

**Maulana Abul Kalam Azad University of Technology, West Bengal**  
**Syllabus for B. Tech in Electronics & Communication Engineering**  
(Applicable from the academic session 2018-2019)

**Semester-IV**

<b>EC401</b>	<b>Analog Communication</b>	<b>3L:0T:0P</b>	<b>3 credits</b>
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- Mod-1 Introduction to Analog Communication: **8L**  
Elements of communication system - Transmitters, Transmission channels & receivers (1), Concept of modulation, its needs (1).
- Continuous Wave Linear Modulation:
- a) Amplitude modulation (AM-DSB/TC): Time domain representation of AM signal (expression derived using a single tone message), modulation index, frequency domain (spectral) representations, illustration of the carrier and side band components; transmission bandwidth for AM; Phasor diagram of an AM signal; Calculation of Transmitted power & sideband power & Efficiency; concept of under, over and critical modulation of AM-DSB-TC.
  - b) Other Amplitude Modulations: Double side band suppressed carrier (DSBSC) modulation: time and frequency domain expressions, bandwidth and transmission power for DSB. Single side band modulation (SSB) both TC & SC and only the basic concept of VSB, Spectra and band-width.
- Mod-2 Generation & Detection of Amplitude Modulation: **8L**
- a) Generation of AM: Concept of i) Gated and ii) Square law modulators, Balanced Modulator.
  - b) Generation of SSB: Filter method, Phase shift method and the Third method
- Demodulation for Linear Modulation:  
Demodulation of AM signals: Detection of AM by envelope detector, Synchronous detection for AM-SC, Effects of Frequency & Phase mismatch, Corrections. Principle of Super heterodyne receivers: Super heterodyning principle, intermediate frequency, Local oscillator frequency, image frequency.
- Mod-3 Angle Modulation: **8L**
- a) Frequency Modulation (FM) and Phase Modulation (PM): Time and Frequency domain representations, Spectral representation of FM and PM for a single tone message, Bessel's functions and Fourier series. ; Phasor diagram ;
  - b) Generation of FM & PM: Narrow and Wide-band angle modulation, Basic block diagram representation of generation of FM & PM, Concept of VCO & Reactance modulator
  - c) Demodulation of FM and PM: Concept of frequency discriminators, Phase Locked Loop
- Mod - 4 Multiplexing **8L**
- a) Frequency Division Multiplexing, Time Division Multiplexing, (FDM)
  - b) Stereo - AM and FM: Basic concepts with block diagrams
  - c) Random Signals and Noise in Communication System:

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- i) Noise in Communication systems - Internal & External noise, Noise Temperature, Signal-to-Noise ratio, White noise, thermal noise, Figure of Merit.
- ii) Noise performance in Analog Communication systems: SNR calculation for DSB/TC, DSB-SC, SSB-TC, SSB-SC & FM
- d) Conditional probability, communication example, joint probability, statistical independence, random variable-continuous and discrete, cumulative distribution function, probability density function – Gaussian, Rayleigh and Rician.

**Text Books:**

- 7. Taub and Schilling , “Principles of Communication Systems”, 2<sup>nd</sup> ed., Mc-Graw Hill
- 8. B.P.Lathi -Communication Systems- BS Publications
- 9. V Chandra Sekar - Analog Communication- Oxford University Press

**References:**

- 1. Carlson—Communication System,4/e , Mc-Graw Hill
- 2. Proakis & Salehi Fundamentals of Communication Systems- Pearson
- 3. Singh & Sapre—Communication Systems: 2/e, TMH
- 4. P K Ghosh- Principles of Electrical Communications- University Press
- 5. L.W.Couch II, “Digital and Analog Communication Systems”, 2<sup>e</sup>, Macmillan Publishing
- 6. Blake, Electronic Communication Systems- Cengage Learning
- 7. S Sharma, Analog Communication Systems- Katson Books

**Learning outcome:**

Module - 1: The learner must be able to appreciate the need for modulation and calculate the antenna size for different carrier frequencies.

From the functional representation of the modulated carrier wave, the learner must be able to identify the type of modulation, calculate the side-band frequencies, identify the modulating and carrier frequencies, decide the type of generation method to be adopted. Solve problems.

Module - 2: After understanding the basic concepts the learner must be able to compare between the different demodulation methods, design an envelope detector, calculate the IF and image frequencies for the superheterodyne receivers given the carrier and modulating frequencies, calculate the oscillator frequency.

Module - 3: From the functional representation of the modulated carrier wave, the learner must be able to identify the type of modulation, calculate the side-band frequencies, identify the modulating and carrier frequencies, decide the type of generation method to be adopted. Solve problems.

Module - 4: Appreciate the importance of Multiplexing, find out their application areas. The learner must be able to calculate the Noise temperature & SNR for different systems, also compare between the performance of the different modulation methods by comparing their SNR. Also Understand the statistical analysis of Communication System.

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<b>EC402</b>	<b>Analog circuits</b>	<b>3L:0T:0P</b>	<b>3 credits</b>
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**Module I**

**10L**

Diode Circuits: Rectifiers, Clipper, Clamper

Amplifier models: Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier.

Biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features, small signal analysis, low frequency transistor models, estimation of voltage gain, input resistance, output resistance etc., design procedure for particular specifications, low frequency analysis of multistage amplifiers.

**Module II**

**6L**

High frequency transistor models, frequency response of single stage and multistage amplifiers, cascode amplifier. Various classes of operation (Class A, B, AB, C etc.), Feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc.,

**Module III**

**6L**

Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators(phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), Multivibrators (Monostable, Astable and Bistable)

Current mirror: Basic topology and its variants, V-I characteristics, output resistance and minimum sustainable voltage ( $V_{ON}$ ), maximum usable load.

**Module IV**

**10L**

Differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR.

OP-AMP: Basic structure and characteristics, inverting and non-inverting amplifiers

OP-AMP applications: Integrator and differentiator, summing amplifier, Log-Antilog amplifiers, Schmitt trigger and its applications.

Active filters: Low pass, high pass, band pass and band stop, design guidelines.

**Text/Reference Books:**

1. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.
2. J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992.
3. P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
4. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College11 Publishing, Edition IV
6. Paul R. Gray and Robert G.Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley, 3<sup>rd</sup> Edition

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**Course Outcomes:**

At the end of this course students will demonstrate the ability to

1. Understand the characteristics of diodes and transistors
2. Design and analyze various rectifier and amplifier circuits
3. Design sinusoidal and non-sinusoidal oscillators
4. Understand the functioning of OP-AMP and design OP-AMP based circuits

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<b>EC403</b>	<b>Microprocessor &amp; Microcontroller</b>	<b>3L:0T:0P</b>	<b>3 credits</b>
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**Module I** **10L**

Microprocessors 8085 and 8086- Pin description, memory, data structure/ access. Overview of microcomputer systems and their building blocks, memory interfacing, concepts of interrupts and Direct Memory Access (DMA), instruction sets of microprocessors (with examples of 8085 and 8086

**Module II** **8L**

Interfacing with peripherals- timer, serial I / O, parallel I / O, A/D and D/A converters; Arithmetic coprocessors, System level interfacing design.

**Module III** **8L**

Concepts of virtual memory, Cache memory; Advanced coprocessor architectures- 286, 486, Pentium; Microcontrollers 8051 systems- pin and port description.

**Module IV** **6L**

Introduction to RISC processors; ARM microcontrollers interface design.

**Text/Reference Books:**

1. R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085/8080A, Penram International Publishing, 1996
2. D A Patterson and J H Hennessy, "Computer Organization and Design The hardware and software interface. Morgan Kaufman Publishers.
3. Douglas Hall, Microprocessors Interfacing, Tata McGraw Hill, 1991.
4. Kenneth J. Ayala, The 8051 Microcontroller, Penram International Publishing, 1996.
5. Keneth Ayala, keneth. J. Ayala- The 8086 Microprocessor: Programming and interfacing the PC- West Pub.

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

1. Do assembly language programming
2. Do interfacing design of peripherals like, I/O, A/D, D/A, timer etc.
3. Develop systems using different microcontrollers
4. Understand RSIC processors and design ARM microcontroller based systems

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ES-CS401	Design and Analysis of Algorithm	3L:0T:0P	3 credits
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**Objectives of the course**

- Analyze the asymptotic performance of algorithms.
- Write rigorous correctness proofs for algorithms.
- Demonstrate a familiarity with major algorithms and data structures.
- Apply important algorithmic design paradigms and methods of analysis. synthesise efficient algorithms in common engineering design situations.

**Detailed contents:**

**Module 1:**

**8L**

Introduction: Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds - best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem.

**Module 2:**

**8L**

Fundamental Algorithmic Strategies: Brute-Force, Greedy, Dynamic Programming, Branch-and-Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving, Bin Packing, Knapsack TSP. Heuristics - characteristics and their application domains.

**Module 3:**

**6L**

Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.

**Module 4:**

**6L**

Tractable and Intractable Problems: Computability of Algorithms, Computability classes - P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques.

**Module 5:**

**4L**

Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP - PSPACE

**Suggested books:**

1. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2. Fundamentals of Algorithms - E. Horowitz et al.

**Suggested reference books**

1. Algorithm Design, 1ST Edition, Jon Kleinberg and Éva Tardos, Pearson.
2. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.
3. Algorithms—A Creative Approach, 3RD Edition, Udi Manber, Addison-Wesley, Reading, MA.

**Course Outcomes**

1. For a given algorithms analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms.

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2. Describe the greedy paradigm and explain when an algorithmic design situation calls for it. For a given problem develop the greedy algorithms.
3. Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Synthesize divide-and-conquer algorithms. Derive and solve recurrence relation.
4. Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. For a given problems of dynamic-programming and develop the dynamic programming algorithms, and analyze it to determine its computational complexity.
5. For a given model engineering problem model it using graph and write the corresponding algorithm to solve the problems.
6. Explain the ways to analyze randomized algorithms (expected running time, probability of error).
7. Explain what an approximation algorithm is. Compute the approximation factor of an approximation algorithm (PTAS and FPTAS).

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<b>BS-M401</b>	<b>Numerical Methods (BS)</b>	<b>2L:0T:0P</b>	<b>2 credits</b>
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**Module I**

**10L**

Approximation in numerical computation: Truncation and rounding errors, Fixed and floating-point arithmetic, Propagation of errors.

Interpolation: Newton forward/backward interpolation, Lagrange's and Newton's divided difference Interpolation.

Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Expression for corresponding error terms.

**Module II**

**8L**

Numerical solution of a system of linear equations:

Gauss elimination method, Matrix inversion, LU Factorization method, Gauss-Seidel iterative method.

Numerical solution of Algebraic equation: Bisection method, Regula-Falsi method, Newton-Raphson method.

**Module III**

**4L**

Numerical solution of ordinary differential equation: Euler's method, Runge-Kutta methods, Predictor-Corrector methods and Finite Difference method.

(6)

Text Books:

1. C.Xavier: C Language and Numerical Methods.
2. Dutta & Jana: Introductory Numerical Analysis.
3. J.B.Scarborough: Numerical Mathematical Analysis.
4. Jain, Iyengar, & Jain: Numerical Methods (Problems and Solution).

References:

1. Balagurusamy: Numerical Methods, Scitech.
2. Baburam: Numerical Methods, Pearson Education.
3. N. Dutta: Computer Programming & Numerical Analysis, Universities Press.
4. Soumen Guha & Rajesh Srivastava: Numerical Methods, OUP.
5. Srimanta Pal: Numerical Methods, OUP.



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<b>BS-B401</b>	<b>Biology for Engineers</b>	<b>2L:1T:0P</b>	<b>3 credits</b>
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**Module 1.**

*2 hours*

*Introduction*

**Purpose:** To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry

Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18<sup>th</sup> Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

**Module 2.**

*3 hours*

*Classification*

**Purpose:** To convey that classification *per se* is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted.

Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on

(a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes.  
(c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion - aminotelic, uricotelic, ureotelic (e) Habitata- aquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus

**Module 3.**

*4 hours*

*Genetics*

**Purpose:** To convey that “Genetics is to biology what Newton’s laws are to Physical Sciences”

Mendel’s laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

**Module 4.**

*4 hours*

*Biomolecules*

**Purpose:** To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine

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Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.

**Module 5.**

*4 Hours*

*Enzymes*

**Purpose:** To convey that without catalysis life would not have existed on earth

Enzymology: How to monitor enzyme catalyzed reactions. How does an enzyme catalyze reactions. Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.

**Module 6.**

*4 hours*

*Information Transfer*

**Purpose:** The molecular basis of coding and decoding genetic information is universal. Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

**Module 7.**

*5 hours*

*Macromolecular analysis*

**Purpose:** How to analyse biological processes at the reductionistic level

Proteins- structure and function. Hierarchy in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

**Module 8.**

*4 hour*

*Metabolism*

**Purpose:** The fundamental principles of energy transactions are the same in physical and biological world.

Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergonic reactions. Concept of  $K_{eq}$  and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to  $CO_2 + H_2O$  (Glycolysis and Krebs cycle) and synthesis of glucose from  $CO_2$  and  $H_2O$  (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge

**Module 9.**

*3 hours*

*Microbiology*

Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and

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media compositions. Growth kinetics.

**References:**

- 1) **Biology: A global approach:** Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
- 2) **Outlines of Biochemistry,** Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons
- 3) **Principles of Biochemistry (V Edition),** By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
- 4) **Molecular Genetics (Second edition),** Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
- 5) **Microbiology,** Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

**Course Outcomes**

After studying the course, the student will be able to:

- Describe how biological observations of 18<sup>th</sup> Century that lead to major discoveries.
- Convey that classification *per se* is not what biology is all about but highlight the underlying criteria, such as morphological, biochemical and ecological
- Highlight the concepts of recessiveness and dominance during the passage of genetic material from parent to offspring
- Convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine
- Classify enzymes and distinguish between different mechanisms of enzyme action.
- Identify DNA as a genetic material in the molecular basis of information transfer.
- Analyse biological processes at the reductionistic level
- Apply thermodynamic principles to biological systems.
- Identify and classify microorganisms.

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<b>EC491</b>	<b>Analog Communication Lab</b>	<b>0L:0T:2P</b>	<b>1 credits</b>
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1. Measurement of modulation index of an AM signal.
2. Measurement of output power with varying modulation index an AM signal(for both DSB- & SSB).
3. Measurement of distortion of the demodulated output with varying modulation index of an AM signal (for both DSB-SC & SSB).
4. Measurement of power of different frequency components of a frequency modulated signal & the measurement of the bandwidth.
5. Design and set up a PLL using VCO & to measure the lock frequency.
6. Design and set up a FM demodulator using PLL.
7. Measurement of SNR of a RF amplifier.
8. Measurement of selectivity, sensitivity, fidelity of a superheterodyne receiver.
9. One innovative experiment.

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EC492	Analog Electronic Circuits Lab	0L:0T:2P	1 credits
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1. Conduct experiment to test diode clipping (single/double ended) and clamping circuits (positive/negative).
2. Design and set up the following rectifiers with and without filters and to determine ripple factor and rectifier efficiency:  
(a). Full Wave Rectifier      (b). Bridge Rectifier
3. Design and set up the BJT common emitter amplifier using voltage divider bias with and without feedback and determine the gain- bandwidth product from its frequency response.
4. Set-up and study the working of complementary symmetry class B push pull power amplifier and calculate the efficiency
5. Realize BJT Darlington Emitter follower with and without bootstrapping and determine the gain, input and output impedances
6. Conduct an experiment on Series Voltage Regulator using Zener diode and power transistor to determine line and load regulation characteristics.
7. Design and set-up the following tuned oscillator circuits using BJT, and determine the frequency of oscillation.  
R-C Phase shift Oscillator/Wien Bridge Oscillator
8. Plot the transfer and drain characteristics of n-channel MOSFET and calculate its parameters, namely; drain resistance, mutual conductance and amplification factor.
9. Design, setup and plot the frequency response of Common Source JFET/MOSFET amplifier and obtain the bandwidth.

Course Outcome:

**Students will be able to:**

- CO1: Design and test rectifiers, clipping circuits, clamping circuits and voltage regulators.
- CO2: Compute the parameters from the characteristics of JFET and MOSFET devices.
- CO3: Design, test and evaluate BJT amplifiers in CE configuration.
- CO4: Design and test JFET/MOSFET amplifiers.
- CO5: Design and test a power amplifier.
- CO6: Design and test various types of oscillators.

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<b>EC493</b>	<b>Microprocessor &amp; Microcontroller Lab</b>	<b>0L:0T:2P</b>	<b>1 credits</b>
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1. Familiarization with 8085 & 8051 simulator on PC.
2. Study of prewritten programs using basic instruction set (data transfer, Load/Store, Arithmetic, Logical) on the KIT. Assignments based on above
3. **Programming using kit and simulator for:**
  - i) Table look up
  - ii) Copying a block of memory
  - iii) Shifting a block of memory
  - iv) Packing and unpacking of BCD numbers
  - v) Addition of BCD numbers
  - vi) Binary to ASCII conversion
  - vii) String Matching, Multiplication using shift and add method and Booth's Algorithm
4. Program using subroutine calls and IN/OUT instructions using 8255 PPI on the trainer kit e.g. subroutine for delay, reading switch state and glowing LEDs accordingly.
5. Study of timing diagram of an instruction on oscilloscope..
6. Interfacing of 8255: Keyboard and Multi-digit Display with multiplexing using 8255
7. Study of 8051 Micro controller kit and writing programs as mentioned in S/L3. Write programs to interface of Keyboard, DAC and ADC using the kit.
8. Serial communication between two trainer kits

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<b>BS-M491</b>	<b>Numerical Methods Lab (BS)</b>	<b>0L:0T:2P</b>	<b>1 credits</b>
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Assignments on Newton forward /backward, Lagrange's interpolation.

2. Assignments on numerical integration using Trapezoidal rule, Simpson's 1/3 rule, Weddle's rule.
3. Assignments on numerical solution of a system of linear equations using Gauss elimination and Gauss-Seidel iterations.
4. Assignments on numerical solution of Algebraic Equation by Regular-falsi and Newton Raphson methods.
5. Assignments on ordinary differential equation: Euler's and Runge-Kutta methods.
6. Introduction to Software Packages: Matlab / Scilab / Labview / Mathematica.