AC 7/6/2014 Item 4.39

UNIVERSITY OF MUMBAI

Bachelor of Electronics Engineering

Third Year (Semester V and VI), Revised course

(Rev2012) From Academic Year 2014-15

(As per Credit Based Semester and Grading System with effect from the academic year 2012–2013)

From Dean's Desk:

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's) and course objectives and course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Semester based Credit and Grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 3-2 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

Credit and grading based system was implemented for First Year of Engineering from the academic year 2012-2013. Subsequently this system will be carried forward for Second Year Engineering in the academic year 2013-2014, for Third Year and Final Year Engineering in the academic years 2014-2015 and 2015-2016 respectively.

Dr. S. K. Ukarande
Dean,
Faculty of Technology,
Member - Management Council, Senate, Academic Council
University of Mumbai, Mumbai

Preamble:

In the process of change in the curriculum there is a limited scope to have major changes in the fundamental subjects which are mainly part of second year of engineering. The exposure to the latest technology and tools used all over the world is given by properly selecting subjects and their hierarchy in pre-final and final year. Thus this syllabus is made to groom the undergraduate students best suited and competent in all respect with best possible efforts put in by the experts in framing detail contents of individual subjects.

The engineering education in India is expanding in manifolds and the main challenge is the quality education. All the stakeholders are very much concerned about it. To meet this challenge, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the one of the approach of quality assurance in higher education and it is also an achieving recognition.

The institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of graduation. An engineering program must ensure that its graduates understand the basic concepts of science and mathematics, have gone through one engineering field in department of appreciate and use its methodologies of analyses and design, and have acquired skills for life-long learning.

An engineering program must therefore have a mission statement which is in conformity with program objectives and program outcomes that are expected of the educational process. The outcomes of a program must be measureable and must be assessed regularly through proper feedback for improvement of the programme. There must be a quality assurance process in place within the institute to make use of the feedback for improvement of the programme. The curriculum must be constantly refined and updated to ensure that the defined objectives and outcomes are achieved. Students must be encouraged to comment on the objectives and outcomes and the role played by the individual courses in achieving them. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

I, as Chairman, Board of Studies in Electronics Engineering University of Mumbai, happy to state here that, heads of the department and senior faculty from various institute took timely and valuable initiative to frame Program Educational Objectives as listed below.

1. To provide students with a strong foundation in the mathematical, scientific and engineering fundamentals necessary to formulate, solve and analyze engineering problems and to prepare them for graduate studies.
2. To prepare students to demonstrate an ability to identify, formulate and solve electronics engineering problems.
3. To prepare students to demonstrate ability to design electrical and electronics systems and conduct experiments, analyze and interpret data.
4. To prepare students to demonstrate for successful career in industry to meet needs of Indian and multi-national companies.
5. To develop the ability among students to synthesize data and technical concepts from applications to product design.
6. To provide opportunity for students to work as part of teams on multidisciplinary projects.
7. To promote awareness among students for the life-long learning and to introduce them to professional ethics and codes of professional practice.

These are the suggested and expected main objectives and individual affiliated institute may add further in the list. In addition to Program Educational Objectives, for each course of undergraduate program, objectives and expected outcomes from learner's point of view are also included in the curriculum to support the philosophy of outcome based education. I believe strongly that small step taken in right direction will definitely help in providing quality education to the stake holders.

The subjects offered to undergraduate students in pre-final year are at par to the requirement of industry. The students are also made competent to appear for various competitive examination conducted in India and abroad. The subjects offered are at enough level to prepare a base of the students to understand and learn latest state of technology. The students are trained in such a way that they become versatile in hardware and software simulation. Some subjects offered upgrades them in the field of information and technology which is a need of today's' era.

At the end I must outset extend my gratitude to all experts who contributed to make curriculum competent at par with latest technological development in the field of electronics engineering.

Dr. D. G. Borse
Chairman, Board of Studies in Electronics Engineering

Semester V

Sub Code	Subject Title	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
EXC501	Microcontrollers and Applications	04	--	--	04	--	--	04
EXC502	Design with Linear Integrated Circuits	04	--	--	04	--	--	04
EXC503	Electromagnetic Engineering	04	--	--	04	--	--	04
EXC504	Signals and Systems	04	--	#01	04	--	01	05
EXC505	Digital Communication	04	--	--	04	--	--	04
EXS506	* Business Communication and Ethics	--	*04	--	--	02	--	02
EXL501	Microcontrollers and Applications Laboratory	--	02	--	--	01	--	01
EXL502	Design with Linear Integrated Circuits Laboratory		02			01	--	01
EXL503	Digital Communication Laboratory	--	02	--	--	01	--	01
EXL504	Mini Project I	--	#02	--	--	02	--	02
Total		**20**	**10+02**	**01**	**20**	**07**	**01**	**28**

***Common to all branches, 02 Hrs. Class wise and 02 Hrs. Batch wise # Class wise**

Semester V

Subject Code	Subject Title	Examination Scheme							
		Theory Marks				Term Work	Practical And Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. of Test 1 & Test 2					
EXC501	Microcontrollers and Applications	20	20	20	80	--	--	--	100
EXC502	Design with Linear Integrated Circuits	20	20	20	80	--	--	--	100
EXC503	Electromagnetic Engineering	20	20	20	80	--	--	--	100
EXC504	Signals and Systems	20	20	20	80	25	--	--	125
EXC505	Digital Communication	20	20	20	80	--	--	--	100
EXS506	* Business Communication and Ethics	--	--	--	--	50	--	--	50
EXL501	Microcontrollers and Applications Laboratory	--	--	--	--	25	25	--	50
EXL502	Design with Linear Integrated Circuits Laboratory	--	--	--	--	25	25	--	50
EXL503	Digital Communication Laboratory	--	--	--	--	25	---	25	50
EXL504	Mini Project I	--	--	--	--	25	--	25	50
Total		**100**	**100**	**100**	**400**	**175**	**50**	**50**	**775**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
EXC501	Microcontrollers and Applications	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of Test 1 and Test 2					
EXC501	Microcontrollers and Applications	20	20	20	80	--	--	--	100

Course Pre-requisite:

- EXC303: Digital Circuits and Design
- EXC402: Discrete Electronic Circuits
- EXC403: Microprocessor and Peripherals

Course Objectives:

1. Learner shall study Architecture of microcontroller like intel8051 and ARM and its usages.
2. Learner shall also develop interpretation, analysis and design skill using microcontrollers and various peripherals.
3. At the end of course learner should be capable to design and develop a simple microcontroller based application.

Course Outcomes:

The student should be able to:

1. Explain basic terminology and describe the components, parts and operation of a microcontroller based system.
2. Describe the microcontroller architecture and usages of the instruction set of the representative microcontrollers.
3. Explain and perform input/output and interrupt operations in a microcontroller system.
4. Interpret and write simple programs for microcontroller applications.

Module No.	Unit No.	Topics	Hrs.
1		**8051 Microcontroller Architecture**	6
	1.1	8051 architectural features and its purpose, advantages	
2		**8051 Microcontroller Assembly Language Programming**	12
	2.1	Bit, byte, word processing, format conversion between HEX, BCD, ASCII	
	2.2	Data movement / copy operations, Block transfer of data, data swap / exchange	
	2.3	Arithmetic, logical, and stack operation, loops, condition evaluation, decision making based on flags	
	2.4	Call, return, jumps, serial and parallel port handling, timer / counter handling, interrupts and its handling	
3		**8051 Microcontroller Hardware and Software Applications**	10
		Objectives: Interpreting logical, electrical, timing specification, requirement of following interfaces and interfacing and accessing/controlling using assembly programs	
	3.1	External memory interfacing and memory access cycles, polled I/O, Interrupt I/O	
	3.2	**Serial communication using RS232**: Pulse width modulation and DC motor interfacing, electromagnetic relay, stepper motor interfacing, switch interfacing, SCR firing circuit (with electrical isolation)	
	3.3	**Parallel input/output interfacing**: 7-segment LED display interfacing, 8-bit parallel DAC interfacing, 8-bit parallel ADC interfacing, 4x4 matrix keyboard interfacing, temperature (resistive, diode based) sensor, optical (photodiode/ phototransistor, LDR) sensors interfacing, 16x2 generic alphanumeric LCD interfacing	
4		**ARM7TDMI(ARMv4T) Architectural**	10
	4.1	Features, purpose, and advantages	
	4.2	Processor operating states, memory formats, data types, operating modes, registers	
	4.3	The program status registers, exceptions, interrupt latencies, and pipelined architecture advantage	
5		**ARM7TDMI(ARMv4T) Assembly Language Programming**	10
	5.1	8,16,32 bit and floating point numbers processing, format conversion between Hex, BCD, ASCII, data movement/copy operations, block transfer of data, data swap/exchange	
	5.2	Arithmetic, logical, and stack operation, loops, condition evaluation and decision making based on flags, control transfers (Call, Return, Jumps), processor state changing (ARM ←→ THUMB)	
	5.3	Exceptions, interrupts and its handling	
6		**LPC2148 based C Program Applications**	4
	6.1	Applications for On-chip ADC, DAC, parallel port, and serial port accessing	
		Total	52

Reference Books:

1. Kenneth J. Ayala, "*The 8051 Microcontroller architecture, Programming and Applications*" Penram international, Cengage Learning India Pvt. Ltd, (Patparganj), New Delhi.
2. M. A. Mazadi and J. C. Mazadi, "*The 8051 Microcontroller and Embedded Systems*", Pearson Education, Asia
3. V. Udayashankara, "*8051 Microcontroller Hardware, Software and Application*", McGraw-Hill.
4. David Seal, "*ARM Architecture*", Reference Manual (2nd Edition)
5. William Hohl, "*ARM Assembly Language: Fundamentals and Techniques"*

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered as final IA marks

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3: Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining questions will be selected from all the modules.

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Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
EXC502	Design With Linear Integrated Circuits	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of Test 1 and Test 2					
EXC502	Design With Linear Integrated Circuits	20	20	20	80	--	--	--	100

Course Pre-requisite:

- FEC105: Basic Electrical & Electronics Engineering
- EXC302: Electronic Devices
- EXC303: Digital Circuits and Design
- EXC402: Discrete Electronic Circuits

Course Objectives:

1. To teach fundamental principles of standard linear integrated circuits.
2. To develop a overall approach for students from selection of integrated circuit, study its specification, the functionality, design and practical applications

Course Outcomes:

After successful completion of the course student will be able to

1. Demonstrate an understanding of fundamentals of integrated circuits.
2. Analyze the various applications and circuits based on particular linear integrated circuit.
3. Select and use an appropriate integrated circuit to build a given application.
4. Design an application with the use of integrated circuit

Module No.	Unit No.	Topics	Hrs.
1		**Fundamentals of Operational Amplifier**	06
	1.1	Ideal Op Amp, characteristics of op-amp, op-amp parameters, high frequency effects on op-amp gain and phase, slew rate limitation, practical determination of op-amp parameters, single supply versus dual supply op-amp	
	1.2	Operational amplifier open loop and closed loop configurations, Inverting and non-inverting amplifier	
2		**Applications of Operational Amplifier**	12
	2.1	**Amplifiers:** Adder, subtractor, integrator, differentiator, current amplifier, difference amplifier, instrumentation amplifier and application of Op-Amp in transducer measurement system with detail design procedure, single supply DC biasing techniques for inverting, non-inverting and differential amplifiers	
	2.2	**Converters:** Current to voltage and voltage to current converters, generalized impedance converter	
	2.3	**Active Filters:** First order filters, second order active finite and infinite gain low pass, high pass, band pass and band reject filters	
	2.4	**Sine Wave Oscillators:** RC phase shift oscillator, Wien bridge oscillator, Quadrature oscillator	
3		**Non-Linear Applications of Operational Amplifier**	12
	3.1	**Comparators:** Inverting comparator, non-inverting comparator, zero crossing detector, window detector and level detector	
	3.2	**Schmitt Triggers:** Inverting Schmitt trigger, non-inverting Schmitt trigger with adjustable threshold levels	
	3.3	**Waveform Generators:** Square wave and triangular wave generator with duty cycle modulation	
	3.4	**Precision Rectifiers:** Half and full wave precision rectifiers and their applications	
	3.5	Peak detectors, sample and hold circuits, voltage to frequency converter, frequency to voltage converter, logarithmic converters and antilog converters	
4		**Data Converters**	06
	4.1	Performance parameters of ADC, single ramp ADC, ADC using DAC, dual slope ADC, successive approximation ADC, flash ADC, ADC0808/0809 and its interfacing	
	4.2	Performance parameters of DAC, binary weighted register DAC, R/2R ladder DAC, inverted R/2R ladder DAC, DAC0808 and its interfacing	
5		**Special Purpose Integrated Circuits**	08
	5.1	Functional block diagram, working, design and applications of Timer 555.	
	5.2	Functional block diagram, working and applications of VCO 566, PLL 565, multiplier 534, waveform generator XR 2206, power amplifier LM380	
6		**Voltage Regulators**	08
	6.1	Functional block diagram, working and design of three terminal fixed (78XX, 79XX series) and three terminal adjustable (LM 317, LM 337) voltage regulators	
	6.2	Functional block diagram, working and design of general purpose 723 (LVLC, LVHC, HVLC and HVHC) with current limit and current fold-back protection, Switching regulator topologies, functional block diagram and working of LT1070 monolithic switching regulator	
		Total	52

Recommended Books:

1. Sergio Franco, "*Design with operational amplifiers and analog integrated circuits*", Tata McGraw Hill, 3rd Edition.
2. William D. Stanley, "*Operational Amplifiers with Linear Integrated Circuits* ", Pearson, 4th Edition
3. D. Roy Choudhury and S. B. Jain, "*Linear Integrated Circuits*", New Age International Publishers, 4th Edition.
4. David A. Bell, "*Operation Amplifiers and Linear Integrated Circuits*", Oxford University Press, Indian Edition.
5. Ramakant A. Gayakwad, "*Op-Amps and Linear Integrated Circuits*", Pearson Prentice Hall, 4th Edition.
6. R. P. Jain, "*Modern Digital Electronics*," Tata McGraw Hill, 3rd Edition.
7. J. Millman and A. Grabel, "*Microelectronics*", Tata McGraw Hill, 2nd Edition.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3: Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining questions will be selected from all the modules.

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Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
EXC 503	Electromagnetic Engineering	4	--	--	4	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
EXC 503	Electromagnetic Engineering	20	20	20	80	--	--	--	100

Prerequisites: Knowledge of Vector Calculus, Cylindrical and Spherical coordinate systems

Course Objective:

1. To study relationship between electrostatics, steady magnetic field and time varying fields using Maxwell's equations for different media
2. To understand the propagation of wave in different media like dielectric and conducting media by solving wave equation and find parameters of media
3. To calculate energy transported by means of electromagnetic waves from one point to another and to study polarization of waves
4. To solve electromagnetic problems using different numerical methods
5. To extend students' understanding about wave propagation by different techniques such as ground waves and space waves
6. To study radiation from a current element

Course Outcomes:

1. Ability to find nature of electric or magnetic fields produced due to different charge distributions
2. Ability to understand working of different equipment based on electromagnetic effects used in day to day life
3. Knowledge of behavior of EM waves and travelling of waves in free space as well as media
4. Ability to identify and solve problems related to the propagation of waves
5. Ability to understand the basics of wave propagation required for the study of antennas

Module No.	Unit No.	Topics	Hrs.
1.0		**Basic Laws of Electromagnetic and Maxwell's Equations**	10
	1.1	Coulomb's law, Gauss's law, Bio-Savart's law, Ampere's law, Poisson's and Laplace equations	
	1.2	Boundary conditions for static electric and magnetic fields	
	1.3	**Maxwell's Equations:** Integral and differential form for static and time varying fields and its interpretations	
2.0		**Uniform Plane Wave Equation and Power Balance**	10
	2.1	**Wave equation:** Derivation and its solution in cartesian co-ordinates	
	2.2	**Solution of wave equations:** Partially conducting media, perfect dielectrics and good conductors, concept of skin depth	
	2.3	**Electromagnetic Power:** Poynting Vector and power flow in free space and in dielectric, conducting media	
	2.4	**Polarization of wave:** Linear, Circular and Elliptical	
	2.5	**Propagation in different media:** Behavior of waves for normal and oblique incidence in dielectrics and conducting media, propagation in dispersive media	
3.0		**Radiation Field and Computation**	12
	3.1	Concept of vector potential, fields associated with Hertzian dipole	
	3.2	Radiation resistance of elementary dipole with linear current distribution, radiation from half-wave dipole and quarter-wave monopole	
	3.3	**Finite Difference Method (FDM):** Neumann type and mixed boundary conditions, Iterative solution of finite difference equations, solutions using band matrix method	
	3.4	**Finite Element Method (FEM)**: triangular mesh configuration, finite element discretization, element governing equations, assembling all equations and solving resulting equations	
	3.5	**Method of Moment (MOM):**Field calculations of conducting wire, parallel conducting wires	
4.0		**Fundamentals of Antenna**	10
	4.1	**Antenna Parameters:** Radiation intensity, directive gain, directivity, power gain, beam width, band width, gain and radiation resistance of current element	
	4.2	**Half-wave dipole and folded dipole:** Reciprocity principle, effective length and effective area	
	4.3	Radiation from small loop and its radiation resistance, Helical antenna	
5.0		**Radio Wave Propagation**	10
	5.1	**Types of wave propagation:** Ground, space, and surface wave propagation, tilt and surface waves, impact of imperfect earth and earth's behavior at different frequencies	
	5.2	**Space wave propagation:** Effect of imperfection of earth, curvature of earth, effect of interference zone, shadowing effect of hills and building, atmospheric absorption, Super-refraction, scattering phenomena, troposphere propagation and fading	
	5.3	**Sky Wave Propagation:** Reflection and refraction of waves, ionosphere and earth magnetic field effect	
	5.4	**Measures of ionosphere propagation:** Critical frequency, angle of incidence, maximum unstable frequency, skip distance, virtual height, variations in ionosphere	
Total			**52**

Recommended Books:

1. W.H. Hayt, and J.A. Buck, "*Engineering Electromagnetics*", McGraw Hill Publications, 7th Edition, 2006
2. R.K. Shevgaonkar, "*Electromagnetic Waves*", TATA McGraw Hill Companies, 3rd Edition, 2009
3. Edward C. Jordan and Keth G. Balmin, "*Electromagnetic Waves and Radiating Systems*", Pearson Publications, 2nd Edition, 2006
4. Matthew N.D. Sadiku, "*Principles of Electromagnetics*", Oxford International Student 4th Edition, 2007
5. J.D. Kraus, R.J. Marhefka, and A.S. Khan, "*Antennas & Wave Propagation*", McGraw Hill Publications, 4th Edition, 2011

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered as final IA marks

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3: Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining questions will be selected from all the modules.

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Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
EXC504	Signals and Systems	04	--	#01	04	--	01	05

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
EXC504	Signals and Systems	20	20	20	80	25	-	-	125

#Class wise

Course Objective:

1. To provide a comprehensive coverage of continuous time and discrete time of Signals and Systems.
2. To introduce various time domain and frequency domain methods for analysis of Signals and systems.

Course Outcome:

1. Student will be able to differentiate between continuous time and discrete time of Signals and Systems.
2. Student will be able to do time domain and frequency domain analysis of Signals and systems.

Module No.	Unit No.	Topics	Hrs.
1.		**Continuous And Discrete Time Signals And Systems**	8
	1.1	Mathematical representation, classification of CT and DT signals, arithmetic operations on the signals, transformation of independent variable	
	1.2	Mathematical representation, classification of CT and DT systems	
	1.3	Sampling and reconstruction, aliasing effect	
2		**Time Domain Analysis Of Continuous and Discrete Signals And Systems**	6
	2.1	Properties of LTI systems, impulse and step response.	
	2.2	Use of convolution integral and convolution sum for analysis of LTI systems.	
	2,3	Properties of convolution integral/sum.	
3		**Frequency Domain Analysis of Continuous Time System Using Laplace Transform**	8
	3.1	Need of Laplace transform, review of Laplace transform, properties, inverse of Laplace transform, concept of ROC, poles and zeros	
	3.2	Unilateral Laplace transform	
	3.3	Analysis and characterization of LTI system using Laplace transform: impulse and step response, causality, stability, stability of causal system	
	3.4	Block diagram representation	
4		**Frequency Domain Analysis of Discrete Time System Using Z Transform**	14
	4.1	Need of Z transform, definition, properties of unilateral and bilateral Z Transform, mapping with s plane, relationship with Laplace transform	
	4.2	Z transform of standard signals, ROC, poles and zeros of transfer function, inverse Z transform	
	4.3	Analysis and characterization of LTI system using Z transform: impulse and step response, causality, stability, stability of causal system	
	4.4	Block diagram representation, system realization	
5		**Frequency Domain Analysis of Continuous and Discrete Signals**	12
	5.1	Review of Fourier series, Discrete time Fourier series, its properties	
	5.2	Fourier transform, properties of Fourier transform, relationship with Laplace and Z transform	
	5.3	Discrete time Fourier transform, properties, frequency sampling, Discrete Fourier transform, properties	
6		**Correlation and Spectral Density**	04
	6.1	Comparison of convolution and correlation, Auto and cross correlation, energy/power spectral density	
	6.2	Relation of ESD, PSD with auto-correlation	
	6.3	Relationship between ESD/PSD of input and output of LTI system	
		Total	52

Recommended Books:

1. Alan V. Oppenheim, Alan S. Willsky, and S. Hamid Nawab, "*Signals and Systems*", 2nd Edition, PHI learning, 2010.
2. Tarun Kumar Rawat, "*Signals and Systems*", Oxford University *Press 2010.*
3. John Proakis and Dimitris Monolakis, "*Digital Signal Processing*", Pearson Publication, 4th Edition.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3: Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining questions will be selected from all the modules.

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Term Work:

At least 10 assignments based on the entire syllabus of Subject **EXC504 (Signals and Systems)** should be set to have well predefined inference and conclusion. The assignments should be students' centric and attempt should be made to make assignments more meaningful, interesting and innovative. Term work assessment must be based on the **overall performance** of the student with **every assignment graded from time to time**. The grades should be converted into marks as per the **Credit and Grading System** manual and should be **added and averaged**. The grading and term work assessment should be done based on this scheme.

The final certification and acceptance of term work ensures satisfactory performance of tutorial work and minimum passing marks in term work.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
EXC 505	Digital Communication	4	--	--	4	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
EXC 505	Digital Communication	20	20	20	80	--	--		100

Prerequisites: Knowledge of Probability Theory and Signals and Systems

Course Objective:

1. To understand basic Concept of Probability Theory in communication systems.
2. To understand basic concept of Information Theory and Source Coding.
3. To understand Pulse Shaping techniques for optimum transmission of signal.
4. To understand Band pass digital modulation and demodulation (binary and M-level;
5. ASK, PSK and FSK), including their performance in noise.
6. To understand basic concept of channel error correcting codes.
7. To understand basic concept of spread spectrum techniques.

Expected Outcomes:

1. Ability to find nature of random signal and its statistical characteristics.
2. Ability to understand how to make code optimum in containing information generated by source..
3. Ability to find the technique to enhanced the transmission efficiency of the system.
4. Ability to understand different modulation techniques such as bandwidth limited and power limited.
5. Ability to find the technique to combat transmission impairments.
6. Ability to find the modulation technique used in wireless communication..

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Module No.	Unit No.	Topics	Hrs.
1		**Application of Probability Theory in Communication Systems**	07
	1.1	Introduction to digital communication system, significance of AWGN channel, pulse dispersion in the channel	
	1.2	Introduction to probability and sample space , Baye's rule, conditional probability and statistical independence, random variables, probability functions, mean and variance of random variables and sum of random variables	
	1.3	**Probability Models**: Binomial Distribution, Poisson Distribution, Gaussian PDF, Rayleigh PDF and Rician PDF, Central-Limit Theorem	
	1.4	Binary Synchronous Channel(BSC), development of optimal receiver	
2		**Information Theory and Source Coding**	05
	2.1	Measure of Information, Entropy, Information rate, Channel capacity	
	2.2	Capacity of a Gaussian channel, bandwidth, S/N trade-off, Shannon's source coding theorem	
	2.3	Coding to increase the average information per bit, Huffman coding, Lempel Ziv coding, examples and applications of source coding	
3		**Pulse Shaping for Optimum Transmission**	08
	3.1	Line codes and their desirable properties, PSD of digital data.	
	3.2	**Baseband PAM transmission**: Concept of inter channel and inter symbol interference, eye pattern	
	3.3	Concept of equalizer to overcome ISI, Nyquist's Criterion for distortion less transmission	
	3.4	Duo-binary encoding and modified duo-binary encoding	
4		**Digital Modulation Techniques**	15
	4.1	Digital modulation formats, coherent and non- coherent reception	
	4.2	**Binary modulation techniques:** BPSK, BFSK , BASK	
	4.3	**M-ary Modulation techniques:** QPSK, M-ary PSK, MSK , M-ary FSK, M-ary QAM, Differential encoded BPSK & D-QPSK	
	4.4	**Optimal Reception of Digital Data**: A baseband signal receiver and its Probability of error	
	4.5	Optimum receiver and its transfer function, matched filter and its properties	
5		**Error Control Codes**	12
	5.1	Need for channel encoding, discrete memory-less channel , redundancy, code rate ,code efficiency and hamming bound	
	5.2	Linear block codes, cyclic codes, block interleaving	
	5.3	**Convolution codes**: State diagram, code tree, trellis diagram	
	5.4	Decoding of Convolutional codes using Viterbi algorithm	
6		**Spread Spectrum Modulation**	05
	6.1	Need for spread spectrum modulation, pseudo noise sequence generation, direct-sequence spread spectrum (DSSS)	
	6.2	Processing gain and jamming margin, frequency–hop spread spectrum (FHSS)	
	6.3	**Application of spread spectrum :** DS-CDMA	
		Total	52

Recommended Books:

1. Simon Haykin, "*Communication System*", John Wiley And Sons ,4th Ed
2. Taub Schilling And Saha, "*Principles Of Communication Systems*", Tata Mc-Graw Hill, Third Ed
3. Amitabha Bhattacharya, "*Digital Communication*", Tata Mcgraw Hill
4. Lan A. Glover and Peter M. Grant, "*Digital Communications*", Pearson, 2nd Ed.
5. John G. Proakis, "*Digital Communications*", Mcgraw Hill , 5th Ed

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3: Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining questions will be selected from all the modules.

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Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
EXS 506	Business Communication and Ethics	--	*04	--	--	02	--	02

*02 hrs. Theory class wise and 02 hrs. Practical batch wise

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
EXS 506	Business Communication and Ethics	--	--	--	--	50	--	--	50

Course Pre-requisite

- FEC206 Communication Skills

Course Objective

1. To inculcate in students professional and ethical attitude, effective communication skills, teamwork, skills, multidisciplinary approach and an ability to understand engineer's social responsibilities.
2. To provide students with an academic environment where they will be aware of the excellence, leadership and lifelong learning needed for a successful professional career.
3. To inculcate professional ethics and codes of professional practice
4. To prepare students for successful careers that meets the global Industrial and Corporate requirement' provide an environment for students to work on Multidisciplinary projects as part of different teams to enhance their team building capabilities like leadership, motivation, teamwork etc.

Course Outcomes: A learner will be able to …..

1. communicate effectively in both verbal and written form and demonstrate knowledge of professional and ethical responsibilities
2. Participate and succeed in Campus placements and competitive examinations like GATE, CET.
3. Possess entrepreneurial approach and ability for life-long learning.
4. Have education necessary for understanding the impact of engineering solutions on Society and demonstrate awareness of contemporary issues.

Module No.	Unit No.	Topics	Hrs.
1.0		**Report Writing**	08
	1.1	Objectives of report writing	
	1.2	Language and Style in a report	
	1.3	Types of reports	
	1.4	Formats of reports: Memo, letter, project and survey based	
2.0		**Technical Proposals**	02
	2.1	Objective of technical proposals	
	2.2	Parts of proposal	
3.0		**Introduction to Interpersonal Skills**	08
	3.1	Emotional Intelligence	
	3.2	Leadership	
	3.3	Team Building	
	3.4	Assertiveness	
	3.5	Conflict Resolution	
	3.6	Negotiation Skills	
	3.7	Motivation	
	3.8	Time Management	
4.0		**Meetings and Documentation**	02
	4.1	Strategies for conducting effective meetings	
	4.2	Notice	
	4.3	Agenda	
	4.4	Minutes of the meeting	
5.0		**Introduction to Corporate Ethics and etiquettes**	02
	5.1	Business Meeting etiquettes, Interview etiquettes, Professional and work etiquettes, Social skills	
	5.2	Greetings and Art of Conversation	
	5.3	Dressing and Grooming	
	5.4	Dinning etiquette	
	5.5	Ethical codes of conduct in business and corporate activities (Personal ethics, conflicting values, choosing a moral response, the process of making ethical decisions)	
6.0		**Employment Skills**	06
	6.1	Cover letter	
	6.2	Resume	
	6.3	Group Discussion	
	6.4	Presentation Skills	
	6.5	Interview Skills	
		Total	26

Recommended Books:

1. Fred Luthans, "*Organizational Behavior"* , Mc Graw Hill, edition
2. Huckin and Olsen, "*Technical Writing and Professional Communication"*, Mc Graw Hill
3. Wallace and Masters, "*Personal Development for Life and Work"* , Thomson Learning, 12th edition
4. Heta Murphy, "*Effective Business Communication"* , Mc Graw Hill, edition
5. B N Ghosh, "*Managing Soft Skills for Personality Development*", Tata McGraw
6. Bell . Smith, "*Management Communication*" Wiley India Edition,3rd edition.
7. Dr.K.Alex , "*Soft Skills*",S Chand and Company

Internal Assessment (IA): There will be no IA written examination

End Semester Examination: There will be no ESE written examination

List of Assignments

Term Work

Term work shall consist of assignments as listed below

1. Report Writing (Synopsis or the first draft of the Report)
2. Technical Proposal (Group activity, document of the proposal)
3. Interpersonal Skills (Group activity and Role play)
4. Interpersonal Skills (Documentation in the form of soft copy or hard copy)
5. Meetings and Documentation (Notice, Agenda, Minutes of Mock Meetings)
6. Corporate ethics and etiquettes (Case study, Role play)
7. Cover Letter and Resume
8. Printout of the PowerPoint presentation

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

1. Assignments : 20 marks
2. Project Report Presentation: 15 marks
3. Group Discussion: 15 marks

At least total 08 assignments, project report presentation and group discussion covering entire syllabus must be given during the batch wise practical. The assignments and project work should be students' centric and an attempt should be made to make assignments more meaningful, interesting and innovative. Term work assessment must be based on the overall performance of the student with every assignment / project / group discussion graded from time to time. The average of grades converted in to marks should be taken into account for term work assessment.

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Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
EXL501	Microcontrollers and Applications Laboratory	--	02	--	--	01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of Test 1 and Test 2					
EXL501	Microcontrollers and Applications Laboratory	--	--	--	--	25	25	--	50

Term Work:

At least 10 experiments based on the entire syllabus of Subject **EXC501 (Microcontrollers and Applications Laboratory)** should be set to have well predefined inference and conclusion. Few computation/simulation based experiments are encouraged. The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the **overall performance** of the student with **every experiment graded from time to time**. The grades should be converted into marks as per the **Credit and Grading System** manual and should be **added and averaged**. The grading and term work assessment should be done based on this scheme.

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

Practical and Oral exam will be based on the entire syllabus.

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Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
EXL502	Design With Linear Integrated Circuits Laboratory	--	02	--	--	01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of Test 1 and Test 2					
EXL502	Design With Linear Integrated Circuits Laboratory	--	--	--	--	25	25		50

Term Work:

At least 10 experiments based on the entire syllabus of Subject **EXC502 (Design with Linear Integrated Circuits)** should be set to have well predefined inference and conclusion. Few computation/simulation based experiments are encouraged. The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the **overall performance** of the student with **every experiment graded from time to time**. The grades should be converted into marks as per the **Credit and Grading System** manual and should be **added and averaged**. The grading and term work assessment should be done based on this scheme.

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

Practical and Oral exam will be based on the entire syllabus.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
EXL 503	Digital Communication Laboratory	--	02	--	--	01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of Test 1 and Test 2					
EXL503	Digital Communication Laboratory	--	--	--	--	25	--	25	50

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Term Work:

At least 10 experiments based on the entire syllabus of Subject **EXC 505(Digital Communication) should** be set to have well predefined inference and conclusion. Computation/simulation based experiments are encouraged. The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the **overall performance** of the student with **every experiment graded from time to time**. The grades should be converted into marks as per the **Credit and Grading System** manual and should be **added and averaged**. The grading and term work assessment should be done based on this scheme.

The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work

Oral examination will be based on the entire syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
EXL504	Mini Project I	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam			
		Test 1	Test 2	Ave. Of Test 1 and Test 2				
EXL504	Mini Project I	--	--	--	--	25	25	50

Term Work:

The main intention of Mini Project is to make student enable to apply the knowledge and skills learned out of courses studied to solve/implement predefined practical problem. The students undergo various laboratory/tutorial/simulation laboratory/work shop courses in which they do experimentation based on the curriculum requirement. The Mini Project may be beyond the scope of curriculum of courses taken or may be based on the courses but thrust should be on

- Learning additional skills
- Development of ability to define and design the problem and lead to its accomplishment with proper planning
- Learn the behavioral science by working in a group

The group may be maximum **four** (04) students. Each group will be assigned one faculty as a supervisor. The college should keep proper assessment record of progress of the project and at the end of the semester it should be assessed for awarding TW marks. The TW may be examined by approved internal faculty appointed by the head of the institute. The final examination will be based on demonstration in front of internal and external examiner. In the examination each individual student should be assessed for his/her contribution, understanding and knowledge gained about the task completed.

The students may use this opportunity to learn different computational techniques as well as some model development. This they can achieve by making proper selection of Mini Projects.

Semester VI

Sub Code	Subject Title	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
EXC601	Basic VLSI Design	04	--		04	--		04
EXC602	Advanced Instrumentation Systems	04	--	--	04	--	--	04
EXC603	Computer Organization	04	--	--	04	--	--	04
EXC604	Power Electronics I	04	--	--	04	--	--	04
EXC605	Digital Signal Processing and Processors	04	--	--	04	--	--	04
EXC606	Modern Information Technology for Management	02	--	--	02	--	--	02
EXL601	VLSI Design Laboratory	--	02	--	--	01	--	01
EXL602	Digital Signal Processing and Processors Laboratory	--	02	--	--	01	--	01
EXL603	Advanced Instrumentation and Power Electronics Laboratory	--	02	--	--	--	--	01
EXL604	Mini Project II	--	#02	--	--	02	--	02
Total		**22**	**08**	**--**	**22**	**04**	**--**	**27**

 # Class wise

Semester VI

Subject Code	Subject Title	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. of Test 1 & Test 2					
EXC601	Basic VLSI Design	20	20	20	80	--	--	--	100
EXC602	Advanced Instrumentation Systems	20	20	20	80	--	--	--	100
EXC603	Computer Organization	20	20	20	80	--	--	--	100
EXC604	Power Electronics I	20	20	20	80	--	--	--	100
EXC605	Digital Signal Processing and Processors	20	20	20	80	--	--	--	100
EXC606	Modern Information Technology for Management	10	10	10	40	--	--	--	50
EXL601	VLSI Design Laboratory	--	--	--	--	25	--	25	50
EXL602	Digital Signal Processing and Processors Laboratory	--	--	--	--	25	--	25	50
EXL603	Advance Instrumentation and Power Electronics Laboratory	--	--	--	--	25	25	--	50
EXL605	Mini Project II	--	--	--	--	25	25	--	50

Total		**110**	**110**	**110**	**440**	**100**	**50**	**50**	**750**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
EXC601	Basic VLSI Design	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of Test 1 and Test 2					
EXC601	Basic VLSI Design	20	20	20	80	--	--	--	100

Course Pre-requisite:

- EXC302: Electronic Devices
- EXC303: Digital Circuits and Design
- EXC402: Discrete Electronic Circuits
- EXC502: Design With Linear Integrated Circuits

Course Objectives:

1. To teach fundamental principles of VLSI circuit design and layout techniques
2. To highlight the circuit design issues in the context of VLSI technology

Course Outcomes:

After successful completion of the course student will be able to

1. demonstrate a clear understanding of choice of technology and technology scaling
2. design MOS based circuits and draw layout
3. realize logic circuits with different design styles
4. demonstrate a clear understanding of system level design issues such as protection, timing and power dissipation

Module No.	Unit No.	Topics	Hrs.
1		**Technology Trend**	6
	1.1	**Technology Comparison:** Comparison of BJT, NMOS and CMOS technology	
	1.2	**MOSFET Scaling:** Types of scaling, Level 1 and Level 2 MOSFET Models, MOSFET capacitances	
2		**MOSFET Inverters**	10
	2.1	**Circuit Analysis:** Static and dynamic analysis (Noise, propagation delay and power dissipation) of resistive load and CMOS inverter, comparison of all types of MOS inverters, design of CMOS inverters, CMOS Latch-up	
	2.2	**Logic Circuit Design:** Analysis and design of 2-I/P NAND and NOR using equivalent CMOS inverter	
3		**MOS Circuit Design Styles**	10
	3.1	**Design Styles:** Static CMOS, pass transistor logic, transmission gate, Pseudo NMOS, Domino, NORA, Zipper, C^2MOS, sizing using logical effort	
	3.2	**Circuit Realization:** SR Latch, JK FF, D FF, 1 Bit Shift Register, MUX, decoder using above design styles	
4		**Semiconductor Memories**	08
	4.1	**SRAM:** ROM Array, SRAM (operation, design strategy, leakage currents, read/write circuits), DRAM (Operation 3T, 1T, operation modes, leakage currents, refresh operation, Input-Output circuits), Flash (mechanism, NOR flash, NAND flash)	
	4.2	**Peripheral Circuits:** Sense amplifier, decoder	
5		**Data Path Design**	08
	5.1	**Adder:** Bit adder circuits, ripple carry adder, CLA adder	
	5.2	**Multipliers and shifter:** Partial-product generation, partial-product accumulation, final addition, barrel shifter	
6		**VLSI Clocking and System Design**	10
	6.1	**Clocking:** CMOS clocking styles, Clock generation, stabilization and distribution	
	6.2	**Low Power CMOS Circuits:** Various components of power dissipation in CMOS, Limits on low power design, low power design through voltage scaling	
	6.3	**IO pads and Power Distribution:** ESD protection, input circuits, output circuits, simultaneous switching noise, power distribution scheme	
	6.4	**Interconnect:** Interconnect delay model, interconnect scaling and crosstalk	
		Total	52

Recommended Books:

1. Sung-Mo Kang and Yusuf Leblebici, "*CMOS Digital Integrated Circuits Analysis and Design*", Tata McGraw Hill, 3rd Edition.
2. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, "*Digital Integrated Circuits: A Design Perspective*", Pearson Education, 2nd Edition.
3. Etienne Sicard and Sonia Delmas Bendhia, "*Basics of CMOS Cell Design*", Tata McGraw Hill, First Edition.
4. Neil H. E. Weste, David Harris and Ayan Banerjee, "*CMOS VLSI Design: A Circuits and Systems Perspective*", Pearson Education, 3rd Edition.
5. Debaprasad Das, "*VLSI Design*", Oxford, 1st Edition.
6. Kaushik Roy and Sharat C. Prasad, "*Low-Power CMOS VLSI Circuit Design*", Wiley, Student Edition.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3: Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining questions will be selected from all the modules.

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Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
EXC602	Advanced Instrumentation System	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
EXC602	Advanced Instrumentation System	20	20	20	80	--	--	--	100

Course Objectives:

1. To understand basic functions and working of Pneumatic and Hydraulic components used in Instrumentation Process System.
2. To understand principles of process parameter transmission and conversion of process parameters to electrical and vice versa.
3. To become familiar with control system components and their application in process control.
4. Learners are expected to understand various controllers used in process control and the tuning methods of controllers.

Module No.	Unit No.	Topics	Hrs.
1.	1.1	**Concepts of Advancement in Instrumentation**	06
		Data acquisition and data logging, telemetry in measurement, basic requirement of control system and components	
2		**Pneumatic Components**	12
	2.1	ISO symbols, pneumatic air supply system, air compressors, pressure regulation devices, directional control valves	
	2.2	**Special types of pneumatic valve:** pilot-operated valves, non-return valves, flow control valves, sequence valves, and time delay valve	
	2.3	Single and double acting linear actuators, special type of double acting cylinder, rotary actuators, air motors	
	2.4	**Process control pneumatics:** flapper nozzle system, volume boosters, air relays, pneumatic transmitters and controllers, pneumatic logic gates, dynamic modeling of pneumatic circuits	
3		**Hydraulic Components.**	06
	3.1	Hydraulic pumps, Pressure regulation method, loading valves	
	3.2	Hydraulic valves and actuators, speed control circuits for hydraulic actuators	
	3.3	Selection and comparison of pneumatic, hydraulic and electric systems	
4		**Transmitters and Converters**	12
	4.1	Electronic versus pneumatic transmitters, 2-wire; 3-wire and 4-wire current transmitters	
	4.2	**Electronic type:** temperature, pressure, differential pressure, level, flow transmitters and their applications Smart (Intelligent) transmitters, Buoyancy transmitters and their applications.	
	4.3	**Converters**: Pneumatic to Electrical and Electrical to Pneumatic converters	
5		**Process Control Valves**	08
	5.1	Globe, ball, needle, butterfly, diaphragm, pinch, gate, solenoid, smart control valves and special designs of globe valves	
	5.2	Flow characteristics, control valve parameters, control valve capacity, valve rangeabilty, turn-down, valve size, valve gain	
	5.3	Selection criteria, specifications and installation of control valves	
	5.4	**Valve Positioners**: Necessity, types-motion balance and force-balance, effect on performance of control valve	
	5.5	**Control Valve Actuators:** Electrical, pneumatic, hydraulic, electro-mechanical, digital actuators. selection criteria of valve actuators	
6		**Controllers and Controller Tuning**	08
	6.1	**Continuous and discontinuous controller:** proportional controller, proportional band, RESET controller, rate controller, composite controller, cascade controller, feed-forward controller	
	6.2	Need and different method of controller tuning	
		Total	52

Recommended Books:

1. Bella G. Liptak, "*Process Control and Optimization, Instrument Engineer's Handbook"*, 4th Edition, CRC Press
2. WG Andrews and Williams, "*Applied Instrumentation in the process Industries, Vol. - I and II*", Gulf Publication
3. Terry Barlett, "*Process Control System and Instrumentation*", Delimar Cengage learning Reprint-2008
4. Andrew Parr, "*Hydraulics And Pneumatics- A Technician's And Engineer's Guide*", Jaico Publishing House, Mumbai
5. C.D.Johnson, "*Process Control and Instrument Technology"*, Tata Mcgraw Hill.
6. J. W. Hatchison, "*ISA Handbook of Control Valves*", 2nd Edition, ISA, 1990.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3: Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining questions will be selected from all the modules.

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Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
EXC603	Computer Organization	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of Test 1 and Test 2					
EXC603	Computer Organization	20	20	20	80	--	--	--	100

Course objectives:

1. To conceptualize the basics of organizational and architectural issues of a digital computer.
2. To analyze performance issues in processor and memory design of a digital computer.
3. To understand various data transfer techniques in digital computer.
4. To analyze processor performance improvement using instruction level parallelism.

Course Outcomes:

The student should be able:

1. To understand basic structure of computer.
2. To perform computer arithmetic operations.
3. To understand control unit operations.
4. To understand the concept of cache mapping techniques.
6. To design memory organization (banks for different word size operations).
5. To understand the concept of I/O organization.
6. To conceptualize instruction level parallelism.

Module No.	Unit No.	Topics	Hrs.
1		**Introduction to Computer Organization**	10
	1.1	Fundamental units of computer organization, evolution of computers, von neumann model, performance measure of computer architecture	
	1.2	Introduction to buses and connecting I/O devices to CPU and Memory, bus structure,	
	1.3	Introduction to number representation methods, integer data computation, floating point arithmetic.	
2		**Processor Organization and Architecture**	14
	2.1	CPU Architecture, register organization, instruction formats, basic instruction cycle, instruction interpretation and sequencing	
	2.2	**Control unit:** soft wired (micro-programmed) and hardwired control unit design methods	
	2.3	Microinstruction sequencing and execution, micro operations, concepts of nano programming.	
	2.4	Introduction to RISC and CISC architectures and design issues, case study on 8085 microprocessor, features, architecture, pin configuration and addressing modes	
3		**Memory Organization**	12
	3.1	Introduction to memory and memory parameters, classifications of primary and secondary memories, types of RAM and ROM, allocation policies, memory hierarchy and characteristics	
	3.2	Cache memory concept, architecture (L1, L2, L3), mapping techniques, cache coherency	
	3.3	Interleaved and associative memory, virtual memory, concept, segmentation and paging, page replacement policies	
4		**Input / Output Organization**	8
	4.1	Types of I/O devices and access methods, types of buses and bus arbitration, I/O interface, serial and parallel ports	
	4.2	Types of data transfer techniques, programmed I/O, interrupt driven I/O and DMA	
	4.3	Introduction to peripheral devices, scanner, plotter, joysticks, touch pad, storage devices	
5		**Introduction To Parallel Processing System**	4
	5.1	Introduction to parallel processing concepts, Flynn's classifications, pipeline processing, instruction pipelining, pipeline stages, pipeline hazards	
6		**Introduction to Intel IA32 Architecture.**	4
	6.1	Intel IA32 family architecture, register structure, addressing modes, advancements in arithmetic and logical instructions, exception handling in IA32 architecture	
		Total	52

Recommended Books:

1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, "*Computer Organization*", Fifth Edition, Tata McGraw-Hill.
2. John P. Hayes, "*Computer Architecture and Organization*", Third Edition.
3. William Stallings, "*Computer Organization and Architecture: Designing for Performance*", Eighth Edition, Pearson.
4. B. Govindarajulu, "*Computer Architecture and Organization: Design Principles and Applications*", Second Edition, Tata McGraw-Hill.
1. Dr. M. Usha and T. S. Srikanth, "*Computer System Architecture and Organization*", First Edition, Wiley-India.
2. Ramesh Gaonkar, "*Microprocessor Architecture, Programming and Applications with the 8085"*, Fifth Edition,Penram.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3: Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining questions will be selected from all the modules.

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Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
EXC604	Power Electronics I	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of Test 1 and Test 2					
EXC604	Power Electronics I	20	20	20	80	--	--	--	100

Course Pre-requisite:

- EXC302: Electronic Devices

Course Objectives:

1. To teach power electronic devices and there characteristics.
2. To highlight power electronic based rectifier, inverter and chopper.

Course Outcomes:

After successful completion of the course student will be able to

1. Discuss tradeoffs involved in power semiconductor devices.
2. Analyze different types of rectifier and inverter.
3. Carry out verifications of issues involved in rectifier via simulations

Module No.	Unit No.	Contents	Hrs.
1		**Silicon Controlled Rectifiers**	10
	1.1	Principle of operation of SCR, static and dynamic characteristics, gate characteristics	
	1.2	Methods of turning on (type of gate signal), firing circuits (using R, R-C, UJT),commutation circuit	
	1.3	Protection of SCR	
2		**Other Switching Devices**	08
	2.1	**Principle of operation, characteristics, rating and applications of:** TRIAC, DIAC, GTO, MOSFET, IGBT and power BJT	
	2.2	Driver circuits for power transistors	
3		***Controlled Rectifiers**	12
	3.1	Half wave controlled rectifiers with R, R-L load,	
	3.2	Full wave controlled rectifiers, half controlled and fully controlled rectifiers with R, R-L load **(effect of source inductance not to be considered)**	
	3.3	Single phase dual converter, three phase half controlled and fully controlled rectifiers with R load only ***Numerical based on calculation of output voltage**	
4		***Inverters**	10
	4.1	**Introduction, principle of operation, performance parameters of:** Single phase half / full bridge voltage source inverters with R and R-L load, three phase bridge inverters (120^0 and 180^0 conduction mode) with R and R-L load	
	4.2	Voltage control of single phase inverters using PWM techniques, harmonic neutralization of inverters, applications ***Numerical with R load only**	
5		**Choppers**	6
	5.1	Basic principle of step up and step down choppers	
	5.2	**DC-DC switching mode regulators:** Buck, Boost, Buck-Boost, Cuk regulators, (CCM mode only)	
6		**AC Voltage Controllers**	4
	6.1	Principle of On-Off control, principle of phase control, single phase bidirectional control with R and RL load	
7		**Cycloconvertor**	2
	7.1	Introduction, single phase and three phase Cyclo-converters, applications	
		Total	52

Recommended Books:

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1. M. H. Rashid, "*Power Electronics*", Prentice-Hall of India
2. Ned Mohan, "*Power Electronics*", Undeland, Robbins, John Wiley Publication
3. Ramamurthy, " *Thyristors and Their Applications*"
4. Alok Jain, "*Power Electronics and its Applications*", Penram International Publishing (India) Pvt. Ltd.
5. Vedam Subramanyam, "*Power Electronics*", New Age International
6. Landers, "*Power Electronics*", McGraw Hill
7. M.D. Singh and K. B. Khanchandani, "*Power Electronics*", Tata McGraw Hill
8. P. C. Sen, "*Modern Power Electronics*", Wheeler Publication

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3: Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining questions will be selected from all the modules.

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Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
EXC 605	Digital Signal Processing and Processors	4	--	--	4	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
EXC 605	Digital Signal Processing and Processors	20	20	20	80	--	--	--	100

Course Objective:

1. To study DFT and its computation
2. To study the design techniques for digital filters
3. To study the finite word length effects in signal processing
4. To study the fundamentals of digital signal processors
5. To get acquainted with the DSP applications

Course Outcome:

Students will be able to understand concept of digital filters

1. Students will be able to decide the selection and design of digital filters
2. Students will understand the effect of hardware limitation
3. Students will be understand need of DSP processors
4. Students will be able to understand the use and application of DSP processors

Module No.	Unit No.	Topics	Hrs.
1.0		**Discrete Fourier Transform and Fast Fourier Transform**	10
	1.1	**Discrete Fourier Series**: Properties of discrete Fourier series, DFS representation of periodic sequences.	
	1.2	**Discrete Fourier transforms**: Properties of DFT, linear convolution of sequences using DFT, computation of DFT, relation between Z-transform and DFS	
	1.3	**Fast Fourier Transforms**: Fast Fourier transforms (FFT), Radix-2 decimation in time and decimation in frequency FFT algorithms, inverse FFT, and composite FFT	
2.0		**IIR Digital Filters**	10
	2.1	Mapping of S-plane to Z-plane, impulse invariance method, bilinear Z transformation (BLT) method, frequency warping, pre-warping	
	2.2	**Analog filter approximations**: Butter worth and Chebyshev, design of IIR digital filters from analog filters, design examples	
	2.3	Analog and digital frequency transformations	
3.0		**FIR Digital Filters**	10
	3.1	Characteristics of FIR digital filters, frequency response, location of the zeros of linear phase FIR filters	
	3.2	Design of FIR digital filters using window techniques, Gibbs phenomenon, frequency sampling technique, comparison of IIR and FIR filters	
4.0		**Finite Word Length Effects in Digital Filters**	08
	4.1	Number representation, fixed point, sign-magnitude, one's complement, two's complement forms, floating point numbers	
	4.2	Quantization, truncation, rounding, effects due to truncation and rounding, Input quantization error, Product quantization error, co-efficient quantization error, zero-input limit cycle oscillations, overflow limit cycle oscillations, scaling	
	4.3	Quantization in Floating Point realization IIR digital filters, finite word length effects in FIR digital filters, quantization effects in the computation of the DFT- quantization errors in FFT algorithms	
5.0		**Introduction to DSP Processors**	08
	5.1	Introduction to fixed point and floating point DSP processor, multiplier and multiplier accumulator (MAC), modified bus structures and memory access schemes in DSPs, multiple access memory, multiport memory, VLIW architecture, pipelining, special addressing modes, on-chip peripherals	
	5.2	Features of TMS 320c67xx DSP processor, architecture of TMS 320c67xx DSP processor, architecture features: computational units, bus architecture memory, data addressing, address generation unit, program control, program sequencer, pipelining, interrupts, features of external interfacing, on-chip peripherals, hardware timers, host interface port, clock generators, SPORT	
6.0		**Applications of DSP Processors**	06
	6.1	Speech Processing: Speech analysis, speech coding, sub band coding, channel vocoder, homomorphic vocoder, digital processing of audio signals.	
	6.2	**Radar signal processing**: Radar principles, radar system and parameter considerations, signal design	
Total			**52**

Recommended Books:

1. Proakis J., Manolakis D., "*Digital Signal Processing*", 4th Edition, Pearson Education
2. Oppenheim A., Schafer R., Buck J., "*Discrete Time Signal Processing*", 2nd Edition, Pearson Education.
3. Babu R., "*Digital Signal Processing*", 4th Edition, Scitech Publications.
4. B. Venkata Ramani and M. Bhaskar, "*Digital Signal Processors, Architecture, Programming and Applications*", Tata McGraw Hill, 2004.
5. L. R. Rabiner and B. Gold, "*Theory and Applications of Digital Signal Processing*", Prentice-Hall of India, 2006.
6. B. Kumar, "*Digital Signal Processing*", New Age International Publishers, 2014.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3: Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining questions will be selected from all the modules.

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Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
EXC 606	Information Technology For Management of Enterprises	2	--	--	2	--	--	02

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
EXC 606	Information Technology For Management of Enterprises	10	10	10	40	--	--	--	50

Course Objectives:

1. The course contains the basics of Information Technology and its application in a business environment.
2. To know about E- Business using Information systems with the help of case studies, exhibits, diagrams and illustrations.

Course outcomes:

1. Student will explore production tools, various protocols which run the business infrastructure system and business system managements
2. Students will learn importance of IT tools in content management
3. Student will learn Management Information System and its application in various businesses.

Module No.	Unit No.	Topics	Hrs.
1		**IT Infrastructure**	6
	1.1	Information technology	
	1.2	Computing infrastructure: software	
	1.3	Networking infrastructure	
	1.4	Cabling infrastructure	
	1.5	Wires less infrastructure	
	1.6	Storage infrastructure	
2		**IT Production Tool**	6
	2.1	Security infrastructure	
	2.2	Office tools	
	2.3	Data management tools	
	2.4	Web tools	
3		**Internet and Network Protocol**	4
	3.1	Network management tools	
	3.2	Network protocols and global connectivity	
4		**IT Management**	6
	4.3	E-Business Highway- business automation platform	
	4.4	Infrastructure management	
	4.5	Security management	
	4.6	Information management and audit	
5		**IT Applications**	4
	5.1	E Governance	
	5.2	Connected world and E-commerce	
	5.3	Information systems	
	5.4	Business systems	
		Total	26

Reference Books:

1. B Muthukumaran, "*Information Technology for Management*", Oxford University Press
2. Kenneth C. Laudon and Jane P. Laudon, "*Management Information Systems*", Pearson Education

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered as final IA marks

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 10 marks.
2. Total 4 questions need to be solved.
3: Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining questions will be selected from all the modules.

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Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
EXL601	Basic VLSI Design Laboratory	--	02	--	--	01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of Test 1 and Test 2					
EXL601	Basic VLSI Design Laboratory	--	--	--	--	25	--	25	50

Term Work:
At least 10 experiments based on the entire syllabus of Subject **EXC601 (VLSI Design)** should be set to have well predefined inference and conclusion. Computation/simulation based experiments are encouraged. The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the **overall performance** of the student with **every experiment graded from time to time**. The grades should be converted into marks as per the **Credit and Grading System** manual and should be **added and averaged**. The grading and term work assessment should be done based on this scheme.
The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
Oral exam will be based on the entire syllabus.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
EXL602	Digital Signal Processing and Processors Laboratory	--	02	--	--	01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of Test 1 and Test 2					
EXL602	Digital Signal Processing and Processors Laboratory	--	--	--	--	25	--	25	50

Term Work:
At least 10 experiments based on the entire syllabus of Subject **EXC605 Digital Signal Processing and Processors** should be set to have well predefined inference and conclusion. Computation/simulation based experiments are encouraged. The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the **overall performance** of the student with **every experiment graded from time to time**. The grades should be converted into marks as per the **Credit and Grading System** manual and should be **added and averaged**. The grading and term work assessment should be done based on this scheme.
The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
Oral exam will be based on the entire syllabus.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
EXL603	Advanced Instrumentation and Power Electronics Laboratory	--	02	--	--	01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of Test 1 and Test 2					
EXL603	Advanced Instrumentation and Power Electronics Laboratory	--	--	--	--	25	25	--	50

Term Work:
At least 10 experiments based on the entire syllabus of Subject **EXC602 and EXC 604** should be set to have well predefined inference and conclusion. Computation/simulation based experiments are encouraged. The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the **overall performance** of the student with **every experiment graded from time to time**. The grades should be converted into marks as per the **Credit and Grading System** manual and should be **added and averaged**. The grading and term work assessment should be done based on this scheme.
The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
Practical and oral exam will be based on the entire syllabus of **EXC602 and EXC 604**

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ETL604	Mini Project II	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		Test 1	Test 2	Ave. Of Test 1 and Test 2				
ETL604	Mini Project II	--	--	--	--	25	25	50

Term Work:

The main intention of Mini Project is to make student enable to apply the knowledge and skills learned out of courses studied to solve/implement predefined practical problem. The students undergo various laboratory/tutorial/simulation laboratory/work shop courses in which they do experimentation based on the curriculum requirement. The mini Project may be beyond the scope of curriculum of courses taken or may be based on the courses but thrust should be on

- Learning additional skills
- Development of ability to define and design the problem and lead to its accomplishment with proper planning.
- Learn the behavioral science by working in a group

The group may be maximum **four** (04) students. Each group will be assigned one faculty as a supervisor. The college should keep proper assessment record of progress of the project and at the end of the semester it should be assessed for awarding TW marks. The TW may be examined by approved internal faculty appointed by the head of the institute. The final examination will be based on demonstration in front of internal and external examiner. In the examination each individual student should be assessed for his/her contribution, understanding and knowledge gained about the task completed.

The topic of Mini Project I and II may be different and / or may be advancement in the same topic. The students may use this opportunity to learn different computational techniques as well as some model development. This they can achieve by making proper selection of Mini Projects.