

# **UNIVERSITY OF MUMBAI**

## Revised Syllabus for the Third Year Electronics Engineering (Semester V & VI)

(With effect from the academic year 2009-2010)

**UNIVERSITY OF MUMBAI**  
**SCHEME OF INSTRUCTION AND EVALUATION (R2007) COURSE**  
**B.E. (ELECTRONICS ENGINEERING)**

**SEMESTER: V**

Sr No	Subjects	No.of Periods per week (60 minutes each)			Duration of Theory Papers (Hours)	Marks				
		Lecture	Practical	Tutorial		Theory	Term-Work	Practical (3 Hrs)	Oral	Total
1	Continuous Time Signal & System	4	2	-	3	100	25	-	25	150
2	Microprocessor and Microcontroller - I	4	2	-	3	100	25	25	-	150
3	Electromagnetic Engineering	3	-	1	3	100	25	-	-	125
4	Linear Integrated circuits and Design	4	2	-	3	100	25	25	-	150
5	Digital communication and coding Techniques	4	2	-	3	100	25	-	25	150
6	EVS	2	-	1#	2	50	25	-	-	75
7	Electronics Workshop II	-	4	-	-	-	-	-	50	50
	Total...	22	12	2		550	150	50	100	850

#Classwise tutorial

**COURSE: B.E. (ELETRONICS ENGINEERING)**

**SEMESTER: VI**

Sr. No	Subjects	No.of Periods per week (60 minutes each)			Duration of Theory Papers (Hours)	Marks				
		Lecture	Practical	Tutorial		Theory	Term-Work	Practical 3 hrs	Oral	Total
1	Discrete time Signal and System	4	2	-	3	100	25	-	25	150
2	Microprocessor and Microcontroller - I	4	2	-	3	100	25	25	-	150
3	Microwave devices and circuits	4	2	-	3	100	25	-	-	125
4	Electronic Instrumentation System	4	2	-	3	100	25	-	25	150
5	Power Electronics	4	2	-	3	100	25	25	-	150
6	Elective – 1 <ul style="list-style-type: none"> <li>• Communication systems and applications</li> <li>• Medical electronics</li> <li>• Computer Organization</li> </ul>	4	2	-	3	100	25	-	-	125
	Total...	24	12	-	-	600	150	50	100	850

<b>Lectures: 4 hours / week</b>	<b>Theory Paper: 3 hours and 100 marks</b>
<b>Practicals: 2 hours / week</b>	<b>Termwork: 25 marks Oral Exam:25 Total:150</b>

**T.E. (ELECTRONICS) SEMESTER V**  
**Continuous Time Signal & System**

**Objective**

1. To introduce the student to the idea of signals and systems analysis and characterization in continuous domain.
2. To provide a foundation to numerous other courses that deal with signal and system concepts directly or indirectly: viz: communication, control, statistical signal processing etc

**Pre-requisite:** Basic knowledge of Fourier analysis, Laplace Transform and sampling theorem

**1 Introduction to signals & Systems (10 Hours)**

Definition of Signal  
Elementary Continuous Time (CT) signals like unit step, Impulse, ramp, exponential, sinusoidal etc.  
Operations on signal like shifting, flipping, scaling, addition, multiplication  
Breaking of a CT signal in different basic components  
Concept of system  
Classification of system on the basis of linearity, time variance, causality, memory, stability, invertibility etc  
System representation by a differential equation

**2. Convolution and correlation (Hours 06)**

Concept of Impulse Response  
Convolution integral and system response in CT domain  
Properties, Autocorrelation and its property. Relation of autocorrelation to signal energy, power, ESD, and PSD. Cross correlation and its property.

**3. Fourier Series (FS) & Fourier Transform (FT) for CT systems (Hours 12)**

Review of Trigonometric series, Exponential series properties and uses  
Amplitude & phase spectra  
Power Spectral Density  
Parseval's relation, Relation between Trigonometric and Exponential Fourier series, Gibbs Phenomenon  
The Fourier Transform (FT)  
FT of basic signals  
Properties of FT and derivations  
FT of periodic signals  
Conceptual introduction to C.T. short time Fourier Transform (STFT)  
Energy Spectral Density  
Analog to Digital conversion & its Reconstruction

#### **4. Fundamentals of Random processes (Hours 6)**

Introduction, concept of random variable, PDF of uniform, Gaussian and exponential random variable. Properties of Mean, variance and moments. Two or more random variables, Random processes

#### **5. Laplace transform analysis of signals and systems (Hours 8)**

Definition & properties of Two-sided & one-sided Laplace Transform.

Region of Convergence (ROC)

inverse Laplace transform

Relationship with Fourier Transform & mapping

BIBO stability and ROC

Pole-zero diagram

Impulse response of a system, and impulse response of cascade and parallel systems

Time domain analysis for first and second order systems

Solution to differential equations and system behavior. Zero

state & zero input responses

System response to complex exponential inputs.

#### **6. State -Variable Techniques (Hours 6)**

State –Variable concepts and state variable model , TF

from state variable model and vice versa. Diagonalization

State equations & their time domain and frequency domain solutions

State transition matrix

System state equations

#### **Text- Books:**

1. S. Haykin, Signals and Systems, Wiley Eastern Publication
2. M J. Roberts, Fundamentals of Signals and Systems, second reprint, Tata McGraw- Hill, 2008
3. J.G. Proakis, D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and applications, Prentice Hall of India, 1995
4. Ashok Ambardar, Analog and Digital Signal Processing, Thomson Learning, second edition, 2001
5. B.P.Lathi, linear systems and signals Oxford University Press second Indian Impression, 2007
6. D.D. Shah & A.C. Bhagali, Signals and systems, MPH publication.

#### **Additional Reading:**

1. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th edition, Prentice Hall, 1998
2. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.
3. R.A.Gabel, Signals and linear systems, John wiley and Sons.
4. chen, Signals and Systems Oxford University Press Third Indian Impression, **2007**
5. I J Nagrath, S N Sharma, R Ranjan, and S Kumar, "Signals and Systems", Tata Mcgraw Hill

**Suggested list of simulations**

1. Generation and transformations of basic C.T. signals(2 simulations)
2. Verification of sampling theorem
3. Impulse and step response of a C.T. system
4. Demonstration of Fourier series coefficients
5. Demonstration of Fourier transform of signals
6. Demonstration of Laplace transform of signals
7. Finding Mean, variance and standard deviation of random data
- 8.State space to TF and TF to state space conversion

**T.W. / Oral****Examination: Term work:**

The term work shall consist of at least four assignments and six MATLAB or C simulations covering the whole of syllabus, duly recorded and graded. This will carry a weightage of fifteen marks. A test shall be conducted and will carry a weightage of ten marks. The distribution of marks for term work shall be as follows:

Laboratory work (Experiments and Journal): 10 marks. Test (at least one): 10 marks.

Attendance (Practical and Theory): 05 marks.

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

**Theory Examination:**

1. Question paper will be comprise of total 7 questions, each of 20 marks.
2. Only 5 questions need to be solved.
3. Question number 1 will be compulsory and will cover all modules.
4. Remaining questions will be mixed in nature. (e.g.- suppose Q.2 has part (a) from, module 3 then part (b) will be from any module other than module 3.)
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
6. No question should be asked from pre-requisite module

**T.E. (ELECTRONICS) SEMESTER V**  
**Microprocessor and Microcontroller-I**

<b>Lectures: 4 hours / week</b>	<b>Theory Paper: 3 hours and 100 marks</b>
<b>Practicals: 2 hours / week</b>	<b>Practical Exam: 3 marks:25</b> <b>Term work: 25 marks Total:150</b>

Objective: Objective of this course is to introduce to the students the fundamentals of microprocessor and microcontroller.

Pre-Requisite: Concept of Basic Electronics and Digital Logic Systems.

**Hours 08**

**1. Basics 8085:**

- Basic 8085 microprocessor architecture and its functional blocks.
- 8085 microprocessor IC pin outs and signals, address, data and control buses.
- 8085 features.
- Interrupt system of 8085.
- Stack and subroutine.
- Types of memory and memory interfacing.
- Decoding techniques-absolute and partial.
- Mapping techniques -I/ O mapped I /O and memory mapped-I/O.
- Serial I/O lines of 8085 and the implementation asynchronous serial data communication using SOD and SID.

**Hours 09**

**2. Programming with 8085:**

- Basic instruction set,
- Timing states, machine cycles and instruction cycles.
- Instruction timing diagram and, interrupt process and timing diagram of interrupt instruction execution.
- Writing assembly language programs.
- Looping, counting and indexing operations related programs.
- Stacks and subroutines operations related programs.
- Conditional call and return instructions operations related programs.
- Debugging programs.

**Hours06**

3. Study and Interfacing of peripherals 8155, 8255, 8253/8254, 8259 with 8085.

**Hours08**

**4. Basics of 8051:**

- Comparison of microprocessor and microcontroller.
- Architecture and pin functions of 8051 chip controller.
- CPU timing and machine cycles.
- Internal memory organization.
- Program counter and stack.
- Input/output ports.
- Counters and timers.
- Serial data input and output
- Interrupts.
- Power saving modes.

## Hours09

### 5. Programming with 8051:

1. Instruction set, addressing modes.
2. Immediate, registers, direct and indirect data movement and exchange instructions.
3. Push and pop op-codes.
4. Arithmetic and logic instructions,
5. bit level operations,
6. jump and call instructions,
7. input/output port programming,
8. programming timers,
9. asynchronous serial data communications and
10. hardware interrupt service routines interfacing of LCD display hex keyboard ADC0808. DAC0808 and stepper motor with 8051 current trends in microprocessors and practical implementation.

## Hours08

### 6. Introduction to ARM Processor

1. ARM family architecture,
2. Register architecture,
3. Memory access and addressing modes,
4. Arithmetic and logical instructions,
5. Branching instructions.

Comparative study of salient features of 8051 and its derivatives like 89C51, 89C52, 89C2051 and 89C2052. Current processor and controller survey. (cost, availability, popularity)

#### Recommended Books:

1. Mazidi & Mazidi, The 8085 microcontroller & embedded system, using assembly and C, 2<sup>nd</sup> edi, pearson edu.
2. Microprocessor and interfacing 8085, Douglas V Hall, Tata Mc Gram Hill.
3. Microprocessor-Architecture, programming and application with 8085, gaonkar, penram international.
4. Crisp, introduction to microprocessor & microcontrollers, 2e Elsevier, 2007.
5. ARM system-on-chip architecture, 2e pearson education.
6. Calcut, 8051 microcontrollers: An applications based introduction, Elsevier.
7. DV kodavade, S.Narvadkar, 8085-86 microprocessors Architecture progg and interfaces, wiley.
8. Udyashankara V., Mallikarjunaswamy, 8051 microcontroller, TMH.
9. Han-way Huang, using The MCS-51 microcontroller, Oxford university press.
10. Ayala, 8051 microcontroller, cengage(Thomson).
11. Rout, 8085 microcontroller-architecture, programming and application, 2<sup>nd</sup> edi, penram international.

## **Suggested Practical list for TW**

### **8085 Based (Max 02)**

- 01) Addition and subtraction of two 8-bit numbers with programs based on different addressing modes of 8085A.
- 02) Addition and subtraction of two 16-bit numbers. (Using 2's complement method, also programs which access numbers from specified memory locations.)
- 03) Addition and subtraction of two 16-bit BCD numbers. (Using DAA instruction.)
- 04) Multiplication of two 8-bit numbers using the method of successive addition and Shift & add.
- 05) Division of two 8-bit numbers using the method of successive subtraction and shift & subtract.
- 06) Block transfer and block exchange of data bytes.
- 07) Finding the smallest and largest element in a block of data.
- 08) Arranging the elements of a block of data in ascending and descending order.
- 09) Converting 2 digit numbers to their equivalents.  
a) BCD to HEX and b) HEX to BCD
- 10) Generating delays of different time intervals using delay subroutines and measurement of delay period on CRO using SOD pin of 8085A.
- 11) Generation of Fibonacci Series

### **Application Based (Max 2)**

- 01) Program controlled data transfer using 8255 PPI  
A) To INPUT data bytes from peripheral port and to store them in memory.  
B) To OUTPUT data bytes from memory peripheral port and to store them in memory.
- 02) Study of interrupts by enabling them in main line program and then executing different subroutines when TRAP, RST 7.5, RST 6.5 & RST 5.5 are activated.
- 03) Interfacing 7 segment LED display using 8255A – in static and dynamic mode
- 04) Interfacing ADC 0808/0809
- 05) Interfacing DAC 0808.
- 06) Interfacing stepper motor with microprocessor using 8255A – in Half and Full excitation.
- 07) Interfacing a Centronics type printer.
- 08) Interfacing a Thumbwheel switches.
- 09) Interfacing of 8253/8254.

### **8051 experiments (Max 2)**

1. Arithmetic operations
2. Packing and unpacking
3. Ascending and descending
4. 8051 timer based experiment
5. Transmission of character using RS 232 to PC(preferably on bread board)
6. 16 \* 2 LCD and Hex keyboard interface (preferably on bread board)
7. ADC or DAC interface (any application) (preferably on bread board)

**On latest:****Experiments are to be performed on Proteus VSM Platform (Min 4)**

To design and test circuits on

1. LED blinking,
2. 7segments display,
3. 16\*2 multiple character LCD,
4. Run stepper motor/DC motor,
5. Implement square wave,
6. Temperature display using
7. Demonstration of traffic lights,
8. Speed control of motor,

Using ARM Processor,

**Practical/Oral Examination:**

Practical Examination will be based on experiments performed from the list of experiment given in the syllabus and the evaluation based on the same experiment.

Oral will be based on any experiment performed from the list of experiment given in the syllabus and the entire syllabus,

**Term-work**

Term work shall consist of minimum ten experiments and a written test.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments and Journal): 10 marks.

Test (at least one): 10 marks.

Attendance (Tutorials and Theory): 05 marks.

The final certification and acceptance of term-work ensures the satisfactory performance of Tutorials work and minimum passing in the term-work.

**Theory Examination:**

1. Question paper will comprise of total 7 questions, each of 20 marks.
2. Only 5 questions need to be solved.
3. Question number 1 will be compulsory and will cover all modules.
4. Remaining questions will be from the same module or mixed in nature. (e.g.- suppose Q.2 has part (a) from, module 3 then part (b) will be from any module other than module 3.)
5. In the question paper, weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
6. No question should be asked from pre-requisite module.

## **T.E. (ELECTRONICS) SEMESTER V**

### **Electromagnetic Engineering**

<b>Lectures: 3 per week</b>	<b>Theory Paper: 3 hours and 100 marks</b>
<b>Tutorial: 1 ( each of 60min)</b>	<b>Term work: 25 marks Total:125</b>

**Objective:** Electromagnetic Field Theory deals with electric and magnetic field vectors, whereas circuit theory deals with voltages and currents that are the integrated effects of electric and magnetic fields. An understanding of Electromagnetic is a must to appreciate Wave Propagation, Antenna Theory, Microwave and Optical Fiber System.-

**Pre-requisite:** Vector Algebra

#### **1. Basics of Electromagnetics** **Hours06**

Co-ordinate systems, line, Surface & Volume Integral, Curl, Divergence & Gradient, Electric Charge, Coulomb's law, Charge distribution, Electric Field Intensity, field due to distributed charges, Electric Flux, Gauss's law, Divergence Theorem, Electric Potential & Potential Gradient, Ampere's Law, Magnetic Flux, Faraday's Law, Poisson & Laplace's Equations

#### **2. Maxwell Equations:** **Hours06**

Formation of Maxwell's Equations

Derivation of various basic electro magnetic laws using Maxwell's Equations, Conditions at Boundary Surfaces

#### **3. Electromagnetic Waves** **Hours05**

The wave equation for free space & conducting medium, Uniform Plane wave, Intrinsic Impedance, Helmholtz Equations, Propagation characteristics of Electromagnetic Wave, Polarization, Poynting's Theorem, Instantaneous, Average & Complex Poynting vector

#### **Hours06**

#### **4. The uniform plane wave Propagation**

plane wave reflection and dispersion, reflection of uniform plane waves at normal incidence, standing wave ratio, wave reflections from multiple interfaces, plane wave propagation in general directions, plane wave reflection at oblique incidence angles, total reflection and total transmission of obliquely incident waves, wave propagation in dispersive media, pulse broadening in dispersive media.

#### **5. Transmission Lines** **Hours 08**

Circuit representation of the parallel-plane transmission line, Transmission Line equations, Transmission Line parameters, Terminated Transmission line, Use of Smith Chart, Impedance matching techniques.

#### **6.Radiation & Electromagnetic Interference (EMI)** **Hours05**

Potential Functions & the electromagnetic field, Potential functions for sinusoidal oscillations, The alternating current element (or Oscillating Electric Dipole), Power radiated by a current element & radiation resistance, EMI Sources, Effects of EMI, Need of EMC (Electromagnetic Compatibility), Electrostatic Discharge (ESD)

**Text Books:**

1. E. C. Jordan & K. G. Balmain-Electromagnetic Waves & Radiating Systems, 2e, PHI, 1988.
2. G.S.N.Raju, Electromagnetic Field Theory and Transmission Lines, Pearson Education, 2e, 2008
3. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw-Hill, 2006

**Additional Reading:**

1. John D Krauss, Engineering Electromagnetics, McGraw-Hill, 6e, 2001.
2. Edminister, Engineering Electromagnetics, Schaum series, Tata McGraw-Hill, 2e, 1992.
3. Samuel Liao, Microwave Devices and Circuits, Prentice Hall publication, 3e - 1994
4. Edgar Hund., Microwave Communication Components & Circuits, Glencoe/3e, Mc-Graw-Hill
5. Nannapaneni Narayana Rao, Elements of Engineering Electromagnetics, 6e, Pearson Education
6. Ashutosh Pramanik, Electromagnetism- Theory & Applications, PHI, 2e-2004
7. David K. Cheng, Field and Wave Electromagnetics, 2e, Pearson Education

**Tutorials:**

- At least eight tutorials based on the above syllabus out of which one tutorial should be based on transmission line problems using Smith Chart only.
- Student shall write some simple Electromagnetic Fields Related simulation programs using MATLAB/SCILAB to demonstrate the applications of field theory.

**Term-work:**

A journal shall be consisting of solved problems in tutorials based on teachings in the lectures, in addition to assignments along-with some simple Electromagnetic Fields Related Simulation programs using MATLAB/SCILAB which will demonstrate the applications of field theory. A test based on the above contents shall be conducted and the test paper shall be attached to the journal as a part of term-work

The distribution of marks for term work shall be as follows,

Tutorials: 10 marks.

Test (at least one): 10 marks.

Attendance (Tutorials and Theory): 05 marks.

The final certification and acceptance of term-work ensures the satisfactory performance of Tutorials work and minimum passing in the term-work.

**Theory Examination:**

1. Question paper will comprise of total 7 questions, each of 20 marks.
2. Only 5 questions need to be solved.
3. Question number 1 will be compulsory and will cover all modules.
4. Remaining questions will be from the same module or mixed in nature. (e.g.- suppose Q.2 has part (a) from, module 3 then part (b) will be from any module other than module 3.)
5. **In the question paper, weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.**
6. No question should be asked from pre-requisite module

## **T.E. (ELECTRONICS) SEMESTER V**

### **Linear Integrated Circuit and Design**

<b>Lectures: 4 per week</b>	<b>Theory Paper: 3 hours and 100 marks</b>
<b>Practical: 2 ( each of 60min)</b>	<b>Practical exam: 3hours Marks 25 Term work: 25 marks Total:150</b>

Objective: To teach the basic concepts in the design of electronic circuits using linear integrated circuits and their applications in the processing of analog signals. Also to introduce a few special function integrated circuits such as Regulator ICS, Waveform generator etc.

Pre-requisite: Passive circuit analysis and transistor behavior. single or two stage amplifier, Diff-Amp and Current Mirror concepts

#### **Hours08**

##### **1. Operational Amplifier Fundamentals**

Basic Op Amp Configurations, Ideal Op Amp Circuits Analysis, Simplified Op Amp Circuits Diagram, Input Bias and Offset Currents,  
Low-Input-Bias-Current Op Amps, Input Offset Voltage,  
Low-Input-Offset-Voltage Op Amps, Input Offset-Error Compensation, Maximum Ratings.  
Open-Loop Response,  
Closed-Loop Response  
Input and Output Impedances  
Transient Response  
Effect of Finite GBP on Integrator Circuits  
Effect of Finite GBP on Filters  
Current-Feedback Amplifiers  
The Stability Problem,  
Stability in Constant-GBP Op Amps Circuits,  
Internal Frequency Compensation  
External Frequency Compensation  
Stability in CFA Circuits  
Composite Amplifiers Op  
Op Amp Powering.  
Slew rate and methods of improving slew rate.

#### **Hours 08**

##### **2. Linear Applications of OP-AMP**

Current shunt feedback (Inverting Amplifier) Current Series feedback (Non-Inverting Amplifier) Summing Amplifier, Averaging Amplifier Difference Amplifier, Instrumentation Applications,  
Integrator/Differentiator using OP-AMP

Current-to-Voltage Converters,  
Voltage-to-Currents Converters,  
Grounded load V/I Converter  
V-F and F-V Converters.  
Sample-and-Hold Amplifiers

#### **Hours08**

### **3. Active Filter**

The Transfer function, First-  
Order Active Filters, Audio  
Filter Applications,  
Standard Second- Order Responses, KRC Filters, Multiple-  
Feedback Filters,  
State-Variable and Biquad Filters,  
Sensitivity, Filter approximations,  
Cascade design,  
Generalized impedance converters, Direct  
design,  
Switched capacitor filters.

#### **Hours08**

### **4. Non Linear Applications of OP-AMP**

Voltage Comparators  
Comparator Application  
Schmitt Triggers, Precision  
Rectifier  
Peak Detectors  
Mono-shot Multi-vibrator  
Astable Multi-vibrator  
Triangular /saw-tooth waveform Generator

#### **Hours10**

### **5. Data Converters and Regulators**

Analog Switches  
A-D Conversion Techniques  
D-A Conversion Techniques  
Integrated ICs employing above techniques and their applications  
Functional block diagram of Voltage Regulators Fixed  
voltage Regulators(78XX and 79XX) Variable Voltage  
Regulators (LM317 and CA723)

#### **Hours06**

### **6. Waveform Generators and synthesizers**

Oscillators using OP-AMP (RC –Phase shift and Wien Bridge oscillators) Monolithic  
Timer – NE555  
Phase-Locked Loops, Monolithic PLLs

**Text Books:**

1. Sergio Franco, Design with operational amplifiers and analog integrated circuits, Third edition, McGraw Hill International edition, 2002.
2. Ramakant A. Gayakwad, 'OP-AMP and Linear IC's', Prentice Hall / Pearson Education, 1994.
3. Robert Coughlin and F Driscoll, Operational Amplifiers and Linear Integrated circuits, sixth edition, Pearson Education Asia, 2001
4. D. Roy Choudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2000.

**Additional Reading:**

1. Donald A. Neamen, Electronic Circuit Analysis and Design, Second edition, McGraw Hill International edition 2001
2. James M. Fiore, Op Amps and Linear Integrated circuits, First reprint, Thomson Asia Pte. Ltd., 2001
3. K.R. Botkar, 'Integrated Circuits'. Khanna Publishers, 1996.

**Suggested Practical list**

Sr.No.	Topic	Experiments
1	Operational Amplifier Fundamentals	Determination of Slew Rate, CMRR and Frequency and offset voltage for IC 741 Op-amp.
2	Linear Applications of OP-AMP	Design and implementation of linear equation for op-amp i.e. $V_O = V_1 + V_2 - V_3$ using IC 741
3		Frequency Response of Integrator/differentiator using simulation Program on SPICE
4	Active Filter	Frequency Response of 2 <sup>nd</sup> order HPF filter on SPICE
5		Frequency Response of 2 <sup>nd</sup> order LPF using SPICE
6	Non-linear Applications of OP-AMP	Design of Schmitt Trigger using IC 741 for designed value of UTP and LTP
7		Design of mono-stable Multi-vibrator for required pulse width using IC 741
8		Design of Astable multi-vibrator for required frequency and Duty cycle using IC 741
9		Design of triangular/Saw-tooth wave from generator using IC 741
10	Data Converters and Regulators	Design of R/2R ladder 4-bit D/A Converter using IC 741
11		Design FLASH TYPE 2-bit A/D converter using LM 324
12		Design of LOW/HIGH Voltage Regulator using IC 723
13	Wave Generators and Synthesizers	Design RC oscillators for required frequency and verify it using SPICE code
14		Design of mono-stable Multi-vibrator for required pulse width using IC 555
15		Design of Astable multi-vibrator for required frequency and Duty cycle using IC 555
16		Verify IC 565 as Frequency Demodulator
17		Verify working of waveform generator ICL 8038

**Practical/ Oral Examination:**

Practical Examination will be based on experiments performed from the list of experiment given in the syllabus and the evaluation based on the same experiment. Oral will be based on any experiment performed from the list of experiment given in the syllabus and the entire syllabus.

**Termwork:**

The term-work shall consist of at least six laboratory experiments covering the whole of syllabus, duly recorded and graded as well as at least four computer simulations using EDA tools like PSPICE duly recorded and graded. This will carry a weightage of Ten marks. A test shall be conducted and will carry a weightage of ten marks.

The distribution of marks for term work shall be as follows

Laboratory work (Experiments and Journal): 10 marks. Test (at least one): 10 marks.

Attendance (Practical and Theory): 05 marks.

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

**Theory Examination:**

1. Question paper will comprise of total 7 questions, each of 20 marks.
2. Only 5 questions need to be solved.
3. Question number 1 will be compulsory and will cover all modules.
4. Remaining questions will be from the same module or mixed in nature. (e.g.- suppose Q.2 has part (a) from, module 3 then part (b) will be from any module other than module 3.)
5. In the question paper, weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
6. No question should be asked from pre-requisite module.

## **T.E. (ELECTRONICS) SEMESTER V**

### **Digital Communication and Coding Techniques**

<b>Lectures: 4 hours / week</b>	<b>Theory Paper: 3 hours and 100 marks</b>
<b>Practicals: 2 hours / week</b>	<b>Oral Exam: 25marks,Term work: 25 marks Total:150</b>

**Objective:** The increase in demand for data transmission coupled with the availability of wideband communication channels and sophisticated integrated circuits have led to the development of efficient and reliable digital communication systems. This course emphasizes impact of the channel limitations and characteristics on data transmission using digital data.

**Pre-Requisite:** Concepts of basic communication techniques – Modulation and Demodulation, Sampling, Fourier Transform.

#### **Hours03**

##### **1. Concept of Probability Theory in communication systems**

Random variables, Mean and Variance of Random variables and sum of random variables, Useful PDFs & CDFs : Gaussian , Rayleigh pdf & Rician Distribution , Binomial and Poisson Distributions, Central-Limit Theorem.

#### **Hours05**

##### **2. Information Theory and Source Coding**

Measure of Information, Entropy, Information rate, Channel capacity, Capacity of a Gaussian channel, Bandwidth - S/N trade-off, Source coding theorem, Coding to increase the average information per bit - Huffman coding, Lempel Ziv coding. Examples and application of source coding.

#### **Hours13**

##### **3. Error Control Codes**

Channel coding theorem. Rationale for coding and types of codes, Discrete memoryless channel , some Algebraic concepts - code efficiency and Hamming bound , linear block codes, Cyclic codes, Convolutional codes , Code tree, state and Trellis diagram. Decoding of convolutional codes using Viterbi algorithm.

#### **Hours06**

##### **4. Pulse Shaping for optimum transmission**

Concept of Inter channel and Inter symbol Interference, Eye Pattern, Nyquist's Criterion for distortion less Baseband Binary Transmission, Correlative Coding.

#### **Hours15**

##### **5. Digital Modulation Techniques**

Digital Modulation formats , coherent and non modulation. Digital modulation techniques- BPSK, Modifications of BPSK, QPSK, M-ary PSK,ASK, QAM, BFSK, M- ary FSK and MSK – Transmitter- Receiver, Power spectra, Bandwidth efficiency, Euclidian distance.

Integrate and dump receiver, Matched filter, correlator. The optimum Receiver.

## Hours06

### 6.Spread Spectrum Modulation –

Spread Spectrum Modulation –Pseudo noise

Sequences, Processing Gain and Jamming Margin, Direct-sequence spread spectrum, Frequency –hop Spread Spectrum. Application of spread spectrum : DS- CDMA

#### Text Books:

1. Simon Haykin- Communication System, , John Wiley and sons
2. Taub Schilling & Saha - Principles of communication systems - Tata McGraw Hill, Third edition.
3. Bernad Sklar,-Digital Communication, Pearson Education , 2nd ed
4. Amitabha Bhattacharya,-Digital communication , Tata McGraw Hill
5. Lan A. Glover, Peter M. Grant -Digital Communications, Pearson education, econd edition.
6. Simon Haykin Digital communication, John Wiley and sons

#### Reference Books:

7. John G. Proakis,- Digital Communications, McGraw Hill , 5th ed
8. William D. Stanley & John m. Jeffords, Electronic Communications Principles and Systems, Cengage Learning.
9. Lathi B.P.,- Modern Digital and Analog communications systems - PRISM Indian edition
10. PROAKIS & SALEHI - Communication system engineering, Pearson Education

#### Proposed Practical list

- 1.BPSK
- 2.QPSK
- 3.BFSK
- 4.QASK
- 5.BER calculation for a digital communication system
- 6.Huffman coding
- 7.Lempel Ziv coding
- 8.Linear Block code - Code generation, dmin, syndrome.
- 9.Cyclic Code - Systematic and non-systematic code generation, syndrome.
- 10.Convolution Code – code generation from generator sequences
- 11.Direct sequence spread spectrum

#### T.W. / Oral Examination:

Oral will be based on any experiment performed from the list of experiment given in the syllabus and the entire syllabus.

**Term Work:**

Term work shall consist of minimum eight experiments, Two Assignments and a written test.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments and Journal) : 10 marks. Test (at least one) : 10 marks.

Attendance (Practical and Theory) : 05 marks.

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

**Theory Examination:**

1. Question paper will comprise of total 7 questions, each of 20 marks.
2. Only 5 questions need to be solved.
3. Question number 1 will be compulsory and will cover all modules.
4. Remaining questions will be from the same module or mixed in nature. (e.g.- suppose Q.2 has part (a) from, module 3 then part (b) will be from any module other than module 3.)
5. **In the question paper, weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.**
6. No question should be asked from pre-requisite module.

## **T.E. (ELECTRONICS) SEMESTER V**

### **Environmental Studies**

<b>Lectures: 2per week</b>	<b>Theory Paper: 2 hours and 50 marks</b>
<b>Tutorial: 1 ( each of 60min)</b>	<b>Term work: 25 marks Total:75</b>

**Objective :Objective of this course is to create environmental awareness, of variety of environmental concerns.**

#### **Hours01**

1. The multidisciplinary nature of environmental studies:  
Definition, Scope and importance need for public awareness.

#### **Hours04**

2. Natural Resources

Renewable and non- renewable resources

Natural resources and associated problems

a.Forest resources: use and over-exploitation, deforestation, case studies, timber extraction, mining, dams and their effects on forests and tribal people.

b.Water resources: use and over utilization of surfaces and ground water, floods drought, conflicts over water, dams-benefits and problems.

c.Mineral resources: use and exploitation, environmental effects of extracting and using mineral sources, case studies.

d.Food resources: World food problems overgrazing, effects of modern agriculture, fertilizers-pesticides problems, Water logging, salinity, case studies.

e.Energy resources: Growing energy needs, Renewable and non- renewable sources,use of alternate energy sources, case studies

f. Land resources: Land as a resource, Land degradation, man induced landslides, soil erosion and desertification

Role of an individual in conservation of natural resources. Equitable use resources for sustainable lifestyles

#### **Hours03**

3. Ecosystems

Concepts of ecosystems

Structure and function of an ecosystem

Producers, consumers and decomposers

Energy flow in ecosystems

Ecological succession

Food chains, food web and ecological pyramids

Introduction, types, characteristics features, structure and function of following ecosystems

a. Forest ecosystems

b. Grassland ecosystems c.

Desert ecosystems

d. Aquatic ecosystems( ponds, streams, lakes, rivers, oceans, estuaries)

#### 4. Biodiversity and its conservation (Hours 4)

Introduction- definition: genetic species and ecosystem diversity

Bio-geographical classification of India

Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values

Biodiversity at global, national, local level

India as a mega diversity nation

Hot spots of bio diversity

Threats to biodiversity: habitat loss, poaching of wild life, man wild life conflicts

Endangered and endemic species of India

Conservation of bio-diversity: In-situ and Ex-situ conservation of biodiversity

#### **Hours04**

5. Environmental Pollution Definition- Causes, effects and control measures of:- a.Air pollution

b.Water pollution

c.Soil pollution

d.marine pollution e.

Noise pollution

f. Thermal pollution g.

Nuclear hazards

Solid waste management: Causes, effect and control measures of urban and industrial wastes

Role of an individual in prevention of pollution

Pollution case studies

Disaster management: floods, earthquake, cyclone and land slides.

#### Hours04

6. Social Issues and environment

From unsustainable to sustainable development. Urban problems related to energy

Water conservation rain water, harvesting, water-shed management.

Resettlement and rehabilitation of people, its problem and concerns case studies.

Environmental ethics, issues and possible solution

Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust case studies.

Waste-land reclamation Consumerism

and waste product Environmental

protection act

Air( prevention and control of pollution) act

Water ( prevention and control of pollution) act

Wide-life protection act.

Forest conservation act.

Issues involved in enforcement of environmental legislation. Public awareness

#### **Hours04**

7. Human population and the environment  
Population growth variation among nations  
Population explosion-family welfare program  
Environment and human health

Human rights

Value education

HIV/AIDS

Women and child welfare

Role of information technology in environment and human health

Case studies

#### **Hours06**

#### **8. Understanding existence and co-existence:**

Interrelation and cyclicity between material order, bio-order, animal-order and human-order.

#### **Understanding the human conduct:**

Relationship in family, justice in relationship, relationship of human with nature(environment), human behavior, human values, nature and morality

#### **Understanding the human society:**

Dimensions of humans Endeavor and objectives, inter-relationship in society, mutual fulfillment and cyclicity in nature.

#### **Theory Examination:**

1. Question paper will be comprising of total 7 questions, each of 10 marks.

2. Only 5 questions need to be solved.

3. Question number 1 will be compulsory and covering the all modules.

4. Remaining questions will be mixed in nature. (e.g.- suppose Q.2 has part (a) from, module 3 then part (b) will be from any module other than module 3.)

5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

#### **Term work:**

Term work shall consist of minimum five projects (PROJECTS SHALL BE DESIGNED ON THE SAME GUIDE- LINE OF GIVEN TEXT BOOK) and a written test.

The distribution of marks for term work shall be as follows,

Laboratory work (Tutorial/Project and Journal): 15 marks. Test (at least one): 10 marks.

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

#### **Recommended Books:**

1. Jagdish Krishnawamy , R J Ranjit Daniels, " Environmental Studies", Wiley India Private Ltd. New Delhi

2. Anindita Basak, Environmental Studies, Pearson

3. Deeksha Dave , "Textbook of Environmental Studies", Cengage learning, THOMSON INDIA EDITION

4. Benny Joseph" Environmental Studies" Tata McGRAW HILL

5. D. L. Manjunath, Environmental Studies, Pearson

6. R. Rajgopalan, Environmental Studies, Oxford

7. Erach Bharucha, Textbook of Environmental Studies , Universities Press/Orient BlackSwan

8. Alok Debi, Environmental science and engineering, university press

9. A. Nagraj, Jeevan Vidya- A Primer.

## T.E. (ELECTRONICS) SEMESTER V

### Electronic Workshop-II

<b>Practical: 04 per week</b>	<b>Oral : 50</b>
<b>Tutorial: -</b>	<b>Term work: 25 marks Total:50</b>

**Objective:** This syllabus is designed to encourage students to design and implement innovative ideas. The syllabus will give them in depth practical knowledge from design to the final verification stage. Documentation of any project is an important part of the project and students are expected to document their work properly in standard IEEE format.

Every group of students should select different projects. Number of students should not be less than TWO and not more than THREE in one group.

#### 1. Computer Architecture

Demonstration of various parts of PC, Installation, Network Configuration and Troubleshooting of PC.

#### 2. Microcontroller/Microprocessor Based Project

Students are expected to design any\* microcontroller/microprocessor based system/application. PCB design, simulation and physical verification of the project should be carried out. Documentation of the project is to be done in standard IEEE format using Latex/WinTex. Project report should include abstract in maximum 100 words, keywords, introduction, design, simulation, implementation, results, conclusion and references.

#### 3. VHDL Based Project

Students are expected to design any\* VHDL based application. Simulation, synthesis and implementation on FPGA/CPLD should to be carried out. Documentation of the project is to be done in standard IEEE format using Latex/WinTex. Project report should include abstract in maximum 100 words, keywords, introduction, design, simulation, implementation, results, conclusion and references.

**\*\* To be approved by the subject in-charge**

#### **Oral Exam include —Project report +Presentation (PPT)**

##### **References:-**

1. Govindarajalu B., "IBM Pc and clones: Hardware, Troubleshooting and Maintenance", Tata McGraw Hill.
2. Gilster Ron, "PC Hardware: A Beginner's Guide", Tata McGraw Hill
3. Minasi Mark, "PC Upgrade and Maintenance Guide", BPB Pub.
4. Hallberg Bruce A., "Networking a Beginners Guide", Tata McGraw Hill
5. Ingram, Peter, "Networking in easy Steps", Dreamtech Press
6. Bigelow Stephen, "Troubleshooting, Maintenance and Repairing PC's", Tata McGraw Hill
7. Brown Stephen and Vranesic Zvonko, "Fundamentals of digital logic with VHDL design", Tata McGraw Hill
8. Perry Douglas, "VHDL Programming by Example", Tata McGraw Hill
9. Bhasker J. "VHDL Primer", Pearson Edu.
10. VHDL Reference Manual
11. Reference Manuals for Selected Microcontrollers/Microprocessors

University of Mumbai			
CLASS: T.E. (Electronics Engineering)			Semester - VI
SUBJECT: Discrete time signals and systems			
Periods per week (each of 60 min.)	Lecture	4	
	Practical	2	
	Tutorial	-	
		Hours	Marks
Evaluation System	Theory Examination	3	100
	Practical Examination		
	Oral Examination	-	25
	Term Work	-	25
		Total	150

<b>Objective</b>	This second course in signals and systems aims to introduce the student to the idea of discrete time signal processing as a foundation course for subjects like image processing, speech processing, filter design, adaptive signal processing. It also covers introduction to DSP processors	
<b>Pre-requisite</b>	Basic Continuous signals and systems	
<b>Module</b>	<b>contents</b>	<b>Hours</b>
1	<b>Discrete Time (DT) signals &amp; Systems</b> Signal classification manipulations Signal Periodicity in DT domain Concept of system and System classification System representation as a difference equation Impulse Response Finite Impulse Response (FIR) & Infinite Impulse Response (IIR) systems Convolution and its properties, auto correlation and cross correlation with its properties BIBO stability condition	8
2	<b>Z Transform</b> Two-sided Z Transform and Region of Convergence (ROC) Properties of Z Transform and derivations Relationship with Laplace Transform & mapping One-sided Z Transform Inverse Z Transform	6
3	<b>D.T. System analysis using Z Transform</b> System Transfer function & Impulse response, pole zero plot BIBO stability and ROC Solution of a difference equation Zero input & zero state responses Frequency response using Analytical & graphical techniques Pole zero plot and filter type for first and second order systems System classification based on phase response as Minimum phase, maximum phase, mixed phase or linear phase systems	10
4	<b>DT Signal Analysis &amp; Computation of Spectra</b> DTFS definitions from orthogonal complex exponentials CTFS & DTFS and Properties of DTFS Power Density spectrum DTFT and properties of DTFT Energy Density spectrum Relationship between DTFT & Z transform	6

5	<b>Discrete Fourier Transform (DFT)</b> DFT and comparison with other transforms DFT Properties Circular Convolution Block convolution using DFT by Overlap-add & Overlap-save methods Fast Fourier Transform (FFT) by radix 2 and radix 3 and radix 4 techniques. Decimation in Time Decimation in frequency with development of flow graphs DFT analysis of Sinusoidal signals Goertzel algorithm Comparison of complex and real, multiplication and additions of DFT and FFT DFT computation by Divide and conquer approach Limitations of DFT Applications of FFT	10
6	<b>DSP Processors and application of DSP</b> Need for Special architecture of DSP processor Difference between DSP processor & microprocessor Fixed point and floating point processors A general DSP processor (TMS320C54XX series), TMS6713, and Da-vinvi Application of DSP to speech, image, biomedical and radar processing	08

**Text-Books:**

1. Ashok Ambardar, Digital Signal Processing, Cengage Learning Publication.
2. J.G. Proakis, D.G. Manolakis, Digital Signal Processing: Principles, Algorithms and applications, Prentice Hall of India, 1995
3. A.V. Oppenheim, Ronald W Schafer, Prentice Hall, 1983
4. E.C. Ifeachor and B.W. Jervis, Digital Signal Processing A Practical approach, Pearson Publication
5. B. Venkata Ramani and M. Bhaskar, Digital Signal Processors, Architecture, Programming and TMH, 2004

**Additional Reading:**

1. S.K. Mitra, Digital Signal Processing, Tata McGraw-Hill Publication, 2001
2. B.P. Lathi, linear systems and signals Oxford University Press second Indian Impression, 2007
3. B.Venkata Ramani and M.Bhaskar, Digital Signal Processors, Architecture, Programming and TMH, 2004
4. R.H. Bishop Learning with Lab View 7 Express Pearson Education
5. Gupta, Virtual Instrumentation using Labview Tata McGraw-Hill Publication
6. Chi-tsong Chen Digital signal processing, Oxford University Press

**Suggested list of simulations**

**Matlab or C/C++ or Labview:**

1. Generation and transformations of basic D.T. signals (2 simulations)
2. Discrete periodicity
3. Convolution, correlation, autocorrelation
4. Z transform of standard signals
5. System impulse response for various inputs
6. Magnitude and phase response using DTF
7. Circular convolution using FFT
8. System realization
9. Application of signal processing operation to practical one dimensional signal e.g. speech signal, ECG signal, music signal etc. (different signal can be used by different students group as a practical assignment)
10. Real time experiments using DSP processor

**T.W./Oral Examination:****Term Work:**

The term work shall consist of at least two numerical assignments and eight MATLAB/C or Labview simulations covering the whole of syllabus, duly recorded and graded. This will carry a weightage of fifteen marks. A test shall be conducted and will carry a weightage of ten marks.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments and Journal):	10 marks
Test (at least one):	10 marks
Attendance (Practical and Theory):	05 marks

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

**Theory Examination:**

1. Question paper will be comprise of total 7 questions, each of 20 marks.
2. Only 5 questions need to be solved.
3. Question number 1 will be compulsory and will cover all modules.
4. Remaining questions will be mixed in nature. (e.g.- suppose Q.2 has part (a) from, module 3 then part (b) will be from any module other than module 3.)
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus
6. No question should be asked from pre-requisite module

University of Mumbai			
<b>CLASS: T.E. (Electronics Engineering)</b>		Semester - VI	
<b>SUBJECT: Microprocessors and Microcontrollers-II</b>			
Periods per week (each of 60 min.)	Lecture	4	
	Practical	2	
	Tutorial	-	
		Hours	Marks
Evaluation System	Theory Examination	3	100
	Practical Examination	3	25
	Oral Examination	-	-
	Term Work	-	25
	Total		150

<b>Objective</b>	The objective of this course is to introduce to the students 16 bit Microprocessors & Microcontrollers
<b>Pre-requisite</b>	Concepts of 8 bit Microprocessor and Microcontroller
<b>Module</b>	<b>Hours</b>
1	<b>8086 and 8088 Microprocessors:</b> Architecture and organization of 8086/8088 microprocessors family, bus interface unit, 8086/8088 hardware pin signals, timing diagram of 8086 family microprocessors, simplified read/write bus cycles, 8086 memory addressing, address decoding, memory system design of 8086 family, timing considerations for memory interfacing, input/output port addressing and decoding, introduction to 8087 floating point coprocessor and its connection to host 8086. 15
2	<b>8086 assembly language programming:</b> Addressing modes, 8086 instruction formats and instruction set, data transfer, arithmetic, bit manipulation, string, program execution transfer and program control instructions, machine codes of 8086 instructions, assemble language syntax, assembler directives, initialization instruction, simple sequential and looping programs in assemble language, debugging assembly language programs 10
3	<b>Programmable Interface and peripheral devices:</b> Interfacing of 8155, 8255 and 8259 with 8086 and study and interfacing of 8257 DMA controller with 8086 Comparative study of salient features of 8086, 80296, 80386, 80486 and Pentium 8
4	<b>PIC Controllers: PIC18</b> 1. PIC18 memory organization, 2. CPU registers, 3. Pipelining 4. Instruction format, 5. Addressing modes, 6. Sample of PIC 18 Instructions. Overview of the 8-bit MCU Market 8
5	<b>PIC18 Assembly language Programming</b> 1. Assembly language programme structure, 2. Assembler directives, 3. Writing programmes to perform arithmetic computations, 4. Programme loops, 5. Reading and writing data in programme memory, 6. Logic instructions, 7. Using programme loop to create time delays, 8. Rotate instructions 8

	9. Using rotate instructions to perform multiplications and divisions.	
6	<b>Parallel Ports</b> <ol style="list-style-type: none"> <li>1. I/O Addressing,</li> <li>2. Synchronization</li> <li>3. Overview of the PIC18 parallel ports,</li> <li>4. Interfacing with simple output devices</li> </ol>	7

**Recommended Books:**

- 1) Microprocessors and Interfacing, Douglas V Hall, Tata McGraw Hill
- 2) Han Way Huang, PIC Microcontroller, Cengage Learning
- 3) Design with PIC Microcontrollers By John B. Peatman, Pearson Education Asia LPE
- 4) The 8086/8088 Family, John Uffenbuck, Pearson Media, LPE
- 5) DV Kodavade, S Narvadkar, 8085-86 Microprocessors Architecture Progg and Interfaces, Wiley
- 6) Ajay Deshmukh, Microcontrollers, TMH
- 7) Smith, Programming The Pic Microcontroller with Mbasic (CD), Elsevier
- 8) Gaonkar Ramesh, Fundamentals of microcontrollers and applications in embedded systems, Penram International Publishing
- 9) Martin Bates, PIC Microcontrollers, 2e, Elsevier

**Practical/Oral Examination:**

Practical Examination will be based on experiments performed from the list of experiment given in the syllabus and the evaluation based on the same experiment.

Oral will be based on any experiment performed from the list of experiment given in the syllabus and the entire syllabus.

**Term Work:**

Term work shall consist of minimum eight experiments and a written test.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments and Journal):	10 marks
Test (at least one):	10 marks
Attendance (Practical and Theory):	05 marks

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

**Suggested Practical list**

**8086 (any 4)**

1. Write a program to arrange block of data in 1) ascending and 2) descending order
2. Write a program to find out any power of a number such that  $Z = X^N$ , where N is programmable and X is unsigned number.
3. Write a programmable delay routine
4. Write a program to find out largest number in a block
5. Experiment on string instructions
6. Write a programme to multiply 32 bit number.

**PIC18:**

**The experiments are to be performed by using Proteus VSM Platform (any 4)**

**To design and test circuits**

1. Addition, Subtraction
2. BCD Adder
3. Multiplication, Division
4. 4 bit LCD driver
5. Working of ADC/DAC
6. Demonstration of Traffic light
7. Implement door bell
8. Data Logger
9. Working of calculator

**On latest: Students can perform**

**Theory Examination:**

1. Question paper will be comprise of total 7 questions, each of 20 marks.
2. Only 5 questions need to be solved.
3. Question number 1 will be compulsory and will cover all modules.
4. Remaining questions will be mixed in nature. (e.g.- suppose Q.2 has part (a) from, module 3 then part (b) will be from any module other than module 3.)
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus
6. No question should be asked from pre-requisite module

University of Mumbai			
CLASS: T.E. (Electronics Engineering)			Semester - VI
SUBJECT: MICROWAVE DEVICES AND CIRCUITS			
Periods per week (each of 60 min.)	Lecture	4	
	Practical	2	
	Tutorial	-	
		Hours	Marks
Evaluation System	Theory Examination	3	100
	Practical Examination	-	-
	Oral Examination	-	-
	Term Work	-	25
		Total	150

<b>Objective</b>	With ever-increasing need for radio-frequency spectrum space, microwave communication and optical communication have grown rapidly. At shorter wavelengths the conventional low frequency circuit analysis no longer holds good and hence knowledge of electromagnetic field theory is required for an adequate description of the electrical phenomenon. An understanding of the microwave principles and working of microwave devices is presented in this course.	
<b>Pre-requisite</b>	Knowledge of basic engineering electro magnetics	
<b>Module</b>	<b>Contents</b>	<b>Hours</b>
1	<b>Introduction to microwave communications</b> Microwave Spectrum and Bands, Limitations of conventional circuit theory concepts at microwave frequencies Applications of Microwaves	2
2	<b>Generation and amplification of microwaves</b> Limitations of conventional vacuum tubes at microwave frequencies Two cavity Klystron amplifiers and Reflex Klystron oscillators: Construction, process of velocity modulation and bunching, Applegate diagram, o/p Power and Efficiency, applications Cylindrical magnetron: Construction and working principle, Hull cut off magnetic equation and Hull cut off voltage equation, Cyclotron angular frequency, applications Travelling wave tube: Construction and working principle, applications Numerical examples based on the above topics	8       4
3	<b>Wave guides</b> Rectangular and Circular wave guides, solution of Maxwell's equation for distribution of fields in the waveguides, Characteristics Equation, Dominant and Degenerate Modes, Group and phase velocities, Cut off frequency  Numerical examples based on the above topics	8   4
4	<b>Wave guide components and analysis</b>  Definition and significance of s-parameters, properties of s-parameters  Construction, working principle and s-matrix representation of the following microwave components.  Cavity resonators, Waveguide Attenuators, Waveguide Phase Shifters, Waveguide Multiport Junctions, E plane and H plane Tees, Magic Tee, Hybrid	8

	Ring, Directional Couplers Microwave Ferrite components, Faraday Rotation Isolator, Gyrator, Circulator Numerical examples based on the above topics	3
5	<b>Microwave solid state devices</b> Principle of Operation and characteristics of Gunn diode, TRAPATT and IMPATT diodes, Microwave transistors, Introduction to strip lines	5
6	<b>Microwave Measurement</b> Measurement of Power, Attenuation, Frequency, VSWR, Cavity Q and Impedance	6

**Text Books:**

- 1) Microwave Devices and Circuits, Samuel Y. Liao, PHI
- 2) Microwave Circuits and Passive Devices, M L Sisodia, G S Raghuvanshi, New Age International (p) Ltd
- 3) Microwave Engineering, Annapurna Sas, Tata McGRAW Hills

**Additional Reading:**

- 1) Electronic Communication Systems, Kennedy, Davis, 4e TMH
- 2) Microwave Engineering, Passive Circuits, Peter A. Rizzi, PHI
- 3) Foundations for Microwave Engineering, 2e, Robert E. Collin John Wiley
- 4) Basic Microwave Techniques & Laboratory Manual Sisodia M.L, Raghuvanshi G.S. 2001 New Age International 9p) Ltd

**Proposed Practical list**

To plot the modes of Reflex Klystron Oscillator  
 To plot the Power Frequency Characteristics of Reflex Klystron Oscillator  
 To plot the Radiation Patter of Horn Antenna  
 Study of Waveguide Attenuators  
 Measurement of Standing Wave Ratio & Reflection Coefficient  
 Measurement of Guide Wavelength  
 Study of Directional Coupler  
 V I Characteristics of Gunn diode

**Term Work:**

Term work shall consist of minimum eight experiments and a written test.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments and Journal): 10 marks  
 Test (at least one): 10 marks  
 Attendance (Practical and Theory): 05 marks

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

**Theory Examination:**

1. Question paper will be comprise of total 7 questions, each of 20 marks.
2. Only 5 questions need to be solved.
3. Question number 1 will be compulsory and will cover all modules.
4. Remaining questions will be mixed in nature. (e.g.- suppose Q.2 has part (a) from, module 3 then part (b) will be from any module other than module 3.)
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus
6. No question should be asked from pre-requisite module

University of Mumbai			
CLASS: T.E. (Electronics Engineering)			Semester - VI
SUBJECT: Electronics Instrumentation System			
Periods per week (each of 60 min.)	Lecture	4	
	Practical	2	
	Tutorial	-	
		Hours	Marks
Evaluation System	Theory Examination	3	100
	Practical Examination	-	-
	Oral Examination	-	25
	Term Work	-	25
		Total	150

<b>Objective</b>	An undergraduate course on instrumentation systems in some form is regarded as an essential element of study for all electronic engineering students. A balance must be drawn between the diversity of sensors that are presented and the diversity of electronic signal processing techniques included so that a strong link with other courses is maintained.	
<b>Pre-requisite</b>	System of units, Measuring Instruments, Measurement of Inductance and Capacitance AC bridges	
<b>Module</b>	<b>Contents</b> <span style="float: right;"><b>Hours</b></span>	
1	<b>Instrumentation System</b> <ul style="list-style-type: none"> <li>• Basic Characteristics of Instruments: static and dynamic</li> <li>• Classification of Instruments</li> <li>• Response for standard inputs: Unit step Ramp and sinusoidal signals</li> <li>• Performance characteristics and</li> <li>• Error analysis of measuring system</li> </ul>	08
2	<b>Transducers</b> <ul style="list-style-type: none"> <li>• Requirement of Transducers</li> <li>• Classification of transducers</li> <li>• Advantages of electrical transducer</li> <li>• Transducer used for measurement of different physical parameters such as: displacement, strain, temperature, pressure, flow, speed, accelerator, vibration, weight, level, sound, force and torque</li> <li>• Sensors used in analytical measurement of PH, viscosity, Humidity and dew point.</li> </ul>	10
3	<b>Signal Generation and Conditioning system</b> <ul style="list-style-type: none"> <li>• Various signal generators and its implementation,</li> <li>• Active and passive filters</li> <li>• Filter design for different applications</li> <li>• Switch capacitor filter</li> <li>• Logarithmic amplifier</li> <li>• Instrumentation amplifier with programmable gain,</li> <li>• Window comparator</li> <li>• Input-output protection circuit</li> <li>• Frequency to voltage and voltage to frequency converters</li> <li>• Current to voltage and voltage to current converters</li> <li>• Data converters</li> </ul>	09

4	<b>Data Acquisition System and Advances in Instrumentation systems</b> <ul style="list-style-type: none"> <li>• Single channel data acquisition,</li> <li>• Multi-channel data acquisition systems,</li> <li>• Monitoring instruments: Indicators, Alarm, Recorders</li> <li>• Data Logger,</li> <li>• PC-based Instrumentation System,</li> <li>• HMI, SCADA</li> <li>• Virtual Instrumentation: concept and applications</li> <li>• Distributed Control System (DCS)</li> </ul>	10
5	<b>Controllers</b> <ul style="list-style-type: none"> <li>• Manipulations Devices</li> <li>• The control valves. Valve characteristics,</li> <li>• Solenoid,</li> <li>• Servomechanism and DC and AC Motor.</li> <li>• Continuous and Discontinuous controller</li> <li>• Proportional controller. Proportional Band,</li> <li>• RESET controller</li> <li>• Rate controller</li> <li>• Composite controller</li> <li>• Cascade controller</li> <li>• Feed-forward controller</li> </ul>	06
6	<b>Calibration of Instruments and Controller Tuning</b> <ul style="list-style-type: none"> <li>• Need of Instrument Calibration</li> <li>• Preparation for calibration</li> <li>• Standard calibration procedure</li> <li>• Five point calibration procedure</li> <li>• Controller tuning: need and different method of controller tuning</li> </ul>	05

**Text Books:**

1. Instrumentation Devices and Systems By C S Rangan, G R Sharma, V S V Mani, 2<sup>nd</sup> ed, Tata McGrawhill Publication
2. Process Control System and Instrumentation By Terry Barlett DELIMAR CENGAGE learning Reprint-2008.

**Additional Reading:**

1. Principles of Industrial Instrumentation and Control System by Chennakesava R. Alavala DELIMAR CENGAGE learning Reprint-2008
2. Instrumentation, Measurement and Analysis by B C Nakra, K K Chaudhary, 2<sup>nd</sup> ed, Tata McGrawhill Publication
3. Measurement system Applications and Design by E O Doebelin – 4<sup>th</sup> ed, Tata McGraw-Hill, 1990
4. Learning with LabVIEW TM7 by Robert H. Bishop Express Pearson Education Publication
5. Instrumentation for Engineer and Scientist by John D Turner Martyn Hill Oxford University Press

**Suggested List of Experiments**

1. To study the Response of different instruments for different test inputs (Unit, Ramp and sinusoidal signals) USE EITHER MATLAB/LabView
2. Study the characteristics of different transducers (Two to Four Experiments can be performed to include transducers in Chapter-2)
3. Design of filter (2<sup>nd</sup> order Butherworth) with discrete components Response can be also observed using VI in LabVIEW
4. Design of Instrumentation Amplifier
5. Study of controller modes or PID controller (Either on Trainer kit or Constructing VI on LabVIEW)
6. Experiment to show calibration of Instrument and tuning of Controller

**Termwork:**

The term-work shall consist of at least laboratory experiments covering the whole of syllabus, duly recorded and graded. The guidelines for carrying out the experiments is as given below

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments and Journal):	10 marks
Test (at least one):	10 marks
Attendance (Practical and Theory):	05 marks

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

**Oral Examination:**

Oral will be based on any experiment performed from the list of experiment given in the syllabus and the entire syllabus.

**Theory Examination:**

1. Question paper will be comprise of total 7 questions, each of 20 marks.
2. Only 5 questions need to be solved.
3. Question number 1 will be compulsory and will cover all modules.
4. Remaining questions will be mixed in nature. (e.g.- suppose Q.2 has part (a) from, module 3 then part (b) will be from any module other than module 3.)
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus
6. No question should be asked from pre-requisite module

University of Mumbai			
CLASS: T.E. (Electronics Engineering)			Semester - VI
SUBJECT: Power Electronics			
Periods per week (each of 60 min.)	Lecture	4	
	Practical	2	
	Tutorial	-	
		Hours	Marks
Evaluation System	Theory Examination	3	100
	Practical Examination	-	25
	Oral Examination	-	-
	Term Work	-	25
		Total	150

<b>Objective</b>	To teach the basic concepts of power electronics. Also to study the important power devices in detail along with basic application of SCR as controlled rectifier. To get skill of developing and design related to power electronics circuits.
<b>Pre-requisite</b>	Concept of semiconductor, rectification, behavior of inductor, capacitor, harmonics, Fourier analysis
<b>Module</b>	<b>Contents</b> <span style="float: right;"><b>Hours</b></span>
1	<b>Semiconductor Power Devices:</b> Characteristics of power diodes, power transistors, power MOSFET, IGBT, SCRs, TRIACs, DIAC and GTO. Rating of power devices, series and parallel connections of SCRs. <span style="float: right;">10</span>
2	<b>SCR protections</b> dv/dt, di/dt, over voltage and over current protection, cooling of semiconductor devices, Isolation circuits using optocoupler and transformer. <span style="float: right;">04</span>
3	<b>Turn ON and Turn OFF Circuits:-</b> Turn ON Methods - study of single phase firing circuits using UJT, ramp and pedestal, cosine inverse, microprocessor/microcontroller based Turn OFF Methods-Forced commutation circuits – Parallel Capacitance, resonant turn off, external pulse commutation, auxiliary thyristors and load commutation. (Class A to F) <span style="float: right;">10</span>
4	<b>Application of Thyristors:-</b> Static circuit breakers, over voltage protectors, zero voltage switch, integral cycle triggering, time delay method, soft start method. <span style="float: right;">06</span>
5	<b>Controlled Rectifier Circuits:-</b> Single Phase:- Half wave, full wave, half controlled and full controlled converters with R & RL Load, effect of Freewheeling diode. Calculations of performance parameters expected. <span style="float: right;">12</span>
6	<b>Controlled Rectifier Circuits:</b> Three Phase: - Half wave, full wave, fully controlled converters with Resistive Load only. <span style="float: right;">06</span>

**Text Books:**

- 1) General Electric: SCR manual, USA
- 2) Ned Mohan: Power electronics; John Wiley Pub.
- 3) M.H. Rashid, Power electronics, PHI India
- 4) M.D. Singh and K.B. Khanchandani. Power electronics, Tata McGraw Hill
- 5) P.C. Sen, Power Electronics, TMH
- 6) Dr. P.S. Bimbhra, Power Electroics, Khanna Publications.

**Additional Reading:**

- 1) Chute and Chute: Electronics in Industry; MGH
- 2) B.W. Williams: Power Electronics, John Wiley, 1975

**Suggested Laboratory Experiments**

- 1) To study SCR Characteristics. Also calculate Values of holding and latching current
- 2) To study Diac/Triac Characteristics. Also calculate Break over voltage of diac and Triac
- 3) Application of diac and triac as light dimmer and fan regulator.
- 4) To study different turn on Methods of SCR
  - 1) R
  - 2) R-C
  - 3)UJT
- 5) To study different turn off Methods of SCR (Class A to Class F)
- 6) To study A-C power control using double R-C Network
- 7) To study single phase full controlled Rectifier with R and R-L Load (with and without Free wheeling diode)
- 8) To study single phase half controlled Rectifier with R Load.
- 9) To study single phase full controlled Rectifier (Semi converter) with R and R-L Load (with and without Free wheeling diode)
- 10) Triggering circuits
  - a) Ramp and Pedestal
  - b) Cosine inverse

**Note:- Students are expected to perform minimum 8 experiments**

**Oral Examination:**

Practical Examination will be based on experiments performed from the list of experiment given in the syllabus and the evaluation based on the same experiment.

Oral will be based on any experiment performed from the list of experiment given in the syllabus and the entire syllabus.

**Termwork:**

The term-work shall consist of minimum eight experiments. Two assignments and a written test.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments and Journal):	10 marks
Test (at least one):	10 marks
Attendance (Practical and Theory):	05 marks

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

**Theory Examination:**

1. Question paper will comprise of total 7 questions, each of 20 marks.
2. Only 5 questions need to be solved.
3. Question number 1 will be compulsory and will cover all modules.
4. Remaining questions will be mixed in nature. (e.g.- suppose Q.2 has part (a) from, module 3 then part (b) will be from any module other than module 3.)
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus
6. No question should be asked from pre-requisite module

University of Mumbai			
<b>CLASS: T.E. (Electronics Engineering)</b>		Semester - VI	
<b>SUBJECT: Communication Systems and Application (Elective-1)</b>			
Periods per week (each of 60 min.)	Lecture	4	
	Practical	2	
	Tutorial	-	
		Hours	Marks
Evaluation System	Theory Examination	3	100
	Practical Examination	-	-
	Oral Examination	-	-
		Term Work	25
		Total	125

<b>Objective</b>	This course acquaints the students with antenna fundamentals and continues with a consideration of overview of different communication systems. This study emphasizes the requirements and standards of a quality television system, both monochrome and color TV, Wide usage of satellite communication and Optical Fiber Communication around us Focus is also on RADAR, its fundamentals and performance factors, that gave birth to microwave technology in later years.	
<b>Pre-requisite</b>	Concepts of basic communication techniques, characteristics of guided and unguided media	
<b>Module</b>	<b>Contents</b>	<b>Hours</b>
1	<b>Antennas:</b> The half wave dipole, Antenna characteristics, effects of Ground on antennas, Effects of Antenna height, Antenna coupling, Antenna arrays: directional HF Antennas, UHF and microwave antennas.	08
2	<b>Television principles:</b> Television system and standards, The composite video signal, Blanking and synchronizing pulses, video modulation and VSB signal.	06
3	<b>Color TV:</b> Color TV transmission, Color reception, PAL-B Standard color TV Transmitter and Receiver (block diagram only), features of Cable TV, Digital TV, HDTV, LCD and Plasma T.V.	08
4	<b>Satellite Communication:</b> Kepler's Laws, Satellite orbits, Spacing and frequency allocation, Look angles, Satellite system link models, multiple access: FDMA, TDMA, Direct broadcast satellite services. Applications of LEO, MEO and Geo-stationary satellites.	10
5	<b>Radar Systems:</b> Basic principles, Radar performance factors, Antenna scanning and tracking, MTI and Pulsed Doppler radar, Continuous wave Doppler radar, FM-CW Radar	08
6	<b>Optical communication systems:</b> Key elements of Optical fiber communication link, Fiber configurations and classifications, Losses in fiber cables, Optical sources, Optical Detectors.	08

**Text Books:**

1. Kennedy, Davis – Electronic Communication Systems, Tata Mcgraw Hill, fourth ed, 1999
2. Wayne Tomasi – Advanced Electronic communication systems, PHI, Sixth ed, 2004
3. Gulati – Monochrome and Color Television, New Age International (P) Ltd.
4. Roy Blake – Electronic communication systems, Thomson Learning, 2<sup>nd</sup> ed, 2002
5. A M Dhake – Television & Video engineering, Tata Mcgraw Hill, 2<sup>nd</sup> ed, 2002

**Reference Books:**

1. Jordon, Balman – Electromagnetic waves and Radiating systems, PHI, 2<sup>nd</sup> ed, 1988
2. Merrill Skolnik – Introduction to Radar System, Tata Mcgraw Hill, Third edition, 2001
3. Michael O Kolawole – Radar system peak detection & Tracking, Elsevier
4. Dennis Roddy – Satellite Communication, Mcgraw Hill, third ed, 2001
5. Pratt Bostian – Satellite Communication, John Wiley and sons, 1986
6. Gerd Keiser – Optical Fiber Communications, Tata Mcgraw Hill, fourth ed, 2008

**PRACTICAL SETUP:**

The experimental list should consist of minimum 8 experiments:

- (i) 2 experiments on Antennas
- (ii) 2 experiments on color TV
- (iii) 2 experiments on Satellite communication
- (iv) 2 experiments on Optical fiber communication

**Term work:**

Term work shall consist of minimum eight experiments, and student presentation (not more than two students per group) on communication Application and written test.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments and Journal):	10 marks
Test (at least one):	10 marks
Attendance (Practical and Theory):	05 marks

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

**Theory Examination:**

1. Question paper will comprise of total 7 questions, each of 20 marks.
2. Only 5 questions need to be solved.
3. Question number 1 will be compulsory and will cover all modules.
4. Remaining questions will be mixed in nature. (e.g.- suppose Q.2 has part (a) from, module 3 then part (b) will be from any module other than module 3.)
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus
6. No question should be asked from pre-requisite module

University of Mumbai			
CLASS: T.E. (Electronics Engineering)			Semester - VI
SUBJECT: Medical Electronics (Elective-1)			
Periods per week (each of 60 min.)	Lecture	4	
	Practical	2	
	Tutorial	-	
		Hours	Marks
Evaluation System	Theory Examination	3	100
	Practical Examination	-	-
	Oral Examination	-	-
	Term Work	-	25
		Total	125

<b>Objective</b>	To understand generation of electrical signal after studying anatomy and physiology of human body and different systems. Picking of signal and use of different instruments under different category such as Diagnostic, Intensive care, Therapeutic equipment and Imaging units. To know safety measures in biomedical equipments, Recording electrodes and recording systems used. Introduce concept of Telemetry and Hospital management system	
<b>Pre-requisite</b>	Knowledge of basic requirements of a good instrument and Human body and different life processes.	
<b>Module</b>	<b>Contents</b> <span style="float: right;"><b>Hours</b></span>	
1	<b>Sources of Bio-Electric Potential</b> <ul style="list-style-type: none"> <li>• Man-Instrument system requirements, difficulties and types</li> <li>• Basics of generation of action potential</li> <li>• Recording Electrodes</li> <li>• Electrode – Electrolyte Interface</li> <li>• Physiological Transducers</li> </ul>	8
2	<b>Bio-potential Amplifiers and signal conditioner and Recording Systems</b> <ul style="list-style-type: none"> <li>• Electrocardiogram</li> <li>• Electroencephalogram</li> <li>• Electro-myogram</li> <li>• Electronic-Spirometer</li> <li>• Electrooculogram</li> <li>• Electroretinogram</li> </ul>	8
3	<b>Diagnostic Equipments</b> <ul style="list-style-type: none"> <li>• Electrocardiograph (ECG)</li> <li>• Electroencephalograph (EEG)</li> <li>• Electromyograph</li> <li>• Pulse oximeter</li> <li>• Measurement of blood pressure, blood flow and cardiac output</li> <li>• Impedence Plethysmography</li> <li>• Measurements in the respiratory system</li> </ul>	8
4	<b>Therapeutic and Prosthetic Equipment</b> <ul style="list-style-type: none"> <li>• Defibrillators</li> <li>• Pacemakers</li> <li>• Ventilators,</li> <li>• Bedside Monitor</li> <li>• Audiometer</li> <li>• Hemodialysis</li> <li>• Infant Incubators</li> </ul>	8

	<ul style="list-style-type: none"> <li>• Muscle and Nerve stimulators</li> <li>• Electrocautery machine</li> <li>• Short wave Diathermy</li> <li>• Ultrasound therapy Unit</li> </ul>	
5	<b>Imaging Equipments</b> <ul style="list-style-type: none"> <li>• Computed Tomography</li> <li>• Magnetic Resonance Imaging</li> <li>• Ultrasonic Imaging System</li> <li>• Positron Emission Tomography</li> </ul>	8
6	<b>Safety and Telemetry in Biomedical Instrumentation</b> <ul style="list-style-type: none"> <li>• Causes on Electrical shock micro &amp; macro shock</li> <li>• Electrical safety codes and standards</li> <li>• Methods of accident preventions</li> <li>• Test of grounding system in patient care area, chassis leakage current</li> <li>• Biomedical Telemetry</li> <li>• Hospital management system</li> </ul>	8

**Text Books:**

1. Webster J.G. – Medical Instrumentation – Application and Design, Wiley and Sons Inc, third edition, 1999
2. Khandpur R.S., Handbook of Biomedical Instrumentation, Tata McGraw Hill, second edition, 2003

**Additional Reading:**

1. Carr and Brown, Introduction to biomedical equipment technology, fourth edition, Pearson press, 2003
2. Cromwell L. Weibell & Pfeiffer, Biomedical Instrumentation and measurements, Prentice Hall of India, 1993
3. John G. Webster, Bioinstrumentation John Wiley and sons, 2004

**Practical list**

Sr.No.	Topic	Title of Experiment
1	Sources of Bio-electric Potential	Recording system can be implemented using Lab VIEW VI
2	Bio-potential Amplifiers	Implement ECG preamplifier using Instrumentation Amplifier
3	Signal conditioner and Recording	Design Band pass Filters for EEG (different types of EEG waveform) using Lab VIEW
4	Therapeutic	Working ECG machine
5	Prosthetic	Blood Pressure monitor Unit
6	Equipment	Pulse Oximeter
7		Electro-spirometer
8	Therapeutic	DC Defibrillator Demo
9	Prosthetic Equipment	Muscle Stimulator

**Termwork:**

Term work shall consist of at least six laboratory experiments covering the whole of syllabus, duly recorded and graded. The experiments can be performed with the help of LabVIEW SW as mentioned in the list. This will carry a weightage of Ten marks. A test shall be conducted and will carry a weightage of ten marks.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments and Journal):	10 marks
Test (at least one):	10 marks
Attendance (Practical and Theory):	05 marks

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

**Theory Examination:**

1. Question paper will comprise of total 7 questions, each of 20 marks.
2. Only 5 questions need to be solved.
3. Question number 1 will be compulsory and will cover all modules.
4. Remaining questions will be mixed in nature. (e.g.- suppose Q.2 has part (a) from, module 3 then part (b) will be from any module other than module 3.)
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus
6. No question should be asked from pre-requisite module

University of Mumbai			
CLASS: T.E. (Electronics Engineering)			Semester - VI
SUBJECT: Computer Organization (Elective-1)			
Periods per week (each of 60 min.)	Lecture	4	
	Practical	2	
	Tutorial	-	
		Hours	Marks
Evaluation System	Theory Examination	3	100
	Practical Examination	-	-
	Oral Examination	-	-
		Term Work	25
		Total	125

<b>Objective</b>	The subject of Computer Organization shall lay a strong fundamental base in understanding the functional and design aspects of various units of digital computer. The emphasis shall be on understanding of Hardware issues in computer design while addressing a number of software issues related to instruction execution, storage allocation etc	
<b>Pre-requisite</b>	Fundamentals of Microprocessor Architecture, Memory interfacing	
<b>Module</b>	<b>Contents</b> <span style="float: right;"><b>Hours</b></span>	
1	<b>Basic Processing Unit –</b> <ul style="list-style-type: none"> <li>• CPU Organization</li> <li>• Some Fundamentals like register transfer, fetching and storing a word from memory</li> <li>• Execution of an Instruction including branch</li> <li>• The data path design</li> </ul> Fixed Point Arithmetic – Addition, Fast Addition, Multiplication, Division Algorithms	8
2	<b>Control Unit –</b> <ul style="list-style-type: none"> <li>• Hardwired Control: Design Example of Multiplier/Divisor</li> <li>• Micro programmed Control: Design Examples</li> <li>• Performance Enhancement using Pipelining: Introduction, Data hazards, Instruction hazards, Super scalar Architecture</li> </ul>	8
3	<b>Memory Organization –</b> <ul style="list-style-type: none"> <li>• Memory System: Multiple Level Memories, Concept of cache and Virtual Memory, Address translation, segmentation, paging, TLB, Memory Allocation, Replacement policies</li> <li>• Cache System:               <ul style="list-style-type: none"> <li>- Cache architectures: Look through and Look Aside</li> <li>- Cache organizations: direct and associative mapping</li> <li>- Replacement Algorithms, Hit Ratio, performance of cache memory</li> </ul> </li> </ul>	8
4	<b>Input/Output Organization –</b> <ul style="list-style-type: none"> <li>• I/O devices types and access methods,</li> <li>• Interrupts and DMA,</li> <li>• Types of busses and bus arbitration, Synchronous and Asynchronous Bus</li> <li>• I/O interface – serial and parallel ports</li> <li>• Storage Devices – Organization, Access techniques of magnetic hard disks and optical disks</li> </ul>	8
5	<b>Introduction to Intel IA32 architecture</b> <ul style="list-style-type: none"> <li>• Intel IA32 architecture: pipelined</li> </ul>	8

	<ul style="list-style-type: none"> <li>• Register Structure, Addressing Modes</li> <li>• Advancements in arithmetic and Logical instructions</li> <li>• Exception handling in IA32 architecture</li> </ul>	
6	<b>Introduction to ARM</b> <ul style="list-style-type: none"> <li>• The ARM Family architecture (RISC)</li> <li>• Register Structure</li> <li>• Memory Access and addressing modes</li> <li>• Arithmetic and Logical Instructions</li> <li>• Branching Instructions</li> </ul>	8

**Suggested Books:**

1. Hamacher, Vranesic, Zaky: Computer Organization, Tata McGraw Hill, Fifth Edition
2. John P Hayes: Computer Architecture and Organization, Tata McGraw Hill
3. Hennessy and Patterson: Computer Organization and Design, Morgan Kauffman

**Practical List**

1. Writing program and Simulation of Arithmetic algorithms (2)  
(Like Booth Multiplier/Division Algorithm etc)
2. Writing program and Simulation for Control Unit (1)  
(Like ALU design)
3. Writing program to evaluate various replacement policies (1)
4. Simple programs using Arithmetic and Logical instructions of IA32 Processor (2)  
(Like ASCII to BCD Conversion, multiplication etc)
5. Assignment on I/O organization (1)
6. Program/Assignment on ARM processor (2)
7. Assignment on Cache Memory Design (1)