MICROPROCESSORS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV (EC/TC

Subject Code	15EC42	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of LectureHours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Familiarize basic architecture of 8086 microprocessor
- Program 8086 Microprocessor using Assembly Level Language
- Use Macros and Procedures in 8086 Programs
- Understand interfacing of 16 bit microprocessor with memory and peripheral chips involving system design
- Understand the architecture of 8088, 8087 Coprocessor and other CPU architectures

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1		
8086 PROCESSOR: Historical background (refer Reference Book 1), 8086 CPU Architecture (1.1 – 1.3 of Text). Addressing modes, Machine language instruction formats, Machine coding the program (2.2, 2.1, 3.2 of Text). **INSTRUCTION SET OF 8086:** Data transfer and arithmetic instructions. Control/Branch Instructions, Illustration of these instructions with example programs (2.3 of Text).	**10 Hours**	**L1, L2, L3**
Module -2		
Logical Instructions, String manipulation instructions, Flag manipulation and Processor control instructions, Illustration of these instructions with example programs. Assembler Directives and Operators, Assembly Language Programming and example programs (2.3, 2.4, 3.4 of Text).	**10 Hours**	**L1, L2, L3**
Module -3		
Stack and Interrupts: Introduction to stack, Stack structure of 8086, Programming for Stack. Interrupts and Interrupt Service routines, Interrupt cycle of 8086, NMI, INTR, Interrupt programming, Passing parameters to procedures, Macros, Timing and Delays. (Chap. 4 of Text).	**10 Hours**	**L1, L2, L3**
Module -4		

8086 Bus Configuration and Timings: Physical memory Organization, General Bus operation cycle, I/O addressing capability, Special processor activities, Minimum mode 8086 system and Timing diagrams, Maximum Mode 8086 system and Timing diagrams. (1.4 to 1.9 of Text). **Basic Peripherals and their Interfacing with 8086 (Part 1)**: Static RAM Interfacing with 8086 (5.1.1), Interfacing I/O ports, PIO 8255, Modes of operation – Mode-0 and BSR Mode, Interfacing Keyboard and 7-Segment digits using 8255 (Refer 5.3, 5.4, 5.5 of Text).	**10 Hours**	**L1, L2, L3**
Module 5		
Basic Peripherals and their Interfacing with 8086 (Part 2): Interfacing ADC-0808/0809, DAC-0800, Stepper Motor using 8255 (5.6.1, 5.7.2, 5.8). Timer 8254 – Mode- 1 and 2 and Interfacing programmes for these modes (refer 6.1 of Text). **INT 21H DOS Function calls** - for handling Keyboard and Display (refer Appendix-B of Text). **Other Architectures:** Architecture of 8088 (refer 1.10 upto 1.10.1 of Text) and Architecture of NDP 8087 (refer 8.3.1, 8.3.5 of Text).	**10 Hours**	**L1, L2, L3**

Course outcomes: At the end of the course students will be able to:

- Explain the History of evaluation of Microprocessors, Architecture of 8086, 8088, 8087, CISC & RISC, Von-Neumann & Harvard CPU architecture
- Write 8086 Assembly level programs using the 8086 instruction set
- Write modular programs using procedures and macros.
- Write 8086 Stack and Interrupts programming
- Interface 8086 to Static memory chips and 8255, 8254, 0808 ADC, 0800 DAC, Keyboard, Display and Stepper motors.
- Use INT 21 DOS interrupt function calls to handle Keyboard and Display

Graduating Attributes (as per NBA)

- Engineering Knowledge
- Problem Analysis
- Design / development of solutions (partly)

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 16marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

Advanced Microprocessors and Peripherals - A.K. Ray and K.M. Bhurchandi, TMH, 3rd Edition, 2012, ISBN 978-1-25-900613-5.

Reference Books:

1. **Microprocessor and Interfacing- Programming & Hardware**, Douglas hall, 2nd edition TMH, 2006.
2. **Microcomputer systems-The 8086 / 8088 Family** – Y.C. Liu and A. Gibson, 2nd edition, PHI -2003.
3. **The 8086 Microprocessor: Programming & Interfacing the PC** – Kenneth J Ayala, CENGAGE Learning, 2011.
4. **The Intel Microprocessor, Architecture, Programming and Interfacing** - Barry B. Brey, 6e, Pearson Education / PHI, 2003.

CONTROL SYSTEMS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV (EC/TC)

Subject Code	15EC43	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Know the basic features, configurations and application of control systems.
- Know various terminologies and definitions for the control systems.
- Learn how to find a mathematical model of electrical, mechanical and electro-mechanical systems.
- Know how to find time response from the transfer function.
- Find the transfer function via Masons' rule.
- Analyze the stability of a system from the transfer function.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Introduction to Control Systems: Types of Control Systems, Effect of Feedback Systems, Differential equation of Physical Systems – Mechanical Systems, Electrical Systems, Analogous Systems. Block diagrams and signal flow graphs: Transfer functions, Block diagram algebra and Signal Flow graphs.	**10 Hours**	**L1, L2, L3**
Module -2		
Time Response of feedback control systems: Standard test signals, Unit step response of First and Second order Systems. Time response specifications, Time response specifications of second order systems, steady state errors and error constants. Introduction to PI, PD and PID Controllers (excluding design).	**10 Hours**	**L1, L2, L3**
Module -3		
Stability analysis: Concepts of stability, Necessary conditions for Stability, Routh stability criterion, Relative stability analysis: more on the Routh stability criterion, Introduction to Root-Locus Techniques, The root locus concepts, Construction of root loci.	**10 Hours**	**L1, L2, L3**
Module -4		

Frequency domain analysis and stability: Correlation between time and frequency response, Bode Plots, Experimental determination of transfer function. Introduction to Polar Plots, (Inverse Polar Plots excluded) Mathematical preliminaries, Nyquist Stability criterion, (Systems with transportation lag excluded) Introduction to lead, lag and lead-lag compensating networks (excluding design).	**10 Hours**	**L1, L2, L3**
Module -5		
Introduction to Digital Control System: Introduction, Spectrum Analysis of Sampling process, Signal reconstruction, Difference equations. Introduction to State variable analysis: Introduction, Concept of State, State variables & State model, State model for Linear Continuous & Discrete time systems, Diaganolisation.	**10 Hours**	**L1, L2, L3**

Course outcomes: At the end of the course, the students will be able to

- Develop the mathematical model of mechanical and electrical systems
- Understand time domain specifications for first and second order systems
- Determine the stability of a system in the time domain using Route Harvitz criteria and root locus technique
- Determine the stability of a system in the frequency domain using Nyquist and bode plots
- Model a control system in continuous and discrete time using state variable techniques

Graduating Attributes (as per NBA)

- Engineering Knowledge
- Problem Analysis
- Design / development of solutions (partly)

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 16 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

J.Nagarath and M.Gopal, " Control Systems Engineering", New Age International (P) Limited, Publishers, Fifth edition-2005, ISBN: 81-224-2008-7.

Reference Books:

1. "Modern Control Engineering," K.Ogata, Pearson Education Asia/PHI, 4th Edition, 2002. ISBN 978-81-203-4010-7.
2. "Automatic Control Systems", Benjamin C. Kuo, John Wiley India Pvt. Ltd., 8th Edition, 2008.
3. "Feedback and Control System," Joseph J Distefano III et al., Schaum's Outlines, TMH, 2nd Edition 2007.

SIGNALS AND SYSTEMS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV (EC/TC)

Subject Code	15EC44	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Understand the mathematical description of continuous and discrete time signals and systems.
- Analyze the signals in time domain using convolution difference/differential equations
- Classify signals into different categories based on their properties.
- Analyze Linear Time Invariant (LTI) systems in time and transform domains.
- Build basics for understanding of courses such as signal processing, control system and communication.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Introduction and Classification of signals: Definition of signal and systems, communication and control systems as examples. Sampling of analog signals, Continuous time and discrete time signal, Classification of signals as even, odd, periodic and non-periodic, deterministic and non-deterministic, energy and power. **Elementary signals/Functions:** exponential, sine, impulse, step and its properties, ramp, rectangular, triangular, signum, sync functions. **Operations on signals:** Amplitude scaling, addition, multiplication, differentiation, integration (Accumulator for DT), time scaling, time shifting and time folding. **Systems:** Definition, Classification: linear and non-linear, time variant and invariant, causal and non-causal, static and dynamic, stable and unstable, invertible.	**10 Hours**	**L1, L2, L3**
Module -2		

Time domain representation of LTI System: System modeling: Input-output relation, definition of impulse response, convolution sum, convolution integral, computation of convolution integral and convolution sum using graphical method for unit step to unit step, unit step to exponential, exponential to exponential, unit step to rectangular and rectangular to rectangular only. Properties of convolution.	**10 Hours**	**L1, L2, L3**
Module -3		
System interconnection, system properties in terms of impulse response, step response in terms of impulse response. **Fourier Representation of Periodic Signals**: Introduction to CTFS and DTFS, definition, properties (No derivation) and basic problems (inverse Fourier series is excluded).	**(04+06 Hours) 10 Hours**	**L1, L2, L3**
Module -4		
Fourier Representation of aperiodic Signals: **FT representation of aperiodic CT signals - FT,** definition, FT of standard CT signals, Properties and their significance. **FT representation of aperiodic discrete signals- DTFT**, definition, DTFT of standard discrete signals, Properties and their significance, **Impulse sampling and reconstruction:** Sampling theorem (only statement) and reconstruction of signals.	**(4+4+2 Hours) 10 Hours**	**L1, L2, L3**
Module -5		
Z-Transforms: Introduction, the Z-transform, properties of the Region of convergence, Properties of the Z-Transform, Inversion of the Z-Transform, Transform analysis of LTI systems.	**10 Hours**	**L1, L2, L3**

Course outcomes: At the end of the course, students will be able to:

- Classify signals and systems
- Determine performance of a system in time-domain given impulse response
- Determine frequency components of a given arbitrary periodic or aperiodic analog signal using Fourier methods
- Determine frequency components of a given arbitrary periodic or aperiodic discrete signal using Fourier methods
- Understandthe properties of Fourier transforms and their use in sampling of analog signals
- Determine stability of a system using Z-Transforms

Graduating Attributes (as per NBA)

- Engineering Knowledge
- Problem Analysis
- Design / development of solutions(partly)

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 16 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

TEXT Book:

Simon Haykins and Barry Van Veen, "Signals and Systems", 2nd Edition, 2008, Wiley India. ISBN 9971-51-239-4.

Reference Books:

1. **Michael Roberts,** "Fundamentals of Signals & Systems", 2nd edition, Tata McGraw-Hill, 2010, ISBN 978-0-07-070221-9.
2. **Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab,** "Signals and Systems" Pearson Education Asia / PHI, 2nd edition, 1997. Indian Reprint 2002.
3. **H. P Hsu, R. Ranjan,** "Signals and Systems", Scham's outlines, TMH, 2006.
4. **B. P. Lathi,** "Linear Systems and Signals", Oxford University Press, 2005.
5. **Ganesh Rao and Satish Tunga,** "Signals and Systems", Pearson/Sanguine Technical Publishers, 2004.

PRINCIPLES OF COMMUNICATION SYSTEMS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV (EC/TC)

Subject Code	15EC45	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Design simple systems for generating and demodulating AM, DSB, SSB and VSB signals
- Understand the concepts in Angle modulation for the design of communication systems
- Design simple systems for generating and demodulating frequency modulated signals
- Learn the concepts of random process and various types of noise.
- Evaluate the performance of the communication system in presence of noise.
- Analyze pulse modulation and sampling techniques

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module – 1		
AMPLITUDE MODULATION: Introduction, Amplitude Modulation: Time & Frequency – Domain description, Switching modulator, Envelop detector. **DOUBLE SIDE BAND-SUPPRESSED CARRIER MODULATION:** Time and Frequency – Domain description, Ring modulator, Coherent detection, Costas Receiver, Quadrature Carrier Multiplexing. **SINGLE SIDE–BAND AND VESTIGIAL SIDEBAND METHODS OF MODULATION:** SSB Modulation, VSB Modulation, Frequency Translation, Frequency- Division Multiplexing, Theme Example: VSB Transmission of Analog and Digital Television (Chapter 3 of Text).	**10 Hours**	**L1, L2, L3**
Module – 2		
ANGLE MODULATION: Basic definitions, Frequency Modulation: Narrow Band FM, Wide Band FM, Transmission bandwidth of FM Signals, Generation of FM Signals, Demodulation of FM Signals, FM Stereo Multiplexing, Phase–Locked Loop: Nonlinear model of PLL, Linear model of PLL, Nonlinear Effects in FM Systems. The Superheterodyne Receiver (refer Chapter 4 of Text).	**10 Hours**	**L1, L2, L3**

Module – 3		
RANDOM VARIABLES & PROCESS: Introduction, Probability, Conditional Probability, Random variables, Several Random Variables. Statistical Averages: Function of a random variable, Moments, Random Processes, Mean, Correlation and Covariance function: Properties of autocorrelation function, Cross–correlation functions (refer Chapter 5 of Text). **NOISE**: Shot Noise, Thermal noise, White Noise, Noise Equivalent Bandwidth (refer Chapter 5 of Text), Noise Figure (refer Section 6.7 of Text).	**10 Hours**	**L1, L2, L3**
Module – 4		
NOISE IN ANALOG MODULATION: Introduction, Receiver Model, Noise in DSB-SC receivers, Noise in AM receivers, Threshold effect, Noise in FM receivers, Capture effect, FM threshold effect, FM threshold reduction, Pre-emphasis and De-emphasis in FM (refer Chapter 6 of Text).	**10 Hours**	**L1, L2, L3**
Module – 5		
DIGITAL REPRESENTATION OF ANALOG SIGNALS: Introduction, Why Digitize Analog Sources?, The Sampling process, Pulse Amplitude Modulation, Time Division Multiplexing, Pulse-Position Modulation, Generation of PPM Waves, Detection of PPM Waves, The Quantization Process, Quantization Noise, Pulse–Code Modulation: Sampling, Quantization, Encoding, Regeneration, Decoding, Filtering, Multiplexing (refer Chapter 7 of Text), Application to Vocoder (refer Section 6.8 of Reference Book 1).	**10 Hours**	**L1, L2, L3**

Course Outcomes: At the end of the course, students will be able to:

- Determine the performance of analog modulation schemes in time and frequency domains.
- Determine the performance of systems for generation and detection of modulated analog signals.
- Characterize analog signals in time domain as random processes and in frequency domain using Fourier transforms.
- Characterize the influence of channel on analog modulated signals
- Determine the performance of analog communication systems.
- Understand the characteristics of pulse amplitude modulation, pulse position modulation and pulse code modulation systems.

Graduating Attributes (as per NBA)

- Engineering Knowledge
- Problem Analysis
- Design / development of solutions (partly)

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

Communication Systems, Simon Haykins & Moher, 5th Edition, John Willey, India Pvt. Ltd, 2010, ISBN 978 – 81 – 265 – 2151 – 7.

Reference Books:

1. **Modern Digital and Analog Communication Systems,** B. P. Lathi, Oxford University Press., 4th edition.
2. **An Introduction to Analog and Digital Communication**, Simon Haykins, John Wiley India Pvt. Ltd., 2008, ISBN 978–81–265–3653–5.
3. **Principles of Communication Systems**, H.Taub & D.L.Schilling, TMH, 2011.
4. **Communication Systems**, Harold P.E, Stern Samy and A Mahmond, Pearson Edition, 2004.
5. **Communication Systems**: **Analog and Digital,** R.P.Singh and S.Sapre: TMH 2nd edition, 2007.

LINEAR INTEGRATED CIRCUITS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV (EC/TC)

Subject Code	15EC46	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Define the basic concepts of OP-Amp.
- Define and describe various parameters of Op-Amp, its characteristics and specifications.
- Discuss the effects of Input and Output voltage ranges upon Op-Amp circuits.
- Sketch and Analyze Op-Amp circuits to determine Input Impedances, output Impedances and other performance parameters.
- Sketch and Explain typical Frequency Response graphs for each of the Filter circuits showing Butterworth and Chebyshev responses where ever appropriate.
- Describe and Sketch the various switching circuits of Op-Amps and analyze its operations.
- Differentiate between various types of DACs and ADCs and evaluate the performance of each with neat circuit diagrams and assuming suitable inputs.

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1		
Operational Amplifier Fundamentals: Basic Op-amp circuit, Op-Amp parameters – Input and output voltage, CMRR and PSRR, offset voltages and currents, Input and output impedances, Slew rate and Frequency limitations. **OP-Amps as DC Amplifiers** – Biasing OP-amps, Direct coupled voltage followers, Non-inverting amplifiers, inverting amplifiers, Summing amplifiers, and Difference amplifiers. Interpretation of OP-amp LM741 & TL081 datasheet. **(Text1)**	**10 Hours**	**L1, L2, L3**
Module -2		
Op-Amps as AC Amplifiers: Capacitor coupled voltage follower, High input impedance – Capacitor coupled voltage follower, Capacitor coupled non inverting amplifiers, High input impedance – Capacitor coupled Non inverting amplifiers, Capacitor coupled inverting amplifiers, setting the upper cut-off frequency, Capacitor coupled difference amplifier. **OP-Amp Applications:** Voltage sources, current sources and current sinks, current amplifiers, instrumentation amplifier, precision rectifiers. **(Text1)**	**10 Hours**	**L1, L2, L3**

Module-3		
More Applications : Limiting circuits, Clamping circuits, Peak detectors, Sample and hold circuits, V to I and I to V converters, Differentiating Circuit, Integrator Circuit, Phase shift oscillator, Wein bridge oscillator, Crossing detectors**,** inverting Schmitt trigger. **(Text 1)** Log and antilog amplifiers, Multiplier and divider. **(Text2)**	**10 Hours**	**L1, L2, L3**
Module -4		
Active Filters: First order and second order active Low-pass and high pass filters, Bandpass Filter, Bandstop Filter. **(Text 1)** **Voltage Regulators:** Introduction, Series Op-amp regulator, IC voltage regulators. 723 general purpose regulators. **(Text 2)**	**10 Hours**	**L1, L2, L3**
Module -5		
Phase locked loop: Basic Principles, Phase detector/comparator, VCO. **DAC and ADC convertor**: DAC using R-2R, ADC using Successive approximation. **Other IC Application:** 555 timer, Basic timer circuit, 555 timer used as astable and monostable multivibrator. **(Text 2)**	**10 Hours**	**L1, L2, L3**

Course outcomes: After studying this course, students will be able to:

- Explain Op-Amp circuit and parameters including CMRR, PSRR, Input & Output Impedances and Slew Rate
- Design Op-Amp based Inverting, Non-inverting, Summing & Difference Amplifier
- Design Op-Amp based AC Amplifiers including Voltage Follower, Inverting / Non-inverting & Difference Amplifier
- Develop circuits for Op-Amp based Voltage / Current Sources & Sinks, Current, Instrumentation and Precision Amplifiers
- Develop circuits for Op-Amp based linear and non-linear circuits comprising of limiting, clampling, Sample & Hold, Differentiator / Integrator Circuits, Peak Detectors ,Oscillators and Multiplier & Devider
- Design first & Second Order Low Pass, High Pass, Band Pass, Band Stop Filters and Voltage Regulators
- Explain applications of linear ICs in phase detector, VCO, DAC, ADC and Timer

Graduate Attributes (as per NBA)

- Engineering Knowledge
- Problem Analysis
- Design / development of solutions

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 16marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under amodule.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. "Operational Amplifiers and Linear IC's", David A. Bell, 2nd edition, PHI/Pearson, 2004. ISBN 978-81-203-2359-9.
2. "Linear Integrated Circuits", D. Roy Choudhury and Shail B. Jain, 4th edition, Reprint 2006, New Age International ISBN 978-81-224-3098-1.

Reference Books:

1. Ramakant A Gayakwad, "Op-Amps and Linear Integrated Circuits," Pearson, 4th Ed, 2015. ISBN 81-7808-501-1.
2. B Somanathan Nair, "Linear Integrated Circuits: Analysis, Design & Applications," Wiley India, 1st Edition, 2015.
3. James Cox, "Linear Electronics Circuits and Devices", Cengage Learning, Indian Edition, 2008, ISBN-13: 978-07-668-3018-7.
4. Data Sheet: http://www.ti.com/lit/ds/symlink/tl081.pdf.

MICROPROCESSOR LABORATORY

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV (EC/TC)

Laboratory Code	15ECL47	IA Marks	20
Number of Lecture Hours/Week	01Hr Tutorial (Instructions) + 02 Hours Laboratory	Exam Marks	80
		Exam Hours	03

CREDITS – 02

Course objectives: This course will enable students to:

- Get familiarize with 8086 instructions and DOS 21H interrupts and function calls.
- Develop and test assembly language programs to use instructions of 8086.
- Get familiarize with interfacing of various peripheral devices with 8086 microprocessor for simple applications.

Laboratory Experiments:	**Revised Bloom's Taxonomy (RBT) Level**
1. Programs involving: **Data transfer instructions like**: i) Byte and word data transfer indifferent addressing Modes ii) Block move (with and without overlap) iii) Block interchange	**L1, L2, L3**
2. Programs involving: **Arithmetic & logical operations like**: i) Addition and Subtraction of multi precision nos. ii) Multiplication and Division of signed and unsigned Hexadecimal nos. iii) ASCII adjustment instructions iv) Code conversions	
3. Programs involving: **Bit manipulation instructions like checking**: i) Whether given data is positive or negative ii) Whether given data is odd or even iii) Logical 1's and 0's in a given data iv) 2 out 5 code v) Bit wise and nibble wise palindrome	

4. Programs involving:

Loop instructions like

i) Arrays: addition/subtraction of N nos., Finding largest and smallest nos., Ascending and descending order
ii) Two application programs using Procedures and Macros (Subroutines)

5. Programs involving

String manipulation like string transfer, string reversing, searching for a string

6. Programs involving

Programs to use DOS interrupt INT 21h Function calls for Reading a Character from keyboard, Buffered Keyboard input, Display of character/ String on console

7. Interfacing Experiments:

Experiments on interfacing 8086 with the following interfacing modules through DIO (Digital Input/Output - PCI bus compatible card / 8086 Trainer)

1. Matrix keyboard interfacing
2. Seven segment display interface
3. Logical controller interface
4. Stepper motor interface
5. ADC and DAC Interface (8 bit)
6. Light dependent resistor (LDR), Relay and Buzzer Interface to make light operated switches

Course outcomes: On the completion of this laboratory course, the students will be able to:

- Program a microprocessor to perform arithmetic, logical and data transfer applications.
- Understand assembler directives, DOS Interrupts, branch and loop operations.
- Interface a microprocessor to various devices for simple applications.
- Effectively utilize microprocessor peripherals.
- Utilize procedures and macros for modular programming.

Graduate Attributes (as per NBA)

- Engineering Knowledge.
- Problem Analysis.
- Design/Development of solutions.

Conduct of Practical Examination:

- All laboratory experiments are to be included for practical examination.
- For examination, one question from software and one question from hardware interfacing to be set.
- Students are allowed to pick one experiment from the lot.
- Change of experiment is allowed only once, in which case Procedure part Marks to be made zero.

LINEAR ICS AND COMMUNICATION LAB

As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV (EC/TC)

Laboratory Code	15ECL48	IA Marks	20
Number of Lecture Hours/Week	01Hr Tutorial (Instructions) + 02 Hours Laboratory	Exam Marks	80
		Exam Hours	03

CREDITS – 02

Course objectives: This laboratory course enables students to:

- Design, Demonstrate and Analyze instrumentation amplifier, filters, DAC, adder, differentiator and integrator circuits, using op-amp.
- Design, Demonstrate and Analyze multivibrators and oscillator circuits using Op-amp
- Design, Demonstrate and Analyze analog systems for AM, FM and Mixer operations.
- Design, Demonstrate and Analyze balance modulation and frequency synthesis.
- Demonstrate and Analyze pulse sampling and flat top sampling.

Laboratory Experiments:	**Revised Bloom's Taxonomy (RBT) Level**
1. Design an instrumentation amplifier of a differential mode gain of 'A' using three amplifiers.	**L1, L2, L3**
2. Design of RC Phase shift and Wein's bridge oscillators using Op-amp.	
3. Design active second order Butterworth low pass and high pass filters.	
4. Design 4 bit R – 2R Op-Amp Digital to Analog Converter (i) using 4 bit binary input from toggle switches and (ii) by generating digital inputs using mod-16 counter.	
5. Design Adder, Integrator and Differentiator using Op-Amp.	
6. Design of Monostable and Astable Multivibrator using 555 Timer.	
7. Demonstrate Pulse sampling, flat top sampling and reconstruction.	
8. Amplitude modulation using transistor/FET (Generation and detection).	
9. Frequency modulation using IC 8038/2206 and demodulation.	
10. Design BJT/FET Mixer.	
11.DSBSC generation using Balance Modulator IC 1496/1596.	
12. Frequency synthesis using PLL.	

Course outcomes: This laboratory course enables students to:

- Gain hands-on experience in building analog systems for a given specification using the basic building blocks.
- Gain hands-on experience in AM and FM techniques, frequency synthesis
- Gain hands-on experience in pulse and flat top sampling techniques
- Make the right choice of an IC and design the circuit for a given application.
- Design and analyze the performance of instrumentation amplifier, LPF, HPF, DAC and oscillators using linear IC.
- Understand the applications of Linear IC for addition, integration and 555 timer operation to generate signals/pulses.

Graduate Attributes (as per NBA)

- Engineering Knowledge.
- Problem Analysis.
- Design/Development of solutions.

Conduct of Practical Examination:

- All laboratory experiments are to be included for practical examination.
- Students are allowed to pick one experiment from the lot.
- Change of experiment is allowed only once, in which case Procedure part Marks to be made zero.