONICS AND COMMUNICATION

M. TECH (DIGITAL ELECTRONICS AND COMMUNICATION)

I – IV Semester

RAMAIAH INSTITUTE OF TECHNOLOGY
(Autonomous Institute, Affiliated to VTU)
BANGALORE – 560 054
About the Institute

Ramaiah Institute of Technology (RIT) (formerly known as M. S. Ramaiah Institute of Technology) is a self-financing institution established in Bangalore in the year 1962 by the industrialist and philanthropist, Late Dr. M S Ramaiah. The institute is accredited with A grade by NAAC in 2016 and all engineering departments offering bachelor degree programs have been accredited by NBA. RIT is one of the few institutes with prescribed faculty student ratio and achieves excellent academic results. The institute was a participant of theTechnical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. All the departments have competent faculty, with 100% of them being postgraduates or doctorates. Some of the distinguished features of RIT are: State of the art laboratories, individual computing facility to all faculty members. All research departments are active with sponsored projects and more than 140 scholars are pursuing PhD. The Centre for Advanced Training and Continuing Education (CATCE), and Entrepreneurship Development Cell (EDC) have been set up on campus. RIT has a strong Placement and Training department with a committed team, a good Mentoring/Proctorial system, a fully equipped Sports department, large airconditioned library with over 1,00,000 books with subscription to more than 300 International and National Journals. The Digital Library subscribes to several online e-journals like IEEE, JET etc. RIT is a member of DELNET, and AICTE INDEST Consortium. RIT has a modern auditorium, several hi-tech conference halls and all are air-conditioned with video conferencing facilities. It has excellent hostel facilities for boys and girls. RIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association. RIT obtained Academic Autonomy for all its UG and PG programs in the year 2007. As per the National Institutional Ranking Framework, MHRD, Government of India, Ramaiah Institute of Technology has achieved 60th rank in 2018 among the top 100 engineering colleges across India.

About the Department

The Department of Electronics and Communication was started in 1975 and has grown over the years in terms of stature and infrastructure. The department has well equipped simulation and electronic laboratories and is recognized as a research center under VTU. The department currently offers a B. E. program with an intake of 120, and two M. Tech programs, one in Digital Electronics and Communication, and one in VLSI Design and Embedded Systems, with intakes of 30 and 18 respectively. The department has a Center of Excellence in Food Technologies sponsored by VGST, Government of Karnataka. The department is equipped with numerous UG and PG labs, along with R & D facilities. Past and current research sponsoring agencies include DST, VTU, VGST and AICTE with funding amount worth Rs. 1 crore. The department has modern research ambitions to develop innovative solutions and products and to pursue various research activities focused towards national development in various advanced fields such as Signal Processing, Embedded Systems, Cognitive Sensors and RF Technology, Software Development and Mobile Technology.
Vision of the Institute

To be an Institution of International Eminence, renowned for imparting quality technical education, cutting edge research and innovation to meet global socio-economic needs.

Mission of the Institute

MSRIT shall meet the global socio-economic needs through

- Imparting quality technical education by nurturing a conducive learning environment through continuous improvement and customization
- Establishing research clusters in emerging areas in collaboration with globally reputed organizations
- Establishing innovative skills development, techno-entrepreneurial activities and consultancy for socio-economic needs

Quality Policy

We at M. S. Ramaiah Institute of Technology strive to deliver comprehensive, continually enhanced, global quality technical and management education through an established Quality Management System complemented by the synergistic interaction of the stakeholders concerned.

Vision of the Department

To be, and be recognized as, an excellent Department in Electronics & Communication Engineering that provides a great learning experience and to be a part of an outstanding community with admirable environment.

Mission of the Department

To provide a student centered learning environment which emphasizes close faculty-student interaction and co-operative education.

To prepare graduates who excel in the engineering profession, qualified to pursue advanced degrees, and possess the technical knowledge, critical thinking skills, creativity, and ethical values.

To train the graduates for attaining leadership in developing and applying technology for the betterment of society and sustaining the world environment.
Program Educational Objectives (PEOs)

PEO1: Be successful practicing professionals or pursue doctoral studies in areas related to the program, contributing significantly to research and development activities

PEO2: Engage in professional development in their chosen area by adapting to new technology and career challenges

PEO3: Demonstrate professional, ethical, and social responsibilities of the engineering profession

Program Outcomes (POs)

PO1: Development of Solutions: An ability to independently carry out research/investigation and development work to solve practical problems

PO2: Technical Presentation Skills: An ability to write and present a substantial technical report/document

PO3: Analyze Complex Systems: A practical ability and theoretical knowledge to design and analyze complex electronics based and/or communication systems

PO4: Develop Novel Designs: An ability to apply their in-depth knowledge in electronics and communications domain to evaluate, analyze and synthesize existing and novel designs

PO5: Team Work and Project Management: An ability to effectively participate as a team member and develop project management skills necessary for a professional environment
CURRICULUM COURSE CREDITS DISTRIBUTION

<table>
<thead>
<tr>
<th>Semester</th>
<th>Professional Courses – Core (Theory &amp; Lab) (PC-C)</th>
<th>Professional Courses – Electives (PC-E)</th>
<th>Technical Seminar (TS)</th>
<th>Project Work/Internship (PW/IN)</th>
<th>Credits in a semester</th>
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# Scheme of Teaching M. Tech (Digital Electronics and Communication)

(Batch 2018 – 2020)

## I Semester

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Category</th>
<th>Credits</th>
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### IV SEMESTER

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### LIST OF ELECTIVES

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<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Subject</th>
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<tr>
<td>1.</td>
<td>MLCE01</td>
<td>Antenna Theory and Design</td>
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<td>MLCE02</td>
<td>Digital System Design using HDL</td>
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<td>MLCE03</td>
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<td>MLCE04</td>
<td>Advanced Signal and Image Processing</td>
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<td>MLCE05</td>
<td>MEMS and Nano Electronics</td>
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<td>6.</td>
<td>MLCE06</td>
<td>Advanced Computer Networks</td>
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<td>7.</td>
<td>MLCE07</td>
<td>Internet of Things</td>
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<td>MLCE08</td>
<td>Broadband Wireless Networks</td>
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<td>9.</td>
<td>MLCE09</td>
<td>CMOS VLSI Circuits</td>
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<td>10.</td>
<td>MLCE10</td>
<td>Communication System Design using DSP</td>
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<td>11.</td>
<td>MLCE11</td>
<td>RF and Microwave Circuit Design</td>
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<td>12.</td>
<td>MLCE12</td>
<td>Simulation, Modeling and Analysis</td>
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<td>13.</td>
<td>MLCE13</td>
<td>Software Defined Radio</td>
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<td>14.</td>
<td>MLCE14</td>
<td>Data Compression</td>
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ADVANCED ENGINEERING MATHEMATICS

Course Code: MLC11  
Prerequisites: Engineering Mathematics  
Course Coordinator: Sadashiva V Chakrasali

UNIT – I

Solving Linear Equations: Introduction, geometry of linear equations, solution sets of linear systems, Gaussian elimination, matrix notation, inverses, partitioned matrices, matrix factorization and determinants

Vector Spaces: Vector spaces and subspaces, linear independence, rank, basis and dimension, linear transformation, change of basis

UNIT – II

Eigen values and Eigen vectors: Eigen values, Eigen vectors and diagonalization, Eigen vectors and linear transformations

Orthogonality: Orthogonal vectors and subspaces, projections, orthogonal bases and Gram – Schmidt orthogonalization

UNIT – III

Orthogonality: Least Squares problems, Inner product spaces, Diagonalization of symmetric matrices, quadratic forms and SVD.

Random Variables: Discrete and continuous random variables, cumulative distribution function (CDF), probability mass function (PMF), probability density function (PDF), Conditional PMF/PDF, expected value, variance functions of a random variable, expected value of the derived random variable.

UNIT – IV

Random Variables: Multiple random variables, joint CDF/PMF/PDF, functions of multiple random variables, multiple functions of multiple random variables, independent/uncorrelated random variables, sums of random variables, moment generating functions.
**Random Processes:** Introduction to random processes, specification of random processes, $n^{th}$ order joint PDFs, independent increments, stationary increments, Mean and correlation of random processes, stationary, wide sense stationary and ergodic processes.

**UNIT – V**

**Random Processes:** Poisson counting process, Wiener process, Markov process.

**Filtering Random Processes:** Random processes as inputs to linear time invariant systems: power spectral density, Gaussian processes as inputs to LTI systems, white Gaussian noise.

**References:**

**Course Outcomes:**
1. Employ linear system and vector space concepts in signal processing and communication (POs: 1, 3, 4)
2. Use eigen values, eigen vectors, diagonalization and SVD in signal processing applications (POs: 1, 3, 4)
3. Analyze different random variables and their statistical parameters (POs: 1, 3, 4)
4. Analyze the nature of multiple random variables (POs: 1, 3, 4)
5. Classify various random processes and analyze the nature of output random process of a LTI systems (POs: 1, 3, 4)
ADVANCED DIGITAL COMMUNICATION

Course Code: MLC12
Pre requisites: Digital Communication
Course Coordinator: T. D. Senthilkumar

Credits: 3:1:0
Contact Hours: 70

UNIT – I

Optimum Receivers for AWGN Channel: Waveform and vector AWGN channels, Optimal detection and error probability for band-limited and power-limited signaling.

Digital Communication through Fading Multipath Channel: Frequency-nonselective slowly fading channel, Diversity techniques for fading multipath channel, Signaling over frequency-selective slowly fading channel.

UNIT – II

Digital Communication through Band-Limited Channels: Optimum receiver for channels with ISI and AWGN, Linear equalization – peak distortion criterion, MSE criterion, Performance of the MSE equalizer, Decision feedback equalization.

UNIT – III


UNIT – IV

Multichannel and Multicarrier Systems: Multichannel digital communications in AWGN channels, Orthogonal frequency division multiplexing – modulation and demodulation in an OFDM system, FFT algorithm implementation of an OFDM system, bit and power allocation in multicarrier modulation

UNIT – V

References:

Course Outcomes:
1. Analyze the performance of band and power limited signals in AWGN and fading channel (POs: 1, 3, 4)
2. Apply equalization techniques to minimize the effect of inter symbol interference (POs: 1, 3, 4)
3. Compare the performance of different adaptive equalization algorithms (POs: 1, 3, 4)
4. Employ multicarrier and multichannel modulation in modern wireless communication systems (POs: 1, 3, 4)
5. Analyze the performance of DSSS and FH spread spectrum systems (POs: 1, 3, 4)
Course Code: MLCL13
Prequisites: Microwaves and Digital Communication
Course Coordinator(s): Sujatha B and T. D. Senthilkumar

LIST OF EXPERIMENTS

Antennas
1. Experimental studies of radiation pattern of microstrip Yagi-Uda and dipole antennas
2. Impedance measurements of Horn/Yagi/dipole/Parabolic antennas
3. Calculate the directivity and gain of Horn antenna from the radiation pattern
4. Experimental studies of radiation pattern of microstrip patch antenna
5. (a) Measure the S-parameters of an antenna using Network Analyzer
   (b) Study the characteristics of transmission line using Network Analyzer
6. Calculate the antenna parameters of different types of antenna using Software/Simulation tool

Digital Communication
7. Analyze the performance of Quadrature Amplitude Modulation (QAM) and M-ary Phase Shift
   Keying (PSK) scheme in AWGN channel, and compare the results with theoretical results
8. Compute Bit Error Rate (BER) for different digital modulation schemes in frequency-flat and slowly
   varying fading channel
9. Bit error rate analysis of digital communication receivers with Maximal Ratio Combining (MRC)
   receive diversity in frequency-flat and slowly varying fading channel
10. Bit error rate analysis of digital communication receivers with Equal Gain Combining (EGC) receive
    diversity in frequency-flat and slowly varying fading channel
11. Simulation of Direct Sequence Spread Spectrum (DSSS) techniques
12. Conduct an experiment for (a) Measurement of numerical aperture and attenuation loss in analog
    fiber optic link (b) voice and data multiplexing using optical fiber

References:

**Course Outcomes:**

1. Plot the radiation pattern of different types of antennas (POs: 1, 3, 4, 5)
2. Determine the parameters like gain, beam width and directivity of antennas (POs: 1, 3, 4, 5)
3. Design an antenna array and find the various parameters like directivity and gain by plotting the radiation pattern using software/simulation tool. (POs: 1, 3, 4, 5)
4. Analyze the performance of the digital modulation receivers in AWGN channel (POs: 1, 3, 4, 5)
5. Analyze the performance of the digital modulation receivers in fading channel (POs: 1, 3, 4, 5)
DIGITAL SYSTEM DESIGN LABORATORY

Course Code: MLCL14
Prerequisites: Digital Electronics
Course Coordinator: Gangadhararaih S L

Credits: 0:0:1
Contact Hours: 28

LIST OF EXPERIMENTS

Using Verilog code design, simulate and synthesize the following with a suitable FPGA.

1. 8 to 3 programmable priority encoder
2. Full Adder using structural modeling
3. Flip Flops (D, SR, T, JK)
4. 3 bit arbitrary Counter, 4 bit binary up/down/up-down counter with synchronous reset, 4 bit Johnson counter, BCD counter
5. Sequential block to detect a sequence (say 11101) using appropriate FSM
6. 8 bit ripple carry adder and carry skip adder
7. 8 bit Carry Select Adder
8. 8 bit Serial, Parallel Multiplier and generate report on area and delay

Using System Verilog code, simulate the following

9. Full Subtractor using structural modeling
10. Flip Flops (D, SR, T, JK)
11. 3-bit synchronous counters, synchronous arbitrary counters
12. 4-bit asynchronous counters

References:
Course Outcomes:
1. Design and model complex combinational circuits using HDL at behavioral, structural and RTL levels. (POs: 1, 3, 4, 5)
2. Design and model complex sequential circuits using HDL at behavioral, structural and RTL levels. (POs: 1, 3, 4, 5)
3. Develop the test benches to simulate combinational and sequential circuits. (POs: 1, 3, 4, 5)
4. Learn how the language infers hardware and helps to simulate and synthesize the digital system. (POs: 1, 3, 4, 5)
5. Implement and analyze the digital systems using FPGAs with respect to speed and area. (POs: 1, 3, 4, 5)
TECHNICAL SEMINAR – I

Course Code: MLC15

Credits: 0:0:2

Prerequisites: Nil

Contact Hours: 56

LIST OF ACTIVITIES

1. Seminar: Research Methods
3. Source/Ideas for a Research Problem
4. Choosing Research Papers
5. Reading Research Papers
6. Summarizing Research Papers: Written
7. Presenting Research: Oral
8. REVIEW – I
9. Critiquing: Oral & Written
10. Detailed analysis of Block Diagrams: Written
11. Detailed Analysis of Block Diagrams: Oral
12. Proposing Technical Solutions: Written
13. Proposing Technical Solutions: Oral
14. REVIEW – II

Course Outcomes:

1. Identify a technical problem by performing a comprehensive literature survey (POs: 1, 2, 3, 4, 5)
2. Compare different solution methods presented in the literature for the technical problem identified (POs: 1, 2, 3, 4, 5)
3. Predict the impact of various software tools and methods for the identified problem (POs: 1, 2, 3, 4, 5)
4. Display initial simulation results, showing replication of existing approaches for the identified problem (POs: 1, 2, 3, 4, 5)
5. Construct a technical block diagram that shows an optimized solution for the identified problem, with respect to existing literature (POs: 1, 2, 3, 4, 5)
## EVALUATION RUBRICS

<table>
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<th>Max Marks</th>
<th>Achievement Levels</th>
<th>CO Mapping</th>
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<td>Inadequate (0 – 33%)</td>
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<td>No information about the specific technical details in the chosen area.</td>
<td>CO1, CO2</td>
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<td>Developing (34 – 66%)</td>
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<td>Some information about the area, but no clarity in internal details.</td>
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<td></td>
<td>Proficient (67 – 100%)</td>
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<td></td>
<td></td>
<td>Clear presentation of the technical details, internal working, and rationale of</td>
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<td></td>
<td></td>
<td>design choices.</td>
<td></td>
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<tr>
<td>Literature Survey</td>
<td>10</td>
<td>Very few quality sources pertinent to the chosen technical area. No recent articles</td>
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<td></td>
<td></td>
<td>used.</td>
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<tr>
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<td></td>
<td>Ample sources from recent past, but not from quality sources or with zero or very</td>
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<tr>
<td></td>
<td></td>
<td>few citations.</td>
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<tr>
<td></td>
<td></td>
<td>Ample sources from quality journals and conferences recently published, and having</td>
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<tr>
<td></td>
<td></td>
<td>abundant citations.</td>
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</tr>
<tr>
<td>Problem Statement</td>
<td>10</td>
<td>No clear problem identified in chosen area.</td>
<td>CO3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Identification of problem area, but no knowledge of underlying technical details.</td>
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<tr>
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<td>Clear identification of problem area, along with parameters having an influence on</td>
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<tr>
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<td>the performance.</td>
<td></td>
</tr>
<tr>
<td>Reproduction of Existing Results</td>
<td>10</td>
<td>No simulation results shown.</td>
<td>CO4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Individual blocks simulated, but no comprehensive simulation.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Complete and consistent reproduction of existing results using appropriate software</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>tools.</td>
<td></td>
</tr>
<tr>
<td>Research Questions</td>
<td>10</td>
<td>No hypothesis proposed.</td>
<td>CO5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hypothesis is not sound/practical, and not backed by technical arguments.</td>
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<tr>
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<td></td>
<td>Sound and practical hypothesis proposed, along with supporting technical/intuitive</td>
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<tr>
<td></td>
<td></td>
<td>arguments.</td>
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</tbody>
</table>

**TOTAL MARKS AWARDED**
WIRELESS COMMUNICATIONS

Course Code: MLC21
Prerequisites: Digital Communication
Course Coordinator: Sarala S M.

Credits: 4:0:0
Contact Hours: 56

UNIT – I

Wireless channel: Wireless channel as a linear time-varying system, physical modeling for wireless channels, input/output model of wireless channel, time and frequency response, statistical models. Reflection from a ground plane, Power decay with distance and shadowing.

Point to point communication: Baseband equivalent channel model, Detection in Rayleigh fading channel, Repetition Coding, Orthogonal Frequency Division Multiplexing.

UNIT – II

Diversity: Introduction, Micro-diversity, Macro-diversity and simulcast, Combination of Signals, Error Probability in fading channels with diversity Reception, transmit diversity.

UNIT – III

Capacity of wireless channels: AWGN channel capacity, Linear time invariant Gaussian channels, capacity of fading channels.

UNIT – IV

Antenna diversity: Receive diversity, Spatial multiplexing and channel modeling, multiplexing capability of MIMO channels, physical modeling of MIMO channels, modeling MIMO fading channels.

UNIT – V

MIMO capacity and multiplexing architectures: V-BLAST architecture, Fast fading MIMO channel, Receiver architectures – Linear de-correlator, Successive cancellation, Linear MMSE receiver, D-BLAST architecture.

References:

**Course Outcomes:**

1. Defining characteristics of wireless channel strength over time and frequency (POs: 1, 3, 4)
2. Employ the concept of different diversity techniques to overcome the effect of small scale multi-path propagation (POs: 1, 3, 4)
3. Demonstrate the impact of channel uncertainty on the performance of diversity combining schemes (POs: 1, 3, 4)
4. Employ the multiple transmit and multiple receive antennas under suitable channel fading conditions (POs: 1, 3, 4)
5. Discuss the performance of MIMO receiver architecture (POs: 1, 3, 4)
ADVANCED EMBEDDED SYSTEMS

Course Code: MLC22  
Prerequisites: Microcontrollers  
Course Coordinator: Lakshmi Shrinivasan  

Credits: 4:0:0  
Contact Hours: 56

UNIT – I

Introduction to Embedded System: Core of the embedded System, Memories, Communication Interface, Sensors and Actuators.


Introduction to ARM Cortex –M Processors: Advantages of the Cortex M processors, applications of the ARM Cortex –M processors, Resources for using ARM processors and ARM microcontrollers.


UNIT – II

Technical Overview ARM Cortex –M4: Processor type, architecture, block diagram, memory System, Interrupt and exception support, features of ARM Cortex –M4 processor.

Low Power and System Control Features: Low power features, using WFI and WFE instructions in programming.

Fault Exceptions and Fault Handling: Overview of faults Causes of faults, enabling fault handlers, fault status registers and fault address registers.
UNIT – III

Architecture of ARM Cortex-M4: Introduction to the architecture, Programmer’s model, behavior of the application program status register (APSR), Memory system, Instruction set: Cortex –M4 specific instructions, barrel shifter, exceptions and interrupts, system control block.

UNIT – IV

Real Time Operating System (RTOS) based Embedded System Design: Operating System Basics, Types of OS, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Task Communication, Task Synchronization, Device Drivers, How to Choose an RTOS

UNIT – V

Embedded System Development Environment: Embedded Firmware design approaches, embedded firmware development languages, the Integrated Development Environment (IDE), Types of Files Generated on Cross-compilation, Disassembler/Decompiler, Simulators, Emulators and Debugging, Target Hardware Debugging and Boundary Scan.

References:

Course Outcomes:
1. Identify the basic building blocks and computational models in embedded systems (POs – 1, 3, 4)
2. Develop the programs using technical knowledge of ARM Cortex M4 for embedded system firmware development (POs – 1, 3, 4)
3. Describe ARM Cortex M4 various architectural features and its importance (POs – 1, 3, 4)
4. Select the RTOS for real time embedded system design (POs – 1, 3, 4)
5. Interpret the importance of debugger tools for embedded system design and development (POs – 1, 3, 4)
ADVANCED EMBEDDED SYSTEMS LABORATORY

Course Code: MLCL23  Credits: 0:0:1
Prerequisites: Microcontrollers and OS  Contact Hours: 28
Course Coordinator: Lakshmi Shrinivasan

LIST OF EXPERIMENTS

Introduction to IDE of ARM Cortex M4
1. Assembly Language Data Transfer programs
2. Factorial of a number generation, largest/smallest number from an given array of N numbers
3. Parity checking (odd or even), Ascending/Descending order of given N numbers

H/W Interfacing Experiments using ARM Cortex M4
4. Design and interface a DC motor speed control and measurement
5. Generation of Sine, triangular and square waveforms using Dual DAC
6. Design and interface a simple elevator system
7. Design and interface a stepper motor for following operations: rotate clockwise, anticlockwise for defined degree of angle
8. Design and interface a simple 3 x 8 calculator type Keypad module
9. Show how an output interfaced hardware module could be controlled using relay

Programs based on RTOS concepts in Linux environment
10. Introduction to Linux commands and fork( ) function demo
11. Show IPC using Pipes and FIFO

Model the given embedded system using UML tool
12. Static and dynamic aspects of the system using basic Class and sequence diagram and generate code

References:
**Course Outcomes:**

1. Use simulation and emulation IDE (POs: 1, 5)
2. Know the assembly instructions of ARM Cortex M4 with the help of assembly code (POs: 1, 3, 5)
3. Write, compile and debug RTOS based programs (POs: 1, 3, 5)
4. Interface and communicate peripheral modules to ARM Cortex M4 microcontroller (POs: 3, 4, 5)
5. Develop various UML diagrams and models for an embedded system (POs: 1, 3, 5)
ADVANCED SIGNAL AND IMAGE PROCESSING LABORATORY

Course Code: MLCL24
Prerequisites: Digital Signal Processing
Course Coordinator(s): Maya V Karki and K Indira

LIST OF EXPERIMENTS

Programs on Adaptive Filters
1. Estimation of power spectrum of AR, MA and ARMA process
2. Design of lattice predictor of order 1
3. Stationary system identification
4. FIR filter model using RLS algorithm
5. FIR filter model using LMS algorithm

Programs on Image Processing
6. Reading and displaying images, applying transformation function: log transform, power law transform, histogram equalization
7. Smoothing and sharpening spatial filters
8. Point, line and edge detection, Boundary detection, Basic Global Thresholding, Ostu’s method and Region based segmentation
9. Extracting region and boundaries, chain code representation, Boundary reconstruction using Fourier Descriptor
10. Dilation and Erosion of an image using structuring Element, Labeling Connected Components, Morphological Reconstruction
11. Object recognition using minimum distance, Bayes classifier
12. Object recognition using feed forward Neural Network classifier

References:
Course Outcomes:
1. Estimation of power spectral density of random process (POs: 1, 4, 5)
2. Design and develop FIR filter model using LMS and RLS algorithm (POs: 1, 4, 5)
3. Analyze various image pre-processing algorithms (POs: 1, 4, 5)
4. Apply segmentation algorithms to detect objects (POs: 1, 4, 5)
5. Develop object recognition algorithms using different classifiers (POs: 1, 4, 5)
TECHNICAL SEMINAR – II

Course Code: MLC25
Prerequisites: Nil

Credits: 0:0:2
Contact Hours: 56

LIST OF ACTIVITIES

1. Detailed discussion of block diagrams
2. Setting up the Simulation environment
3. Simulation of Results
4. Reproduction of Simulation Results: Written
5. Presentation of Simulation Results: Oral
6. Proposing a Technical block diagram: Written
7. Proposing a Technical block diagram: Oral
8. REVIEW – 1
9. Design of Experiments
10. Design of Experiments
11. Presentation of Simulation Results: Written
12. Presentation of Simulation Results: Oral
13. Comprehensive report writing
14. REVIEW – 2

Course Outcomes:

1. Present initial simulation results, replicating existing findings (POs: 1, 2, 3, 4, 5)
2. Propose a technical block diagram with arguments for improved performance (POs: 1, 2, 3, 4, 5)
3. Present the tools required for performing experiments, and justify their appropriateness (POs: 1, 2, 3, 4, 5)
4. Discuss simulation results and optimized performance metrics (POs: 1, 2, 3, 4, 5)
5. Discuss the advantages and disadvantages of approach, along with possible future directions (POs: 1, 2, 3, 4, 5)
## EVALUATION RUBRICS

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Max Marks</th>
<th>Achievement Levels</th>
<th>Marks Awarded</th>
<th>CO Mapping</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Inadequate (0 – 33%)</td>
<td>Developing (34 – 66%)</td>
<td>Proficient (67 – 100%)</td>
</tr>
<tr>
<td>Reproduction of existing results</td>
<td>10</td>
<td>Partial reproduction of results or large variation from reported results, no proper presentation using tables etc.</td>
<td>Partial reproduction of results, but no proper presentation and no analysis.</td>
<td>Complete reproduction of results, with appropriate tables/figures and analysis of results obtained.</td>
</tr>
<tr>
<td>Proposed Approach</td>
<td>10</td>
<td>No proper justification for methods used, or no new methods proposed.</td>
<td>New approach proposed, but without any justification.</td>
<td>New approach proposed, along with technical arguments that support the hypothesis.</td>
</tr>
<tr>
<td>Tool usage</td>
<td>10</td>
<td>Tool usage is not appropriate, is incorrect, or is incomplete.</td>
<td>Tools are used appropriately, but without knowledge of advanced options.</td>
<td>Tools are used appropriately, with complete knowledge of all available settings options suitable for analysis.</td>
</tr>
<tr>
<td>Results</td>
<td>10</td>
<td>Results are not indicative of proposed model, or are incomplete.</td>
<td>Results are complete, but are not better than existing solutions. Proper formats are used for presentation.</td>
<td>Results are presented using appropriate formats, and are better than existing solutions for the problem identified.</td>
</tr>
<tr>
<td>Discussion &amp; Conclusions</td>
<td>10</td>
<td>No discussion of experiments and the results obtained.</td>
<td>Summary of experiments and results obtained thereby.</td>
<td>Summary of experiments and results obtained thereby, along with conclusions and future directions.</td>
</tr>
</tbody>
</table>

**TOTAL MARKS AWARDED**
ERROR CONTROL CODING

Course Code: MLC31                  Credits: 4:0:0
Prerequisites: Information Theory and Coding
Contact Hours: 56

Course Coordinator: Chitra M

UNIT – I
Introduction to algebra: Groups, Fields, binary field arithmetic, Basic properties of GF \((2^m)\), Construction of Galois Field GF \((2^m)\) and its properties, Computation using Galois filed GF \((2^m)\) arithmetic, Vector spaces and matrices on Galois field.

UNIT – II
Linear block codes: Generator and parity check matrices, Encoding circuits, Syndrome and error detection, Minimum distance considerations, Error detecting and error correcting capabilities, Standard array and syndrome decoding, decoding circuits, Hamming codes, Reed-Muller codes, \((24,12)\) Golay codes, Product codes and interleaved codes, applications.

UNIT – III
Cyclic codes: Introduction, Generator and parity check polynomials, Encoding using multiplication circuits, Systematic cyclic codes – Encoding using feedback shift register circuits, generator matrix for cyclic code, Syndrome computing and error detection, Meggitt decoder, Error trapping decoding, \((23,12)\) Golay codes, Cyclic hamming codes, Shortened cyclic codes.

UNIT – IV
BCH codes: Binary primitive BCH codes, Decoding procedures, Implementation of Galois field arithmetic, Implementation of error correction.

Non-binary BCH codes: q-ary linear block codes, Primitive BCH codes over GF(q), Reed-Solomon codes, decoding of non-binary BCH and RS codes: Berlekamp - Massey Algorithm, Gorenstein – Zierler Algorithm.
UNIT – V

Majority Logic decodable codes & Convolutional codes: One step majority logic decoding, one step majority logic decodable codes, Two-step majority logic decoding, Multiple-step majority logic decoding.

Convolutional codes: Encoding of convolutional codes, Structural properties, Distance properties, Viterbi decoding algorithm for decoding, soft output Viterbi algorithm, Stack and Fano sequential decoding algorithms, Majority logic decoding, Introduction to LDPC codes, Geometrical structure of LDPC codes, EG-LDPC codes, PG-LDPC codes, applications.

References:

Course Outcomes:
1. Apply properties of Galois Field to Groups, Fields, Vector Spaces, row space and sub-spaces (POs: 1, 3, 4)
2. Describe linear block codes, RM codes, Golay codes in error detection and error correction (POs: 1, 3, 4)
3. Demonstrate cyclic block codes, cyclic Hamming codes, Shortened cyclic codes and (23, 12) Golay codes in error detection and correction (POs: 1, 3, 4)
4. Illustrate various BCH Codes, RS Codes and other q-ary codes and apply them for error detection and correction (POs: 1, 3, 4)
5. Construct state tables, state diagrams, code-tree diagram and trellis diagrams for convolutional encoders and other higher-order error-control codes and use Viterbi and stack algorithms for decoding those codes (POs: 1, 3, 4)
INTERNSHIP/INDUSTRIAL TRAINING

Course Code: MLC32  
Credits: 0:0:4

Prerequisites: Nil

The evaluation of students will be based on an intermediate presentation, along with responses to a questionnaire testing for outcomes attained at the end of the internship. The rubrics for evaluation of the presentation and the questionnaire for the report will be distributed at the beginning of the internship.

EVALUATION RUBRICS

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Max. Marks</th>
<th>Achievement Levels</th>
<th>CO Mapping</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Inadequate (0% – 33%)</td>
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<tr>
<td>Complex Technical Blocks</td>
<td>10</td>
<td>No working knowledge of the domain.</td>
<td>CO1</td>
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<td>Developing (34% – 66%)</td>
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<tr>
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<td>Working knowledge of the domain, with some knowledge of internal details.</td>
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<td>Proficient (67% – 100%)</td>
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<td>Detailed understanding of the system, along with underlying mechanisms.</td>
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<tr>
<td>Error Debugging</td>
<td>10</td>
<td>No ability to diagnose or correct errors, or improve performance.</td>
<td>CO2</td>
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<tr>
<td></td>
<td></td>
<td>An ability to diagnose errors, but not correct them, no intuition on improving performance.</td>
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<tr>
<td>Professional and Ethical Behavior</td>
<td>10</td>
<td>No knowledge of the requirement of professional and ethical behavior.</td>
<td>CO3</td>
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<tr>
<td></td>
<td></td>
<td>Understands the requirement for professional and ethical behavior.</td>
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<tr>
<td>Engineering and Finance</td>
<td>10</td>
<td>Cannot make the connection between engineering decisions and their economic impact.</td>
<td>CO4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Predict the cost of engineering decisions.</td>
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<tr>
<td>Lifelong Learning</td>
<td>10</td>
<td>No understanding of the requirements for lifelong learning in the engineering profession.</td>
<td>CO5</td>
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<td></td>
<td></td>
<td>Can present examples of the impact of lifelong learning in the engineering industry.</td>
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<td></td>
<td></td>
<td>Can present examples of the impact of lifelong learning, along with predicting future areas of impact of life-long learning.</td>
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</table>

TOTAL MARKS AWARDED
Course Outcomes:

1. Analyze the working of complex technical systems/blocks (POs: 1, 3, 4)
2. Correct errors during functioning and improve the performance of complex technical systems/blocks (POs: 1, 3, 4)
3. Understand the importance of professional and ethical behavior in the engineering workplace (POs: 1, 3, 4)
4. Predict the effect of engineering decisions on financial matters (POs: 1, 3, 4)
5. Appreciate the requirements for constant technology updation (POs: 1, 3, 4)
PROJECT WORK – I

Course Code: MLC33
Prerequisites: Nil

Credits: 0:0:6

The students will be evaluated based on two oral presentations during the semester. In the presentations they will have to discuss the results of their literature survey and initial implementations of the design.

EVALUATION RUBRICS

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<th>Criteria</th>
<th>Max. Marks</th>
<th>Achievement Levels</th>
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<tr>
<td></td>
<td></td>
<td>Inadequate (0% – 33 %)</td>
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<tr>
<td>Phase – I, Review – I</td>
<td></td>
<td>Clear introduction to the domain, along with design decisions and their impacts.</td>
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<td>CO1</td>
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</tr>
<tr>
<td>Introduction</td>
<td>5</td>
<td>Introduction is not clear, or is not technically accurate.</td>
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<tr>
<td>Literature survey</td>
<td>10</td>
<td>Few sources of low quality, with no proper discussion of results.</td>
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<tr>
<td>Methods comparison</td>
<td>10</td>
<td>Methods not explained and compared in terms of internal implementation details.</td>
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<td>Advantages and disadvantages discussed, but not with reference to actual methods.</td>
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<td>Detailed description of existing methods, along with their advantages and disadvantages.</td>
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</table>

TOTAL MARKS AWARDED

CO Mapping

CO1

CO2

CO3
Course Outcomes:
1. Introduce the technical area chosen and demonstrate that the focus of the study is on a significant problem worth investigation (POs: 1, 3, 4, 5)
2. Discuss existing/standard solution strategies for the problem identified and its deficiency in the current scenario (POs: 1, 2, 3, 4, 5)
3. Compare and contrast various research outcomes as part of a literature survey of quality published academic work (POs: 1, 3, 4, 5)
4. Replicate existing results by choosing appropriate tools/methods (POs: 1, 3, 4, 5)
5. Present a technical block diagram and justify its improved performance, with respect to existing methods, through technical arguments (POs: 1, 2, 3, 4, 5)
The students will be evaluated based on two oral presentations, in which they will present their proposed solutions to the problem identified, and discuss the implementation details and results obtained.

### EVALUATION RUBRICS

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<th>Criteria</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Inadequate (0% – 33%)</td>
<td>Developing (34% – 66%)</td>
</tr>
<tr>
<td>Methods discussion</td>
<td>10</td>
<td>A discussion of methods for optimization is not based on technical arguments.</td>
<td>One or more block diagrams presented for optimization, but not justified with technical arguments.</td>
</tr>
<tr>
<td>Initial Results</td>
<td>10</td>
<td>Results are not matching expectations, or are not complete.</td>
<td>Complete results generated, but not an improvement on existing metrics.</td>
</tr>
<tr>
<td>Analysis</td>
<td>5</td>
<td>No discussion about qualitative nature of results.</td>
<td>Results are discussed along with justification for the outcomes.</td>
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**TOTAL MARKS AWARDED**
<table>
<thead>
<tr>
<th>Criteria</th>
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<th>Achievement Levels</th>
<th>Marks Awarded</th>
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<tr>
<td></td>
<td></td>
<td>Phase – II, Review – II</td>
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<tr>
<td></td>
<td></td>
<td>Inadequate (0% – 33%)</td>
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<tr>
<td>Design of Experiments</td>
<td>10</td>
<td>Few experiments conducted, with no relation to problem domain.</td>
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<tr>
<td></td>
<td></td>
<td>Developing (34% – 66%)</td>
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<tr>
<td></td>
<td></td>
<td>Proficient (67% – 100%)</td>
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<tr>
<td>Experimental Results</td>
<td>10</td>
<td>Few results, not covering all cases, and not optimizing performance.</td>
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<tr>
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<td>Performance is moderately optimized with respect to existing approaches, but not to the level predicted by block diagram.</td>
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<tr>
<td></td>
<td></td>
<td>Significant experiments conducted, with no structure and relation to problem domain.</td>
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<tr>
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<td></td>
<td>Significant experiments conducted, with all relevant parameters being tested in an orderly manner, and with relevance to hypothesis.</td>
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<tr>
<td>Discussion</td>
<td>5</td>
<td>No qualitative or quantitative discussion of the method, and its key characteristics.</td>
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<tr>
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<td></td>
<td>Method is discussed, but without arguments justifying the advantages and disadvantages of the approach.</td>
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<tr>
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<td></td>
<td>Method is summarized in detail, along with technical arguments justifying the advantages and disadvantages of the proposed method.</td>
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<td></td>
<td></td>
<td>TOTAL MARKS AWARDED</td>
<td></td>
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</tbody>
</table>

Course Outcomes:
1. Present different methods for improving existing performance metrics with respect to existing literature, along with justified technical arguments (POs: 1, 2, 3, 4, 5)
2. Implement solutions proposed using appropriate software tools (POs: 1, 3, 4, 5)
3. Compare implemented solutions and choose the best possible option based on factors such as societal impact, cost, speed, and practicality (POs: 1, 3, 4, 5)
4. Perform extensive experimentation to prove hypothesis (POs: 1, 3, 4, 5)
5. Discuss the proposed methods pros and cons, and its applicability in different situations, along with scope for improvement (POs: 1, 2, 3, 4, 5)
ELECTIVES
ANTENNA THEORY AND DESIGN

Course Code: MLCE01
Credits: 4:0:0
Prerequisites: Field Theory and Microwave Circuits
Contact Hours: 56
Course Coordinator: Sujatha B

UNIT – I

Antenna fundamental and definitions: Radiation patterns, Directivity and gain, Effective height and aperture, Antenna impedance, Radiation efficiency, Antenna polarization.

Arrays: Array factor for linear arrays, uniformly excited equally spaced linear arrays, Pattern multiplication, Directivity of linear arrays, Multidimensional arrays and Feeding techniques.

UNIT – II

Resonant Antennas: Dipole antenna (Far field electric and magnetic field components, (Radiation resistance), Yagi-Uda antennas.

Broadband antennas: Travelling wave Wire antennas, Helical antennas – Normal mode helix antenna, Axial mode Helix antenna, Bi-conical antennas, sleeve antenna.

UNIT – III

Frequency independent antennas: Principle of frequency independent antennas, Log-periodic antenna.

Microstrip and Printed Antennas: Feeding methods, Rectangular patch, Circular patch, Resonant frequencies and design, Quality factor, Bandwidth and efficiency.

UNIT – IV

Aperture antennas: Techniques for evaluating gain, Pyramidal Horn Antenna, Reflector antennas – Parabolic reflector antenna principles, Axi-symmetric parabolic reflector antenna, Offset parabolic reflectors, Dual reflector antennas, Gain calculations for reflector antennas, Feed antennas for reflectors, Field representations, Matching the feed to the reflector, General feed model, Feed antennas used in practice.
UNIT – V

**Antenna Array Synthesis:** Formulation of the synthesis problem, Synthesis principles, Line sources shaped beam synthesis, Linear array shaped beam synthesis, Comparison of shaped beam synthesis methods, low side lobe narrow main beam synthesis methods, Dolph Chebyshev linear array.

**Computational electromagnetics (CEM) for antennas:** Introduction to CEM, The methods of moments, Pocklington's integral equation, Integral equation and Kirchhoff’s networking equations, Source modeling weighted residual formulations.

**References:**

**Course Outcomes:**
1. Define the parameters of antenna and analyze the uniform excited array antennas (POs: 1, 3, 4)
2. Design the resonant and broad band antennas (POs: 1, 3, 4)
3. Apply different feeding techniques and design microstrip patch antennas (POs: 1, 3, 4)
4. Design the directivity and gain of parabolic reflector and explain the feed methods of reflector antennas (POs: 1, 3, 4)
5. Synthesize antenna beam pattern using different types of distributions and describe the computationally efficient approximations using MOM (POs: 1, 3, 4)
DIGITAL SYSTEM DESIGN USING HDL

Course Code: MLCE02
Pre-requisites: Digital Electronics
Course Coordinator: Gangadharaih S L

Credits: 4:0:0
Contact Hours: 56

UNIT – I


Number Basics: Unsigned and Signed Integers, Fixed and Floating-point Numbers.

UNIT – II

Sequential Basics: Storage elements, Counters, Sequential Data paths and Control, Clocked Synchronous Timing Methodology.

UNIT – III

Memories and Implementation Fabrics: Concepts, Memory Types, Error Detection and Correction.

Implementation Fabrics: ICs, PLDs, Packaging and circuit Boards, Interconnection and signal Integrity.

UNIT – IV


UNIT – V

RTL Modeling Fundamentals: System Verilog Language rules, module, module instances, Hierarchy, Four state data values, Data types, Variable types, Net types, Operators, Continuous Signal Assignments, Procedural Signal Assignments, Modeling Combinational logic and Sequential Logic.
References:

Course Outcomes:
1. Apply the concepts of Verilog modeling to design and verify the operations of complex digital logic circuits. (POs: 1, 3, 4)
2. Design and test pipelined storage elements, sequential data path controllers using Verilog (POs: 1, 3, 4)
3. Apply the concept of Verilog modeling to multi-port memories and FIFO datapaths and FSMs with respect to integrated circuits. (POs: 1, 3, 4)
4. Understand the basics of System Verilog to simulate and synthesize digital systems. (POs: 1, 3, 4)
5. Design and model combinational and sequential circuits using System Verilog. (POs: 1, 3, 4)
OPTICAL COMMUNICATION AND NETWORKING

Course Code: MLCE03  Credits: 4:0:0
Pre-requisites: Digital Communication  Contact Hours: 56
Course Coordinator: M. Nagabushanam

UNIT – I

Introduction: Propagation of signals in optical fiber, different losses, nonlinear effects, solitons, optical sources, detectors.

Optical Components: Couplers, isolators, circulators, multiplexers and filters, gratings, interferometers, optical amplifiers,

UNIT – II

Modulation and Demodulation: Signal formats, ideal receivers, Practical detection receivers, Optical preamplifier, Noise considerations, Bit error rates, Coherent detection.

UNIT – III

Transmission System Engineering: System model, power penalty, Transmitter, Receiver, Different optical amplifiers, Dispersion.

Optical Networks: Client layers of optical layer – SONET/SDH, multiplexing, layers, frame structure, ATM functions, adaptation layers, Quality of service and flow control, ESCON, HIPPI.

UNIT – IV

WDM Network Elements: Optical line terminal optical line amplifiers, optical cross connectors, WDM network design- cost trade-offs, LTD and RWA problems, Routing and wavelength assignment, wavelength conversion.
UNIT – V

Control and Management: Network management functions, management framework, Information model, management protocols, layers within optical layer performance and fault management, impact of transparency.

References:

Course Outcomes:
1. Demonstrate the function of optical components and light propagation mechanism (POs: 1, 3, 4)
2. Analyze the noise performance in optical communication receivers (POs: 1, 3, 4)
3. Define signal impairment in optical networks (POs: 1, 3, 4)
4. Demonstrate the principle of WDM network elements (POs: 1, 3, 4)
5. Appreciate the different network and management protocols in optical networks (POs: 1, 3, 4)
ADVANCED SIGNAL AND IMAGE PROCESSING

Course Code: MLCE04
Pre requisites: Digital Signal Processing
Course Coordinator: Maya V Karki

Credit: 4:0:0
Contact Hours: 56

UNIT – I


UNIT – II


UNIT – III

Image Pre-processing: Basic intensity transformations, Histogram processing, Smoothing and sharpening spatial filters, Segmentation: Point, line and edge detection, Thresholding, Region based segmentation

UNIT – IV

Representation and Morphological Image processing: Representation: Chain codes, signatures, Boundary segments, Image Boundary descriptors: Some simple descriptors and Fourier descriptor.

Morphological Image Processing: Erosion and dilation, Basic Morphological algorithms: Boundary extraction, hole filling extraction of connected components, Thinning, Thickening, skeletons, Morphological Reconstruction.
UNIT – V


References:

Course Outcomes:
1. Design linear predictors and optimum linear filters (POs: 1, 3, 4)
2. Design adaptive filters with LMS and RLS algorithms (POs: 1, 3, 4)
3. Apply segmentation algorithms to detect and link edges in an image (POs: 1, 3, 4)
4. Represent and apply morphological algorithms to describe the shape and characteristics of an object. (POs: 1, 3, 4)
5. Apply different object recognition algorithms to detect objects in a scene (POs: 1, 3, 4)
MEMS AND NANOELECTRONICS

Course Code: MLCE05  Credits: 4:0:0
Prerequisites: Semiconductor Theory  Contact Hours: 56
Course Coordinator: Lakshmi S

UNIT – I

Introduction to MEMS and MEMS devices and systems: Feynman’s vision, multi-disciplinary aspects, application areas. Scaling laws in miniaturization, scaling in geometry, electrostatics, electromagnetics.

Micro and Smart Devices and Systems – Principles: Transduction principles in MEMS Sensors: Actuators: different actuation mechanisms - silicon capacitive accelerometer, piezo-resistive pressure sensor, blood analyzer, conductometric gas sensor, silicon micro-mirror arrays, piezo-electric based inkjet print head, electrostatic comb-driver.

UNIT – II

Micro manufacturing and Packaging: Lithography, thin-film deposition, etching (wet and dry), wafer-bonding, Silicon micromachining: surface, bulk, LIGA process, Wafer bonding process.

Integration and Packaging of MEMS devices: Integration of microelectronics and micro devices at wafer and chip levels, Microelectronic packaging: wire and ball bonding, flip chip, Microsystem packaging examples.

UNIT – III


UNIT – IV


**UNIT – V**

**Fabrication, Measurement and Applications:** Fabrication and measurement techniques for nanostructures, Bulk crystal and heterostructure growth, Nanolithography, etching, other means for fabrication of nanostructures and nanodevices, Techniques for characterization of nanostructures, Spontaneous formation and ordering of nanostructures, Clusters and nanocrystals.

**Applications:** Injection Lasers: Quantum cascade lasers, Single photon sources, Biological tagging, Optical memories, Coulomb blockade devices, Photonic structures, QWIPs, NEMS, and MEMS.

**References:**

**Course Outcomes:**
1. Analyze scaling laws and operation of various practical MEMS systems (POs: 1, 3)
2. Describe various fabrication techniques and packaging methods for MEMS devices (PO: 3)
3. Identify the electronics and RF aspects of MEMS systems (POs: 3, 4)
4. Recognize the distinguishing aspect of nanoscale devices and systems (PO: 3)
5. Examine the basic science behind the design and fabrication of nano scale systems and their applications (PO: 3)
ADVANCED COMPUTER NETWORKS

Course Code: MLCE06
Credits: 4:0:0
Prerequisites: Computer Communication Networks
Contact Hours: 56
Course Coordinator: Flory Francis

UNIT – I

Local Area Networks: Ethernet - Physical layer, MAC, LLC, LAN interconnection, Token ring, Physical layer, MAC, LLC, FDDI

Switching: Introduction, circuit switching, packet switching, multicasting

Scheduling: Introduction, requirements, choices, performance bounds, best effort techniques, Naming and addressing.

UNIT – II

Traffic Management: Introduction, framework for traffic management, traffic models, traffic classes, traffic scheduling.

Control of Networks: Objectives and methods of control, routing optimization in circuit and datagram networks, Markov chains, Queuing models in circuit and datagram networks.

UNIT – III

Congestion and flow control: Window congestion control, rate congestion control, control in ATM Networks, flow control model, open loop flow control, closed loop flow control.

UNIT – IV

Cryptography: Introduction, Symmetric Ciphers, Block Cipher structure, DES, AES cipher, Principles of Public-Key Cryptosystems, RSA algorithm.

UNIT – V

Hash Functions and Message Authentication: One way hash functions using symmetric block algorithms and public key algorithms, Message authentication codes, hash functions, Digital signature algorithm
References:

Course Outcomes:
1. Describe the basic networking, data switching and scheduling techniques of networks (POs: 1, 3)
2. Analyze various network traffic management and control techniques (POs: 1, 3, 4)
3. Discuss the congestion and flow control (POs: 1, 3)
4. Analyze the working for symmetric and public key ciphers. (POs: 1, 3, 4)
5. Illustrate the importance of hash functions and message authentication codes. (POs: 1, 3, 4)
INTERNET OF THINGS

Course Code: MLCE07  Credits: 4:0:0
Prerequisites: Computer Networks  Contact Hours: 56
Course Coordinator: Lakshmi S.

UNIT – I


UNIT – II

Developing Internet of Things: IoT Platform design methodology, Specifications: Requirements, Process, Domain, Information, Services, Level, Functional, Operational, Integration, Application Development

Python Language: Data Types and Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Date and Time Operations, Classes, Python packages of interest for IoT

UNIT – III

IoT Physical Devices and End Points: Basic building blocks of an IoT Device, Raspberry Pi, Linux on Raspberry Pi, Raspberry Pi Interfaces: Serial, SPI, I2C

Programming Raspberry Pi with Python: Controlling LED, Interfacing Switch, Interfacing Light Sensor

UNIT – IV

Cloud and Data Analytics: Introduction to cloud storage models and communication APIs


UNIT – V

IoT Case Studies: Home Automation: Smart Lighting, Home Intrusion Detection; Cities: Smart
Parking Environment: Weather Monitoring System, Weather Reporting Bot, Air Pollution Monitoring, Forest Fire Detection; Agriculture – Smart Irrigation, IoT Printer, IOT in Automobiles: Intelligent Transportation and the Connected Vehicle, Vehicular Ad-hoc Networks (VANETs)

References:

Course Outcomes:
1. Describe the OSI Model for the IoT/M2M systems (POs: 1, 3)
2. Learn basics of design, integration and applications of IoT models (POs: 1, 3)
3. Acquire the knowledge of basic blocks of an IoT devices using Raspberry Pi (PO: 3)
4. Understand cloud storage models and web services for IoT (PO: 3)
5. Appraise with various case studies (POs: 1, 3, 4)
BROADBAND WIRELESS NETWORKS

Course Code: MLCE08       Credits: 4:0:0
Prerequisites: Computer Communication Networks  Contact Hours: 56
Course Coordinator: Flory Francis

UNIT – I

WiMAX genesis and framework: IEEE 802.16 standard from 802.16-2004 to 802.16e, WiMAX forum, WiMAX forum working groups, WiMAX forum white papers, WiMAX products certification, WiMAX certified products, Predicted products and deployment evolution, Product types, Products and deployment Timetable, Other 802.16 Standards, Korean Cousin: WiBro.

Protocol layers and topologies: Protocol Layers of WiMAX, Convergence Sub layer (CS), Medium Access Control Common Part Sub layer (MAC CPS), Security Sub layer, Physical Layer, Single Carrier (SC) and OFDM, Network Management Reference Model, WiMAX Topologies.

UNIT – II

Frequency utilization and system profiles: Cellular concept, Sectorisation, Cluster size considerations, Handover, WiMAX system profiles.

WiMAX physical layer: OFDM transmission, Basic Principle: Use the IFFT Operator, Time domain and Frequency domain OFDM considerations, OFDM symbol parameters, Physical Slot (PS), Peak-to-Average Power Ratio (PAPR), OFDMA and its variants, Subcarrier permutations in WiMAX OFDMA PHY.802.16 transmission chains.

UNIT – III

WiMAX MAC and QoS: CS layer, MAC function and frames, MAC addresses and MAC frames, MAC header format, MAC sub-headers and special payloads, Fragmentation, Packing and Concatenation, Basic, Primary and Secondary Management Connections, User data and MAC Management Messages, TLV encoding in the 802.16 standard, TLV encoding sets, Automatic Repeat Request (ARQ), ARQ feedback format, Hybrid ARQ (HARQ), Scheduling and link adaptation.
UNIT – IV

Multiple access and burst profile: Duplexing – FDD, TDD mode, Transmission of downlink and uplink subframes, OFDM PHY uplink and downlink subframe, OFDMA PHY frame, frame duration, Preambles, Maps of Multiple Access: DL-MAP and UL-MAP, DL-MAP message, UL-MAP message, OFDMA PHY UL and DL MAP Messages, Burst profile usage: DCD Message and DIUC Indicator, Burst profile selection thresholds, DCD (Downlink Channel Descriptor) message, Transmission of the DCD message, DIUC values, UCD (Uplink Channel Descriptor) message and UIUC indicator, Mesh frame, Network control subframe, Schedule control subframe

Uplink bandwidth allocation and request mechanisms: Types of uplink access grant request, Contention based focused bandwidth request in OFDM PHY.

UNIT – V

Radio resource management: Radio engineering consideration for WiMAX systems, Radio resource management procedures, Advanced antenna technologies in WiMAX, Multicast Broadcast Services (MBS), Multi-BS access MBS, MBS frame.

WiMAX architecture: Need for a standardised WiMAX, High-level architecture requirements, Network reference model, Network functionalities.

References:

Course Outcomes:
1. Identify the different protocols and topologies in wireless networks (POs: 1, 3)
2. Discuss cellular concepts and physical layer specifications of WiMAX (POs: 1, 3)
3. Describe the MAC layer responsibilities and its frame format (POs: 1, 3)
4. Employ the various multiple access techniques for efficient spectrum allocation and utilization (POs: 1, 3)
5. Describe the functional blocks of WiMax architecture and RF resource management (POs: 1,3)
CMOS VLSI CIRCUITS

Course Code: MLCE09

Prerequisites: Digital Design

Course Coordinator: M. Nagabushanam

Credits: 4:0:0

Contact Hours: 56

UNIT – I

MOS Transistor Theory: n MOS/p MOS transistor, threshold voltage equation, body effect, MOS device design equation, sub threshold region, Channel length modulation. mobility variation, Tunneling, punch through, hot electron effect MOS models, small signal AC Characteristics, CMOS inverter, $\beta_n / \beta_p$ ratio, noise margin, static load MOS inverters, differential inverter, transmission gate, tristate inverter, BiCMOS inverter.

UNIT – II

CMOS Process Technology: Semiconductor Technology overview, basic CMOS technology, p well / n well / twin well process. Current CMOS enhancement (oxide isolation, LDD, refractory gate, multilayer inter connect), Circuit elements, resistor, capacitor, interconnects, sheet resistance & standard unit of capacitance concepts delay unit time, inverter delays, driving capacitive loads, RC delay Line, Super Buffers, propagation delays, MOS mask layout, stick diagram, design rules and layout, symbolic diagram, masking, scaling of MOS circuits.

UNIT – III


UNIT – IV

Dynamic CMOS and clocking: Introduction, advantages of CMOS over NMOS, CMOS/SOS technology, CMOS/bulk technology, latch up in bulk CMOS, static CMOS design, Domino CMOS structure and design, Charge sharing, Clocking: clock generation, clock distribution, clocked storage elements
UNIT – V

Circuit Simulation: Introduction to circuit simulation, Spice tutorials, Device models, Device characterization, circuit characterization, Simulation mismatches, Monte Carlo simulation

References:

Course Outcomes:
1. Describe basics of CMOS digital integrated circuits (POs: 3, 4)
2. Discuss the fabrication process in CMOS technologies (POs: 1, 3, 4)
3. Analyze the switching characteristics of VLSI circuits (POs: 1, 3, 4)
4. Design and analyze dynamic CMOS circuits (POs: 1, 3, 4)
5. Describe the circuit simulation process for VLSI circuits (POs: 1, 3, 4)
COMMUNICATION SYSTEM DESIGN USING DSP

Course Code: MLCE10  
Credits: 4:0:0

Prerequisites: Analog & Digital Communication  
Contact Hours: 56

Course Coordinator: T. D. Senthilkumar

UNIT – I

Introduction to the course: Digital filters, Discrete time convolution and frequency responses, FIR filters – Using circular buffers to implement FIR filters in C and using DSP hardware, Interfacing C and assembly functions, Linear assembly code and the assembly optimizer. IIR filters – realization and implementation, FFT and power spectrum estimation: DTFT window function, DFT and IDFT, FFT, Using FFT to implement power spectrum.

UNIT – II

Analog modulation scheme: Amplitude Modulation – Theory, generation and demodulation of AM, Spectrum of AM signal, Envelope detection and square law detection, Hilbert transform and complex envelope, DSP implementation of amplitude modulation and demodulation.


SSB: Theory, SSB modulators, Coherent demodulator, Frequency translation, Implementation using DSP hardware.

UNIT – III


UNIT – IV

UNIT – V

PAM: PAM theory, baseband pulse shaping and ISI, Implementation of transmit filter and interpolation filter bank. Simulation and theoretical exercises for PAM, Hardware exercises for PAM.

QAM: Basic QAM transmitter, Constellation examples, QAM structures using passband shaping filters, Ideal QAM demodulation, QAM experiment. QAM receivers – Clock recovery and other frontend sub-systems, Equalizers and carrier recovery systems.

Experiment for QAM receiver frontend: Adaptive equalizer, Phase splitting, fractionally spaced equalizer. Decision directed carrier tracking, Blind equalization, Complex cross coupled equalizer and carrier tracking experiment, Echo cancellation for full duplex modems: Multicarrier modulation, ADSL architecture, Components of simplified ADSL transmitter, a simplified ADSL receiver, Implementing simple ADSL Transmitter and Receiver.

References:


Course Outcomes:

1. Employ C and assembly functions in the implementation of filters and Fourier transforms, using DSP hardware (POs: 1, 3, 4)
2. Apply amplitude modulation concepts in the DSP implementation of AM/DSB transceiver (POs: 1, 3, 4)
3. Demonstrate the DSP hardware implementation of frequency modulation scheme (POs: 1, 3, 4)
4. Analyze the bit error rate performance of the binary modulation receiver (POs: 1, 3, 4)
5. Demonstrate the function of QAM transmitter and receiver hardware (POs: 1, 3, 4)
RF AND MICROWAVE CIRCUIT DESIGN

Course Code: MLCE11  Credits: 4:0:0
Prerequisites: Microwave Circuits  Contact Hours: 56
Course Coordinator: Sujatha B

UNIT – I


UNIT – II


Considerations in Active Networks and design of amplifiers, oscillators and detectors: Stability consideration, gain consideration, Noise consideration.

UNIT – III

Linear and Non-linear Design: Introduction, Types of amplifier, Design of different types of amplifiers, Multi-stage small signal amplifiers

Design of Transistor Oscillators: Oscillator versus Amplifier Design. Oscillation Conditions, Design of Transistor Oscillators, Generator Tuning Networks.

UNIT – IV


RF/Microwave Frequency Conversion II: Mixer Design: Mixers, Mixer types, Conversion loss for SSB mixers, One-Diode (or Single-Ended) Mixers, Two-Diode Mixers, Four Diode Mixers, Eight-Diode Mixers.
UNIT – V

RF/Microwave Control Circuit Design: Phase shifters, Digital phase shifters, Semiconductor phase shifters, PIN Diode Attenuators

RF and microwave IC design, MICs, MIC materials, Types of MICs, Hybrid verses monolithic MICs,

References:

Course Outcomes:
1. Employ transmission line theory, S-parameters, and Smith chart for microwave circuit analysis (POs: 3, 4)
2. Design passive microwave matching circuits (POs: 3, 4)
3. Design microwave amplifiers, oscillators, resonators and micro-strip circuits (POs: 3, 4)
4. Discuss features of active high-frequency matching networks, detector and mixer devices (POs: 3, 4)
5. Design microwave ICs and hybrid ICs using MIC materials (POs: 3, 4)
SIMULATION, MODELING AND ANALYSIS

Course Code: MLCE12  Credits: 4:0:0
Prerequisites: Engineering Mathematics  Contact Hours: 56
Course Coordinator: S. L. Gangadharaiyah

UNIT – I

Basic Simulation Modeling: Nature of simulation, System models, discrete event simulation, Single server simulation, Alternative approaches, other types of simulation

UNIT – II

Building Valid, Credible and Detailed Simulation Models: Techniques for increasing model validity and credibility, comparing real world observations

UNIT – III


UNIT – IV

Random Number Generators: Linear congruential, Other kinds, Testing number generators, Random variate generation: Approaches, Continuous random variates, discrete random variates, Correlated random variates

UNIT – V

Output Data Analysis: Statistical analysis for term initiating simulation, Analysis for steady state parameters, Comparing alternative system configuration, Confidence interval, Variance reduction techniques, Arithmetic and control variates.

References:


**Course Outcomes:**
1. Describe the basic concepts in modeling and simulation (POs: 1, 3, 4)
2. Apply different techniques to increase model validity and credibility (POs: 1, 3, 4)
3. Choose different probability distributions for simulation and modeling (POs: 1, 3, 4)
4. Apply random number variates to develop simulation models (POs: 1, 3, 4)
5. Analyze and test the output data produced by the model (POs: 1, 3, 4)
SOFTWARE DEFINED RADIO

Course Code: MLCE13

Credits: 4:0:0

Prerequisites: Wireless Communication

Contact Hours: 56

Course Coordinator: T. D. Senthilkumar

UNIT – I

Introduction to Software Radio concepts: Characteristics, benefits and design principles of a software radio.

Radio Frequency Implementation issues: Purpose of the RF front-end, Challenges of receiver design, RF receiver front-end topologies, RF components, Transmitter architecture, Noise and distortion in the RF chain, ADC and DAC conversion.

UNIT – II


UNIT – III

Digital Generation of Signals: Introduction – approaches to direct digital synthesis, analysis of spurious signals, bandpass signal generation, performance of direct digital synthesis system, Hybrid DDS-PLL systems, Generation of random sequences, ROM compression techniques

UNIT – IV

ADC and DAC: Introduction. Parameters of ideal and practical data converters – sampling process, quantization, physical model, transfer characteristics, dynamic range, timing issues, analog bandwidth, power consumption, impact of noise and interference, Techniques to improve data converter performance.

UNIT – V

Digital Hardware: Introduction, Hardware elements, DSP processors – core, architectures, addressing, pipelining, multiprocessing using real-time operating systems, software design cycle, maximizing performance, Field programmable gate arrays, Power management issues.
References:

Course Outcomes:
1. Describe the characteristics and design issues of RF components (POs: 1, 3, 4)
2. Employ the principles of sampling rate conversion in implementation of digital polyphase filters (POs: 1, 3, 4)
3. Describe the techniques to generate the digital signals for random sequences (POs: 1, 3, 4)
4. Apply the design principles of data converter to improve its performance (POs: 1, 3, 4)
5. Appraise the use of DSP processors and FPGA in the implementation of SDR (POs: 1, 3, 4)
DATA COMPRESSION

Course Code: MLCE14  Credits: 4:0:0
Prerequisites: Information Theory and Coding  Contact Hours: 70
Course Coordinator: Maya V. Karki

UNIT – I


UNIT – II


UNIT – III

Transform Coding: Transforms – KLT, DCT, DST, DWHT, Quantization and coding of transform coefficients, DWHT entropy coded quantization, Wavelets: multi-resolution analysis and scaling, embedded zero tree coder (EZW), set partitioning in hierarchical trees (SPIHT).

UNIT – IV


UNIT – V

Video Compression Techniques: Video compression based on motion compensation, search for motion vectors, H.261, H.263, MPEG – 1 and MPEG- 2, MPEG-4 and MPEG-7 video coding.
References:

Course Outcomes:
1. Describe coding and decoding text messages using Huffman, arithmetic and dictionary based methods (POs: 3, 4)
2. Differentiate between scalar quantizer, vector quantizer and predictive coding (POs: 1, 3, 4)
3. Apply DCT, DWT, EZW, and SPIHT compression algorithms for images (POs: 1, 3, 4)
4. Illustrate JPEG, JPEG 2000, CELP and MPEG-1 audio standards (POs: 1, 3, 4)
5. Differentiate between different video standards (POs: 1, 3, 4)