Enclosure to Item No. 4.20
27.5.2009

UNIVERSITY OF MUMBAI

Revised Syllabus for the

Third Year Electronics &

Telecommunication Engineering

(Semester V & VI)

(With effect from the academic year 2009-2010)

Third Year Engineering (Semester V & VI) (Revised) Course for Academic Year 2009-10.

Electronics and Telecommunication Engineering.

Scheme for TE, 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.	Random Signal Analysis	4	2		3	100	25	-	-	125
2.	Microprocessors & Microcontrollers - I	4	2	-	3	100	25	25	-	150
3.	RF Circuit Design	4	2	-	3	100	25	25	-	150
4.	Signals and System	4	2	-	3	100	25	-	25	150
5.	Principles of Control Systems	4	2	-	3	100	25	-	25	150
6.	Electronic hardware workshop	-	3	-	-	-	-	-	50	50
7.	Environment Studies	2	-	1*	2	50	25	-	-	75
Total….		**22**	**1**	**1**		**550**	**150**	**5**	**100**	**850**

***Tutorial at classroom level**

University of Mumbai			
CLASS: T.E. (Electronics & Telecommunication Engineering)		Semester - V	
SUBJECT: Random Signal Analysis			
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

Module	Contents	Hours
Objective	**The objective of this course is to analyze the behavior of signals and random phenomena, with special emphasis on its applications to communication engineering, signals and linear systems.**	-
1	**Introduction to Probability:** Classical and relative-frequency-based definitions of probability; sets, fields, sample space and events; axiomatic definition of probability; joint and conditional probabilities, independence, total probability; Bayes' Rule and applications. Random variables: Definition of random variable, Cumulative Distribution Function (CDF), Probability Mass Function (PMF), Probability, Density functions (PDF) and properties, some Special distributions: Uniform, Gaussian and Rayleigh distributions; Binomial, and Poisson Distributions; Mixed Random Variables.	6 hrs 6 hrs
2	**Functions of one random variable:** Functions of one random variable and their distribution and density functions, mean, variance and moments of a random variable, Chebyshev, Markov inequality, characteristic functions, moment theorem. **Functions of two random variable:** Bivariate distributions, joint distribution and density, properties, marginal statistics, independence, one function of two random variables. two functions of two random variables; joint moments, covariance and correlation-independent, uncorrelated and orthogonal random variables; joint characteristic functions, conditional distributions, conditional expected values.	6 6

3	**Stochastic Convergence and limit theorems:** Sequence of random variables, convergence everywhere, almost everywhere, MS,in probability, in distribution and comparison of convergence modes, strong law of large numbers (without proof); Central Limit Theorem (without proof) and its significance.	**7hrs**
4	**Random processes: Discrete and continuous time random processes; probabilistic structure of a random process; mean, autocorrelation and autocovariance functions; stationarity-strict-sensestationary(SSS)andwide-sense stationary (WSS), ergodic processes: autocorrelation function of a WSS process and its properties, cross-correlation function.**	**7hrs**
5	**LTI Systems with stochastic inputs spectral representation of a real WSS process power spectral density and properties, cross-power spectral density and properties, auto-correlation function and power spectral density of a WSS random sequence; linear time-invariant system with a WSS process as an input: stationarity of the output, autocorrelation And power-spectral density of the output; examples of random processes: white noise process and white noise sequence; Gaussian process; Poisson process**	**7hrs**
6	**Markov Chains:** Introduction, Homogeneous chain, stochastic matrix, Randomwalks, highertransition probabilities and the Chapman-Kolmogorov equation, classification of states.	**7hrs**

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 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 the 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 experiments & 3 tutorials and a written test. The distribution of marks for term work shall be as follows,

Laboratory work (Experiments 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.

Practical list

1. Simulation of discrete random variable and estimation of its PMF & CDF
2. Study of uniform, exponential, Rayleigh and Gaussian density functions
3. To study relation between distribution and density functions.
4. To calculate $P(x_1 \leq X \leq x_2)$, $P(X \leq x)$, $P(X \geq x)$, $P(x_1 \leq X \leq x_2)$, from distribution and or density function
5. Study of mixed random variable
6. Study of joint density/distributions.
7. Study of power spectral density
8. Study of random process.
9. Study of ergodic process
10. Study of LTI system with stochastic input

Recommended Books:

1. A. Papoulis and S.U. Pillai, Probability, Random Variables and Stochastic Processes, 4th Edition, McGraw-Hill, 2002

2. P.Z. Peebles, Probability, Random Variables and Random Signal Principles, 4th edition, Mc-Graw Hill, 2000

3. H. Stark and J.W. Woods, Probability and Random Processes with Applications to Signal Processing, 3e, Pearson edu

4. Wim C Van Etten, Introduction to Random Signals and Noise, Wiley

5. Miller, Probability and Random Processes-with applications to signal processing and communication, first ed2007, Elsevier

University of Mumbai			
CLASS: T.E. (Electronics & Telecommunication Engineering)		Semester - V	
SUBJECT: Microprocessors & Microcontrollers - I			
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

Module	Contents	Hours
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	-
1	Basics of 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	10
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	8

	• Conditional call and return instructions operations related programs • Debugging programs.	
3	Study and Interfacing of peripherals 8155/8255, 8253/8254, 8259 with 8085	7
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,	8
	• Program counter and stack, • Input/output ports, • Counters and timers, • Serial data input and output • Interrupts. • Power saving modes	
5	Programming with 8051: Instruction set, addressing modes, immediate, registers, direct and indirect data movement and exchange instructions, push and pop op-codes, arithmetic and logic instructions, bit level operations, jump and call instructions, input/ output port programming, programming timers, asynchronous serial data communications, timer and hardware interrupt service routines. Interfacing of LCD display, hex keyboard, ADC0808, DAC0808 and Stepper motor with 8051 Current trends in microprocessors and practical implementation	8
6	Introduction to ARM Processor • ARM family architecture • Register architecture. • Memory Access and addressing modes. • Arithmetic and Logical Instructions • Branching Instructions	10
	Comparative study of salient features of 8051 and its derivatives like 89C51, 89C52, 89C2051 AND 89C2052 Current processor and controller survey. (cost, availability, popularity)	02

Theory Examination:

1. Question paper will be comprise of total 7 questions, each of 20 marks.
2. All questions must be analytical and design oriented.
3. Only 5 questions need to be solved.
4. Question number 1 will be compulsory and will cover all modules.
5. 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.)
6. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
7. No question should be asked from pre-requisite module.

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) : 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.

Practical list

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.

9) 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)

1) 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 to peripheral port.

2) 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.

3) 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 of Thumbwheel switches.
09) Interfacing of 8253 / 8254.

8051 experiments (Max 2)

Arithmetic operations

Packing and unpacking

Ascending and descending

8051 timer based experiment

Transmission of character using RS 232 to PC(preferably on bread board)

16 * 2 LCD and Hex keyboard interface (preferably on bread board)

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. 16x2 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 Professor

Recommended Books:

1. Mazidi & Mazidi, The 8085 Microcontroller & Embedded system, using Assembly and C, 2nd edi, Pearson edu.
2. Microprocessors 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 Microprocessors & Microcontrollers, 2e, Elsevier, 2007
5. Steve Ferber, 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. Udayashankara 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 Mictoprocessor, Cengage (Thomson)

University of Mumbai			
CLASS:T.E. (Electronics & Telecommunication Engineering)		Semester - V	
SUBJECT: RF Circuit Design			
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

Module	Contents	Hours
Objective	The objective of this course is to introduce to the students the fundamentals of active & passive components and circuits used at RF.	-
Pre-requisite	Concept of Basic Electronics and Wave Theory.	-
1	**Introduction** Importance of Radiofrequency design, Dimensions and units, frequency spectrum. 1] RF behaviour of passive components: High frequency resistors, capacitors & inductors. 2] Chip components and Circuit board considerations : Chip resistors, chip capacitors, surface mounted inductors.	04
2	**Transmission Line Analysis:** Two-wire lines, Coaxial lines and Microstrip lines. Equivalent circuit representation, Basic laws, Circuitparametersforaparallelplate transmission line. 1] General Transmission Line Equation: Kirchhoff voltage and current law representations, Traveling voltage and current waves, general impedance definition, Lossless transmission line model. 2] Microstrip Transmission Lines. 3] Terminated lossless transmission line: Voltage reflection coefficient, propagation constant and phase velocity, standing waves. 4] Special terminated conditions: Input impedance of terminated lossless line, Short circuittransmissionline,Opencircuit transmission line, Quarter wave transmission line. 5] Sourced and Loaded Transmission Line:	10

	Phasor representation of source, Power considerations for a transmission line, input impedance matching, return loss and insertion loss.	
3	**The Smith Chart:** Reflection coefficient in Phasor form, Normalized Impedance equation, Parametric reflection coefficient equation, graphical representation, Impedance transformation for general load, Standing wave ratio, Special transformation conditions. **Admittance Transformations:** Parametric admittance equation, Additional graphical displays. **Parallel and series Connections:** Parallel connections of R and L connections, Parallel connections of R and C connections, Series connections of R and L connections, Series connections of R and C connections, Example of a T Network.	10
4	**RF Filter Design:** Filter types and parameters, Low pass filter, High pass filter, Bandpass and Bandstop filter, Insertion Loss. **Special Filter Realizations:** Butterworth type filter, Chebyshev type filters, Denormalization of standard low pass design. **Filter Implementation:** Unit Elements, Kuroda's Identities and Examples of Microstrip Filter Design. **Coupled Filters:** Odd and Even Mode Excitation, Bandpass Filter Design, Cascading bandpass filter elements, Design examples.	12
5	**Active RF Components:** Semiconductor Basics: Physical properties of semiconductors, PN-Junction, Schottky contact. Bipolar-Junction Transistors: Construction, Functionality, Temperature behaviour, Limiting values. RF Field Effect Transistors: Construction, Functionality, Frequency response, Limiting values. High Electron Mobility Transistors: Construction, Functionality, Frequency response.	8
6	**Active RF Component Modeling:** Transistor Models: Large-signal BJT Models, Small-signal BJT Models, Large-signal FET Models, Small-signal FET Models. Measurement of Active Devices: DC Characterization of Bipolar Transistors, Measurements of AC parameters of Bipolar Transistors, Measurement of Field Effect Bipolar Transistors Transistor Parameters. Scattering Parameter Device Characterization.	10

Theory Examination:

1. Question paper will comprise of total 7 questions, each of 20 marks.
2. All questions must be analytical and design oriented.
3. Only 5 questions need to be solved.
4. Question number 1 will be compulsory and cover all modules.
5. 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.)
6. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
7. No question should be asked from pre-requisite module.

Practical/Oral Examination:

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

Practical list

1. Characterization of resistors.
2. Characterization of Inductors
3. Characterization of capacitors.
4. Study of Q in RLC Series resonance circuits.
5. Study of Q in RLC Parallel resonance circuits.
6. LP Filter Design
7. HP Filter Design
8. BP Filter Design
9. Tutorial on Smith Charts.
10. DC Characterization of BJT.
11. DC Characterization of FET.

Recommended Books:

1. Reinhold Ludwig, Pavel Bretchko, RF Circuit Design, Pearson Education Asia.
2. Joseph J. Carr, Secrets of RF Circuit Design, Tata McGraw-Hill.
3. W.Alan Davis , K K Agarwal, Radio Freuency circuit Design, Wiley
4. Pozar, Microwave Engineering, John Wiley.
5. Mathew M. Radmanesh, RF & Microwave Design Essential,
6. Ian Hickman, Practical RF Handbook, Elsevier

University of Mumbai			
CLASS: S.E. (Electronics & Telecommunication Engineering)		**Semester - V**	
SUBJECT: Signals and 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**

Module	Contents	Hours
Objective	**objectives ofthis course is to study and analyse characteristics of continuous, discrete Signals and systems.**	**-**
Pre-Requisite	**Concept of Fourier Series/Transform, Laplace Transform.**	**-**
1	**REPRESENTATION OF SIGNALS** Continuous and discrete time signals: Classification of Signals – Periodic aperiodic ,even – odd – energy and power signals – Deterministic and random signals – complex exponential and sinusoidal signals – periodicity – properties of discrete time signal –impulse functions and its properties – Transformation in independent variable of signals: time scaling, time shifting. Determination of Fourier series representation of continuous time and discrete time periodic signals, properties of continuous time and discrete time Fourier series.	**8**
2	**ANALYSIS OF CONTINUOUS TIME SIGNALS AND SYSTEMS** Continuous time Fourier Transform and Laplace Transform analysis with examples – properties of the Continuous time Fourier Transform and Laplace Transform basic properties, Parseval's relation, and convolution in time and frequency domains. Basic properties of continuous time systems: Linearity, Causality, time invariance, stability, magnitude and Phase representations of frequency response of LTI systems -Analysis and characterization of LTI systems using Laplace transform & application in electrical networks, Computation of impulse response and transfer function using Laplace transform.	**10**

3	**SAMPLING THEOREM AND z-TRANSFORMS** Representation of continuous time signals by its sample - Sampling theorem – Reconstruction of a Signal from its samples, aliasing – discrete time processing of continuous time signals, sampling of band pass signals. Basic principles of z-transform - z-transform definition – region of convergence – properties of ROC – Properties of z-transform – Poles and Zeros – inverse z-transform using Contour integration - Residue Theorem, Power Series expansion and Partial fraction expansion, Relationship between z-transform and Fourier transform.	**10**
4	**DISCRETE TIME SYSTEMS** Computation of Impulse response & Transfer function using Z Transform., LTI-DT systems - Characterization using difference equation, Block diagram representation, Convolution, Properties of convolution and the interconnection of LTI Systems, Causality and stability of LTI Systems. DTFT, DTFT Properties and examples	**10**
5	**SYSTEMS WITH FINITE AND INFINITE DURATION IMPULSE RESPONSE** Systems with finite duration and infinite duration impulse response – recursive and non-recursive discrete time system – realization structures – direct form – I, direct form – II, Transpose, cascade and parallel forms.	**10**
6	**State Space Analysis** Representation and Solution for continuous and discrete time LTI System	**05**

Theory Examination:

1. Question paper will comprise of total 7 questions, each of 20 marks.
2. All questions must be analytical.
3. Only 5 questions need to be solved.
4. Question number 1 will be compulsory and covering the all modules.
5. 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.)
6. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
7. No question should be asked from pre-requisite module.

Oral Examination:

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

Term work:

Term work shall consist of minimum four experiments and five tutorials and a written test. The distribution of marks for term work shall be as follows,

Laboratory work (Experiments 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.

Practical list

1. Study of operations on signals.
2. Step and impulse response of system.
3. Impulse response using Laplace Transform.
4. Study of Sampling Theorem.
5. Study of Discrete Time Fourier Transform.
6. Pole-Zero plot of Z-transform
7. Realization structures of System

Recommended Books:

1. Simon Haykins, Signal and Systems 2nd edition. , Wiley
2. Oppenheim, Signals and System,2nd , Pearson edu
3. H P Hsu, 'Signals and Systems', TMH, 2006
4. Rao S.S., Signals and System, TMH
5. Zeimer RE, Signals & System: Continuous and Discrete, 4e, Dorling Kindersley(India) Pvt Ltd
6. Lathi B.P., Linear systems and signals, 2nd edi, Oxford Uni Press
7. S. Salivahanan, e.t. 'Digital Signal Processing,' TMH, 2005
8. Stuller, Signal & Systems , Cengage (Thomson)
9. Nagoor Kani. Signals and systems. Tata MacGraw-Hill,2009

University of Mumbai			
CLASS: T.E. (Electronics & Telecommunication Engineering)		**Semester – V**	
SUBJECT: Principles of Control 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

Module	Contents	Hours
Objective	Objective of this course is to understand fundamentals of control systems that has wide applications in industries. To understand optimal performance of the system, understanding and applying to conventional control strategies.	**-**
Pre-requisite	**Concept of electrical network**	**-**
1	**Introduction:** Open loop and closed loop systems, basic structure of a feedback control system. **Dynamic Models and Responses:** Dynamic model of an RLC network, state variable model, impulse response model, transfer function model, standard test/disturbance signals and their models, transfer function model and dynamic response of a second order electrical system.	**10**
2	**Mathematical Modelling of Systems** Basic units of a feedback control system, reduction of system block diagrams, signal flow graphs, Mason's gain rule, block diagram reduction using Mason's gain rule, error detector, block diagram model of a typical control system using simplified sub- system, transfer function blocks.	**10**
3	**Feedback Control System Characteristics:** Stability, sensitivity, disturbance rejection, steady state accuracy, transient and steady state responses of a second order system. Effect of additional zeros and pole locations and dominant poles, steady state error constants, system type numbers and error compensation.	**8**

4	**System Stability analysis and compensation Design** System stability bounds, Routh stability criterions, relative stability and range of stability, root locus concept, system characteristic equation, plotting root loci.	**10**
5	**Nyquist Criterion and Stability Margins:** Nyquist stability criterions, Nyquist plot, gain and phase margins, bode plot of magnitude and phase and determination of stability margins.	**10**
6	**Control Systems Components:** (Transfer function approach) DC servomotors, Synchros, Stepper motor	**5**

Theory Examination:

1. Question paper will comprise of total 7 questions, each of 20 marks.
2. All questions must be analytical.
3. Only 5 questions need to be solved.
4. Question number 1 will be compulsory and covering all modules.
5. 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.)
6. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
7. No question should be asked from pre-requisite module.

Oral Examination:

Oral Examination 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 six experiments and a written test. The distribution of marks for term work shall be as follows,

Laboratory work (Experiments 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.

Practical list

1. Type ‘0’ and Type ‘1’ control system.
2. Closed Loop Control System.
3. Study of Bode Plot
4. Error Detector
5. Linear System Simulator
6. Series Control System
7. Time Response of first and second order systems (RLC).

Simulations:

1. Time Response analysis
2. Frequency response analysis
3. Stability analysis

Recommended Books:

1. Control Systems- Principles and Design- M. Gopal, Tata Mc-Graw Hill Publication
2. Norman Nise, Control Sysmtem Engineering 4th edition, wiley
3. Srivastava Manjita et, Control System, TMH.
4. Control Systems Engineering-I.J Nagrath and M.Gopal New Age International Publishers
5. Modern Control Engineering- Katsuhiko Ogata,4e, Pearson edu
6. Les Fenical, Control System, Cengage Learning

University of Mumbai			
CLASS: T.E. (Electronics & Telecommunication Engineering)		**Semester - V**	
SUBJECT: Electronic Hardware Workshop			
Periods per week (Each of 60 min.)	Lecture	**-**	
	Practical	**2**	
	Tutorial	**-**	
		Hours	**Marks**
Evaluation System	Theory Examination	**-**	**-**
	Practical examination	**-**	**-**
	Oral Examination	**-**	**50**
	Term Work	**-**	
	Total		**50**

Module	Contents	Hours
Objective	The objective of this course is to introduce to the students the basics of circuit assembly and debugging. To encouraging the students to design and implement innovative ideas.	**-**
Pre-Requisite	Concept of Basic Electronics, Digital Logic & Electrical Engg. Fundamentals	
1	**Study of soldering and PCB Design** Students are expected to select any experiment* that they have already performed in earlier semester. Soldering and testing are to be done for the selected experiment. Schematic as well as PCB design is to be carried out using any software tool. A report is to be prepared.	**06**
2	**Analogue Project** **(Design and implementation)** Students are expected to design any project*, of analogue circuit/system, discrete and/or IC based, of their choice (which can be used as experimental set-up in the laboratory). PCB design, fabrication, testing and implementation should be done. Students may use the software simulation for verification of hardware implementation. Documentation of the project is to be in standard IEEE format. Project report should include abstract in 100 words (max), key words, introduction, design, simulation, implementation, results/ results comparison, conclusion and references.	**10**

3	**Digital Project** **(Design and implementation)** Students are expected to design any project*, of digital circuit/ system of their choice, may involve microprocessor/ microcontroller (which can be used as experimental set-up in the laboratory). PCB design, fabrication, testing and implementation should be done. Students may use the software simulation for verification of hardware implementation. Documentation of the project is to be in standard IEEE format. Project report should include abstract in 100 words (max), key words, introduction, design, simulation, implementation, results/ results comparison, conclusion and references.	**12**

* To be approved by the concerned faculty. Students will work in group, Minimum 2 students in each group but not more than 3.

Oral Examination:

Oral Examination will be based on any experiment performed and on the entire syllabus.

Term work:

Students will work in group, Minimum 2 students in each group but not more than 3.
Term work shall consist of minimum TWO Projects.

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work / term-work.

Recommended Books:

1. Bossart, Printed Circuit Boards: Design and Technology, Tata McGraw Hill

University of Mumbai			
CLASS: T.E. (Electronics & Telecommunication Engineering)		**Semester - V**	
SUBJECT: Environmental Studies			
Periods per week (Each of 60 min.)	Lecture	**2**	
	Practical	**-**	
	Tutorial	**1**	
		Hours	**Marks**
Evaluation System	Theory Examination	**2**	**50**
	Practical examination	**-**	**-**
	Oral Examination	**-**	**-**
	Term Work	**-**	**25**
	Total		**75**

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

Module	Contents	Hrs
1	The Multidisciplinary nature of environmental studies Definition, scope and importance Need for public awareness	**1**
2	Natural resources Renewable and non-renewable resources Natural resources and associated problem a. Forest resources: Uses 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 surface 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 resources, case studies. d. Food resources: World food problems overgrazing, effects of modern agriculture, fertilizer- pesticide problems, water logging, salinity, case studies. e. Energy resources: Growing energy needs, renewable and non renewable energy 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 of resources for sustainable lifestyles.	**4**

3	Ecosystems Concepts of an ecosystem Structure and function of an ecosystem Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Flood chains, food webs and ecological pyramids Introduction, types, characteristic features, structure and function of the following ecosystem a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries)	3
4	Biodiversity and its conservation 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 Bio-diversity at global, national, local levels India as a mega diversity nation Hot spots of bio-diversity Threats to biodiversity: Habitat loss, poaching of wild life, man-wildlife conflicts Endangered and endemic species of India Conservation of biodiversity: In –situ and Ex-situ conservation of biodiversity	4
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, affect 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	4

6	**Social issues and environment** **From unsustainable to sustainable development** **Urban problems related to energy** **Water conservation, rain water harvesting, watershed management** **Re-settlement and rehabilitation of people: Its problems and concerns. Case studies** **Environmental ethics: issues and possible solution** **Climate change, global worming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies** **Wasteland reclamation** **Consumerism and waste products** **Environment protection act** **Air(Prevention and control of pollution) act** **Wildlife protection act** **Forest conservation act** **Issues involved in enforcement of environmental legislation public awareness**	**4**
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**	**4**
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 Behavior, Human Values, Nature (Environment), Human Behavior, Human Endeavor and Objectives, Interrelationship 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. Erach Bharucha, text book of environmental studies, Universities Press/Orient Blackswan
2. Jagdish Krishnawamy , R J Ranjit Daniels, " Environmental Studies", Wiley India Private Ltd. New Delhi
3. Anindita Basak, Environmental Studies, Pearson
4. Deeksha Dave , "Textbook of Environmental Studies", Cengage learning, THOMSON INDIA EDITION
5. Benny Joseph" Environmental Studies"Tata McGRAW HILL
6. D. L. Manjunath, Environmental Studies, Pearson
7. R.Rajgopalan, Environmental Studies, Oxford
8. Alok Debi, Environmental science and Engineering", University press
9. A nagraj, Jeevan Vidya-A Primer

Third Year Engineering (Semester V & VI) (Revised) Course for Academic Year 2009-10,
Electronics and Telecommunication Engineering,

TE, Semester VI

Sr. No	ubjects	No. of Periods per week (60 minutes each)			Duration of Theory papers (Hours)	Marks				
		Lecture	Practi-cal	Tuto-rial		Theory	Term-work	Prac-tical (3 Hrs.)	Oral	Total
1.	Microprocessors & Microcontrollers-II	4	2	-	3	100	25	25	-	150
2.	Antenna & Wave Propagation	4	2	-	3	100	25	-	25	150
3.	Industrial Economic & Telecom regulation	2	-	1*	2	50	25	-	-	75
4.	Digital Communication	4	2	-	3	100	25	25	25	175
5.	TV & Video	4	2	-	3	100	25	-	25	150
6.	Elective	4	2	-	3	100	25		25	150
Total….		**22**	**10**	**1**		**550**	**150**	**50**	**100**	**850**

*** In tutorial we should have case study/ Industrial Visit along with routine exercises.**

SCHEME FOR OFFERING ELECTIVE TO STUDENTS (Any ONE): TE, VI Semester

SEM VI:	SEM VI:	SEM VI:	SEM VI:	SEM VI:
1. ACOUSTICS ENGINEERING	**2. MICRO ELECTRONICS**	**3.RADAR ENGINEERING**	**4. DIGITAL TELEPHONY**	**5. NEURAL NETWORKS & FUZZY LOGIC**

University of Mumbai			
CLASS: T.E. (Electronics & Telecommunication Engineering)		**Semester - VI**	
SUBJECT: Microprocessors & Microcontrollers-II			
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**

Module	Contents	Hours
Objective	The objective of this course is to introduce to the students 16 bit Microprocessors & Microcontrollers	-
Pre-requisite	**concept of 8 bit Microprocessor and Microcontroller**	-
1	**8086 and 8088 Microprocessors:** 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 minimum and maximum modes of operation, 8086/8088 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.	**9**
2	**8086 assembly language programming:** 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 instructions, simplesequential and looping programs in assemble language, debugging assembly language programs.	**08**
3	**Programmable Interface and peripheral devices:** Interfacing of 8155, 8255 and 8259 with 8086 and study and interfacing of 8257 DMA controller with 8086. • Comparative study of salient features	**7** **2**

	of 8086, 80196, 80296, 80386, 80486 and Pentium	
4	**PIC Controllers:** • PIC 18 memory organisation • CPU registers • Pipelining • Instruction format • Addressing modes • Sample of PIC 18 Instructions • Overview of the 8- bit MCU Market	**9**
5	PIC 18 Assembly language Programming • Assembly language programme structure • Assembler directives • Writing programmes to perform arithmetic computations • Programme loops • Reading and writing data in programme memory • Logic Instructions • Using programme loop to create time delays • Rotate instructions • Using rotate instructions to perform multiplication & divisions.	**9**
6	Parallel Ports • I/O Addressing. • Synchronization • Overview of the PIC 18 parallel ports • Interfacing with simple output devices	**8**

Theory Examination:

1. Question paper will comprise of total 7 questions, each of 20 marks.
2. All questions must be analytical and design oriented.
3. Only 5 questions need to be solved.
4. Question number 1 will be compulsory and will cover all modules.
5. 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.)
6. In the question paper, weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
7. No question should be asked from **pre-requisite module**.

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) : 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.

Practical list

8086 (any 4)

1. Write a program to arrange block of data in i) ascending and (ii) descending order.
2. Write a program to find out any power of a number such that $Z = X^N$, where 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.

PIC 18

Experiments are to be performed on 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

To design and test circuits on Graphical based LCD, Interface external memory, Temperature display, Key pad interface using AVR controller.

Recommended Books:

1) Microprocessors and Interfacing, Douglas V Hall, Tata Mc Gram Hill
2) Han Way Huang, PIC Microcontroller, Cengage learning
3) Design with PIC MicrocontrollersBy 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.

University of Mumbai			
CLASS: T.E. (Electronics & Telecommunication Engineering)		**Semester - VI**	
SUBJECT: Antenna & Wave Propagation			
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**

Module	Contents	Hours
Objective	The objective of this course is to introduce to the students the basics of radiating elements and effect of propagation of radio waves in actual environment .	-
Pre-requisite	Concept of Electromagnetic field and transmission line.	-
1	**ANTENNA FUNDAMENTALS** Introduction, basic antenna parameters, Radiation pattern, radiation power density, radiation intensity, directivity, beam efficiency, aperture concept, effective height, polarization, input impedance, gain ,radiation efficiency, beam width, bandwidth, beam efficiency, FRIIS transmission equation Basic concepts of Maxwell's equation, vector potential, wave equation, near field and far field radiation, dual equations for electric and magnetic current sources.	**10**
2	**Linear wire antennas** Infinitesimal dipole its radiation field, radiation resistance, radiation sphere, ear field, far field directivity, small dipole, finite length dipole, half wave length dipole, linear elements near or on infinite perfect conductors, ground effects and their application, Folded dipole, sleeve dipole and their applications **Loop Antenna:** Small loop comparison of small loop with short dipole, radiation patterns its parameters and their application.	**10**

3	**Arrays:** Linear arrays, planner arrays and circular arrays. Array of two isotropic point sources, non isotropic sources, principle of pattern multiplication linear arrays of n elements, broadside, Endfire radiation pattern, directivity, Beamwidth and null directions, array factor. Antenna analysis using Dolph-Tschebyscheff.	**9**
4	**Frequency Independent Antennas:** Theory, Log periodic and Yagi antenna. **Microstrip antennas:** Rectangular & circular patch, circular polarization and feed network.	**7**
5	**Reflector antennas:** Plane reflector, corner reflector, procedures, Radiation mechanisms Dielectric wave, dielectric resonator, dielectric horn antenna.	**5**
6	**Antenna Measurement** Antenna Ranges, Radiation Pattern, Gain and directivity, Polarization. **Radio wave propagation** Ground wave propagation, Ionospheric propagation	**5** **6**

Theory Examination:

1. Question paper will comprise of total 7 questions, each of 20 marks.
2. All questions must be analytical.
3. Only 5 questions need to be solved.
4. Question number 1 will be compulsory and covering the all modules.
5. 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.)
6. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
7. No question should be asked from **pre-requisite module**.

Oral Examination:

Oral Examination 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) : 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.

Practical list

1. Draw radiation pattern and find parameters of monopole, dipole antenna
2. End fire array
3. Broadside array
4. Log periodic antenna
5. Helical antenna
6. folded dipole
7. Reflector antenna
8. Rhombic antenna
9. Loop antenna with n number of turns
10. Any micro-strip antenna

Recommended Books:

1) Antenna Theory analysis and design-Costantine A. Balanis, John Wiley publication
2) Antennas-John D. Kraus, Tata McGraw Hill publication
3) Electromagnetics- Jordan Balmann, Prentice Hall of India publication
4) Harish A. R., Antenna and wave propagation, Oxford University Press.

University of Mumbai			
CLASS: T.E. (Electronics & Telecommunication Engineering)		**Semester - VI**	
SUBJECT: Industrial Economics & Telecommunication Regulation			
Periods per week (each of 60 min.)	Lecture	2	
	Practical	-	
	Tutorial	1	
		Hours	Marks
Evaluation System	Theory Examination	2	50
	Practical examination	-	-
	Oral Examination	-	-
	Term Work	-	25
	Total		**75**

	Contents	Hours
Objective	**The objective of this course is to introduce to the students the basic concepts of Economics & Management and give them exposure to Telecommunication Regulation in India/ in general.**	-
Pre-requisite	**General understanding of trade and management**	-
1	**BASIC CONCEPTS IN ECONOMICS** Demand, supply, elasticity of demand and supply, competition, monopoly, oligopoly, monopolistic competition, causes creating categories of monopoly organization, price determination under perfect competition and monopoly, price discrimination, equilibrium of firm under competition and monopoly. Functions of money, supply and demand for money, money price level and inflation, black money, consequences. meaning, magnitude and	**4**
2	**Banking and Taxation system of Country.** Function of commercial banks, multiple credit creation, banking system in India, shortcomings and improvement. Central banking: Function of central banking illustrated with reference to RBI, monitory policy meaning, objectives and features. Sources of public revenue: principles of taxation, direct and indirect taxes, distribution of incidence, tax structure, reform of tax system.	**5**
3	**International Trade and economic crises of 2008,** Theory of international trade, balance of trade and payment, theory of protection, tariffs and subsidies, foreign exchange control, devaluation.	**4**

4	**Basic concept of management**-Planning, organization, communication, Leadership & motivation. **Marketing management** and marketing Mix- Product, Place, price and promotion	**4**
5	**Telecommunications Regulation** -The Task of Regulation, Markets and market failure, The rules of regulation. -The Framework for Regulation, Legal frameworks, Instruments of regulation, Enforcement, Dangers of regulation and operational aspects. -Regulatory Strategy and Price Controls, Market strategies/ structures, Engineering and technology. -Regulation and the Future (John Buckley, Telecommunications Regulation)	**4**
6	National Telecom Policy 1994, New Telecom Policy 1999, Guidelines For Uplinking From India, Broadband Policy 2004, Guidelines For Obtaining License For Providing Direct-To-Home (DTH) Broadcasting Service In India. TRAI Act 1997, Cable Network Act, TRAI Regulation. ITU's role in global communications. (http://www.trai.gov.in/Default.asp http://www.itu.int/net/home/index.aspx http://www.itu.int/net/about/index.aspx Black, Telecommunications Law In The Internet Age, 2002, Elsevier)	**5**

Theory Examination:

1. Question paper will comprise of total 7 questions, each of 10 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 the 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 tutorials, case study/ Industrial Visit reports and a written test.

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

Tutorial work (Tutorials, Case study & Report) : 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. John Buckley, Telecommunications Regulation, Institution of Electrical Engineers © 2003, Published by: The Institution of Electrical Engineers, London, United Kingdom. (ISBN:0852964447)
2. http://www.trai.gov.in/Default.asp
3. http://www.itu.int/net/home/index.aspx
4. http://www.itu.int/net/about/index.aspx
5. Black, Telecommunications Law In The Internet Age, 2002, Elevier
6. Patrick Welch and Gerry Welch, Economics: Theory and Practice, wiley.
7. Economics: Samuelson
8. Modern Economic theory: Dewt & Warma
9. Indian Economy:A.N Agrawal
10. Marketing Management:V.S Ramaswamy
11. Finance for non-finance mangers: B.K Chaterji
12. Management: Hampton David
13. Management: Stephen Robbins and Mary Coulter
14. Marketing Management, a South Asian perspective, Philip Kotler, Kevin Keller, Abraham Koshy and Mithileshwar Jha

University of Mumbai			
CLASS: T.E. (Electronics & Telecommunication Engineering)		**Semester - VI**	
SUBJECT: Digital Communication			
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	-	25
	Term Work	-	25
	Total		**175**

Module	Contents	Hours
Objective	**The objective of this course is to introduce to the students the Basics of Digital Communication**	-
Pre-requisite	**Fundamentals of Communication.**	-
1	**Information theory** Entropy, Shannon Theorem, Shannon - Hartley theorem	**5**
2	**Baseband Transmission:** Discrete PAM signals, power spectra of discrete PAM signals, inter symbol interference, Nyquist's criterion for distortionless baseband transmission, Pulse shaping, line codes, correlative coding, eye diagram, equalization.	**5**
3	**Digital Modulation:** Representation of band pass modulated signal, vector space representation, Gram, Schmidt procedure, signal energy and correlation, ASK, FSK, PSK, DPSK, M-aryl PSK, M-aryl FSK, QPSK, OQPSK, MSK, QAM-Introduction, Modulation, Modulation, demodulation, signal space diagram, spectrum, bandwidth efficiency, power efficiency, probability of error, applications, carrier and timing recovery circuits.	**14**
4	**Base band Detection:** Detection of binary signals- Matched filters, decision threshold in matched filters, error probability, maximum likelihood receiver structure, correlation realization of matched filter.	**5**

5	**Error Control Systems:** Overview, power and band limited channels, optimum decoding, decoded error rate. **Error Control Block Codes:** Introduction, code rate and code distance, some algebraic concepts, generator matrix, of a linear block code, systematic form of G, parity check matrix of a linear blockcode, decoding mechanism, hamming codes, extended hamming codes, shortened hamming codes, systematic for of H matrix,cycliccodes, generator matrix for cyclic codes, polynomial multiplication and division, systematic cyclic codes, practical systematic encoders, binary BCH codes, shortened cyclic codes, cyclic redundancy check(CRC) codes, interleaving, Non algebraic decoding of cyclic codes, Maggot decoding, decoding shortened cyclic codes, burst detection(error) trapping), application areas.	**14**
6	**Convolution Codes:** Introduction, generator polynomial and optimal codes, puncturing code trellis, free distance, Viterbi decoding, hard decision Viterbi decoding, decoding window, soft decision Viterbi decoding, code spectra, recursive systematic codes, code transfer function, application areas.	**10**

Theory Examination:

1. Question paper will comprise of total 7 questions, each of 20 marks.
2. All questions must be analytical.
3. Only 5 questions need to be solved.
4. Question number 1 will be compulsory and covering the all modules.
5. 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.)
6. In the question paper, weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
7. No question should be asked from **pre-requisite module**.

Practical/ Oral Examination:

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

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 and a written test. The distribution of marks for term work shall be as follows,

Laboratory work (Experiments 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.

Practical list

1. Measurement of bit error rate
2. Measurement of coding gain
3. Study of ASK,
4. Study of BFSK
5. Study of BPSK
6. Study of generation of cyclic codes
7. Measurement of bandwidth efficiency of QAM
8. Study of equalizer's performance parameters
9. Study of eye diagram using oscilloscope
10. Study of QPSK waveform using digital oscilloscope
11. Measurement of bandwidth efficiency of QPSK
12. Study of MSK generation and detection.

Recommended Books:

1. Digital Communications-Simon Haykin, John Wiley & Sons publication
2. Principles of Digital Communication, Taub schilling, TMH, 3rd edi
3. Coding Techniques: An introduction to Compression to compression and error control-Graham wade, Palgrave
4. Digital Communications 2nd edition-Bernard Sklar Pearson Education Asia publication
5. Modern Digital and Analog Communication Systems, BP Lathi, 3e, Oxford
6. Communication Systems-B.P Lathi, BS Publications (Hyderabad)

University of Mumbai			
CLASS: T.E. (Electronics & Telecommunication Engineering)		**Semester – VI**	
SUBJECT: Television & Video Engineering			
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**

Module	Contents	Hours
Objective	**The objective of this course is to introduce to the students the basics of picture transmission and reception.**	-
Pre-requisite	**Basic concepts of Communication Engineering**	-
1	**Elements of Basic Television System:** Introduction to video system, sound and picture transmission, scanning process, video signal, aspect ratio, horizontal and vertical resolution, video bandwidth and interlaced scanning, composite video signal for monochrome TV, video signal standards, sound and video modulation, VSB transmission and reception, (CCIR – B standards).	**10**
2	**TV camera tubes:** Basic principle, image orthicon, vidicon, plumbicon, solid-state image scanners.	**5**
3	**Color TV:** Compatibility considerations, Colour theory, chromaticity diagram, generation of colour TV signals, luminance signal, chrominance signal, frequency interleaving process, colour sub-carrier frequency, colour picture tubes, colour picture tube requirements, degaussing, purity convergence, circuit colour receivers set up procedure.	**10**
	Colour TV systems NTSC encoder and decoder, SECAM encoder and decoder. PAL encoder and decoder.	**7**
4	**Television Receiver and its Testing:** Block schematic, VSB correction, Choice of IF's, RF tuner, AGC, video IF section, sync separation, AFC, sound section, SMPS. Troubleshooting–Procedure of troubleshooting, television test charts, introduction to various test instruments. Colour TV receivers, antenna, RF tuner, AFT, video IF amplifier, video detector sound section, first video amplifier	**9**

	delay line colour burst circuit, AGC amplifier, phase discriminator, phase identification amplifier and colour killer, reference oscillator, vertical deflection system, horizontal deflection system, EHT.	
5	**Advanced TV Systems:** CCTV, Cable TV, Direct Broadcasting Satellites, Digital TV.	**7**
6	**IPTV** Multicasting, RTSP, RTCP	**5**

Theory Examination:

1. Question paper will comprise of total 7 questions, each of 20 marks.
2. All questions must be analytical.
3. Only 5 questions need to be solved.
4. Question number 1 will be compulsory and covering the all modules.
5. 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.)
6. In the question paper, weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
7. No question should be asked from **pre-requisite module**.

Oral Examination:

Oral Examination 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 six experiments and a written test.
The distribution of marks for term work shall be as follows,
Laboratory work (Experiments 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.

Practical list

1. Waveform analysis at different points in a color TV receiver kit.
2. Different video patterns using test pattern generator.
3. Video IF and detector section
4. Sound IF and output section
5. Horizontal and Vertical Section.
6. Chroma section.
7. Fault finding
8. Alignment of monochrome and color TV receivers.

Recommended Books:

1. Monochrome and Color Television-Gulati R.R, Wiley Eastern Limited publication.
2. Television and video engineering- R.G.Gupta
   Tata Mc Graw Hill
   publication.
3. Television and video engineering- Dhake A.M, Tata McGraw Hill publication.
4. Video Demystified, 4e, Keith Jack, Elsevier

University of Mumbai			
CLASS: T.E. (Electronics & Telecommunication Engineering)		**Semester - V**	
Elective SUBJECT: ACOUSTICS ENGINEERING			
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**

Module	Contents	Hours
Objective	**The objective of this course is to introduce to the students the fundamentals of radiation, reception, absorption and attenuation of acoustic waves.**	**-**
1	Acoustics waves – Linear wave equation – sound in fluids – Harmonic plane waves Energy density – Acoustics intensity – Specific acoustic impedance – spherical waves - Describer scales. **Reflection and Transmission:** Transmission from one fluid to another normal and oblique incidence – method of images.	**10**
2	**RADIATION AND RECEPTION OF ACOUSTIC WAVES** Radiation from a pulsating sphere – Acoustic reciprocity – continuous line source - radiation impedance-Fundamental property of transducers. **Absorption and attenuation of sound** Absorption from viscosity – complex sound speed and absorption – classical absorption coefficient.	**10**
3	**PIPES RESONATORS AND FILTERS** Resonance in pipes – standing wave pattern absorption of sound in pipes – long wavelength limit – Helmoltz resonator - acoustic impedence - reflection and transmission of waves in pipe – acoustic filters – low pass, high pass and band pass. **Noise, Signal detection, Hearing and speech** Noise, spectrum level and band level – combing band levels and tones – detecting signals in noise – detection threshold – the ear – fundamental properties of hearing – loudness level and loudness – pitch and frequency - voice	**10**

4	**ARCHITECTURAL ACOUSTICS:** Sound in enclosure – A simple model for the growth of sound in a room – reverberation time - Sabine, sound absorption materials – measurement of the acoustic output of sound sources in live rooms – acoustics factor in architectural design. Environmental Acoustics: Weighted sound levels speech interference – highway noise – noise induced hearing loss – noise and architectural design specification and measurement of some isolation design of portions**.**	**12**
5	**TRANSDUCTION** Transducer as an electives network – canonical equation for the two simple transducers transmitters – moving coil loud speaker – loudspeaker cabinets – horn loud speaker, receivers – condenser – microphone – moving coil electrodynamics microphone piezoelectric microphone – calibration of receivers.	**10**

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 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.

Oral Examination:

Oral Examination will be based on any experiment/ Tutorial performed from the entire syllabus.

Term work:

Term work shall consist of minimum six experiments/ Tutorials and a written test. The distribution of marks for term work shall be as follows,

Laboratory work (Experiments 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. Lawrance E. Kinsler, Fundamental of Acoustics, 4th ed., Wiley

University of Mumbai			
CLASS: T.E. (Electronics & Telecommunication Engineering)		**Semester - VI**	
Elective SUBJECT: RADAR ENGINEERING			
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**

Module	Contents	Hours
Objective	The objective of this course is to introduce different radar systems and their applications.	-
Pre-requisite	**Concept of Principles of Communication & Electromagnetic waves.**	-
1	Introduction Nature of Radar, Maximum Unambiguous Range, Radar Waveforms, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications. Related Problems.	**5**
2	**Radar Equation :** Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise and SNR, Integration of Radar Pulses, Radar Cross Section of Targets (simple targets - sphere, cone-sphere), Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment). Related Problems.	**7**
3	**CW and Frequency Modulated Radar :** Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar. FM-CW Radar, Range and Doppler Measurement, Block Diagram and Characteristics (Approaching/ Receding Targets), FM-CW altimeter, Measurement Errors, Multiple Frequency CW Radar.	**10**
4	**Radar Clutters:** Surface clutter radar equations, sea clutter, land clutter, effects of weather on radar angles echoes.	**5**

5	**MTI and Pulse Doppler Radar:** Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs. Range Gated Doppler Filters. MTI Radar Parameters, Limitations to MTI Performance. Non-coherent MTI, MTI versus Pulse Doppler Radar.	**9**
6	**Tracking Radar:** Tracking with Radar, Sequential Lobing, Conical Scan, Monopulse Tracking Radar – Amplitude Comparison Monopulse (one- and two- coordinates), Phase Comparison Monopulse. Target Reflection Characteristics and Angular Accuracy. Tracking in Range, Acquisition and Scanning Patterns. Comparison of Trackers. **Detection of Radar Signals in Noise :** Introduction, Matched Filter Receiver – Response Characteristics and Derivation, Correlation Function and Cross-correlation Receiver, Efficiency of Non-matched Filters, Matched Filter with Non-white Noise. **Radar Receivers** – Noise Figure and Noise Temperature. Displays – types. Duplexers – Branch type and Balanced type, Circulators as Duplexers. Introduction to Phased Array Antennas – Basic Concepts, Radiation Pattern, Beam Steering and Beam Width changes, Series versus Parallel Feeds, Applications, Advantages and Limitations.	**5** **5** **7**

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 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.

Oral Examination:

Oral Examination will be based on any experiment/ Tutorial performed from the entire syllabus.

Term work:

Term work shall consist of minimum six experiments/ Tutorials and a written test. The distribution of marks for term work shall be as follows,

Laboratory work (Experiments 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. Introduction to Radar System - M. I. Skoh1ik, Mc-Graw Hill Publication
2. Radar Principles, Peyton Peebles, Wiley
3. Radar, Edde, Pearson edu

University of Mumbai			
CLASS: T.E. (Electronics & Telecommunication Engineering)		**Semester - VI**	
Elective SUBJECT: MICRO ELECTRONICS			
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**

Module	Contents	Hours
Objective	**The objective of this course is to introduce to the students the fundamentals of IC development.**	-
Pre-requisite	**Concepts of Basic Electronics**	-
1	**Introduction to IC fabrication** General classification of Monolithic circuits, Definitions of LSI,MSI,VLSI, Thin Film technology- Thin Film conductor materials, resistor materials and Substrate materials, Thin Film processing techniques, thin film resistor and capacitor design guidelines, concept of sheet resistance. Various important steps of MOS bipolar IC fabrication such as Crystal growing, wafer cleaning, oxidation, annealing, patternization using photolithography technique, diffusion, metallization, ion-implantation etc. (only qualitative treatment).	**10**
2	**Bipolar Technology** Basics of BJT, its technological structures as implemented in silicon crystal- planar epitaxial transistor, ripple diffused transistor, Bipolar IC process, Monolithic BJT construction, Lateral and Vertical BJTs, Parasitic effects in BJTs, Isolation techniques-PN junction isolation ,Dielectric isolation, Monolithic planar diode configurations.	**10**
3	**MOSFET Technology** Basics of MOSFETs, overview of MOSFET Technologies- PMOS, NMOS, CMOS technology, basic PMOS and NMOS structures as implemented in Si crystal, PMOS Vs. NMOS technology, NMOS IC process steps, parasitic effects in MOSFETs, Short channel effects, Hot electron effects in MOSFETs. CMOS fabrication processes-N well, P well,Twin tub process.	**10**
4	**Basic Circuit elements** Monolithic resistors (construction and characteristics)-Diffused resistors ,Epitaxial	**10**

	resistors, Pinched resistors, Ion Implanted resistors, MOS resistors. Monolithic Capacitors-Junction capacitors, MOs capacitors, poly-poly capacitors, MOS device as capacitor, IC inductors, IC crossovers.	
5	**BASIC CIRCUITS** Simple bipolar N A N D g a t e operation and its realization in silicon structure (using p-n junction isolation technique). A depletion load and enhancement N-MOS inverter and depletion load NAND and NOR gate operation, their technological structures as implemented in silicon crystal. Drawing stick diagrams, color coded mask layout using Lambda (λ)-based (or micron-based) design rules. The CMOS inverter (NOT gate) and NAND gate structure, its stick diagram and mask layout. Parasitic effects in CMOS structure (inverter).	**12**

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 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.

Oral Examination:

Oral Examination will be based on any experiment/ Tutorial performed from the entire syllabus.

Term work:

Term work shall consist of minimum six experiments/ Tutorials and a written test. The distribution of marks for term work shall be as follows,

Laboratory work (Experiments and Journal) : 15 marks.
Test (at least one) : 10 marks.

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List of Experiments:

1. Study of BJT and MOSFET characteristics using circuit simulator
2. Comparison of different logic families
3. Study of static response of Logic gates in different technologies.
4. Study of transient response of Logic gates in different technologies
5. Layout of BJT and MOSFET using software like Magic
6. Layout of simple logic circuit like NAND gates, Adders

Objective of all above experiments is to relate theory and experiments for better understanding of the subject. In addition to above experiments Instructors can design two experiments to simulate different process steps such as oxidation, diffusion or ion implantation. For this, they can use any free software or write Matlab or “C” code.

Recommended Books:

1. Integrated Circuits – K.R. Botkar (Ninth Edition),Khanna publishers
2. Principles of CMOS VLSI Design-Neil H.E Weste, Kamran Esheaghian, Addison Wealey.
3. Basics VLSI Design, systems and circuit-Douglas A Pucknel, K Eshranghian
4. Introduction To VLSI Design-Eugene D. Fabricius-Mc Graw Hill International Edition
5. Microelectronics- J Millman and Grabel , Tata Mc Gaw Hill publisher
6. VLSI technology- S.M Sze
7. Fabrication principles-S.K Gandhi

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

Module	Contents	Hours
Objective	The objective of this course is to introduce to the students the fundamentals of switching and telephony.	**-**
		-
1	**Telephony Background** **An overview of telephone networks, transmission system, switching system,** **Signaling, echo cancellation, working principles of telephone, DC (pulse) and DTMF (tone) signaling**	**8**
2	**Traffic analysis** **Traffic characterization, loss systems, network blocking probabilities, delay systems**	**8**
3	**Digital switching and networks:** **Space division switching, time division switching, time space time (TST) switch, space time space (STS) switch, comparison of TST and STS switches, network synchronization, control and management, timing, timing inaccuracies, network synchronization, network control, Network management**	**08**

4	**.39** **Integrated service digital network (ISDN)** **ISDN overview, ISDN interfaces and functions, usernetworkinterface,ISDNprotocol architecture,** **ISDN physical layer: basic user - network interface, primary rate user- network interface, U interface,** **ISDN data link layer: LPAD protocol, terminal adaptation, bearer channel data link control,** **ISDN network layer: basic call control, control of supplementary services,** **Broadband ISDN (B - ISDN) : Architecture , Protocols** **Digital subscriber loop (DSL): ADSL, HDSL, VDSL, Fiber in loop, wireless local loop (WLL).** **Signaling System Number 7 (SS7): SS7 Architecture signaling date link level, signaling link level, network level, signaling connection control part**	**13**
5	**Introduction to IP telephony and related protocols:** **Overview of TCP/IP protocol** **Resource reservation protocol (RSVP), multi protocol label switching, real time protocol (RTP), session initiation protocol (SIP). H.323 standard, media gateway control protocol**	**9**
6	**Voice over packet networks:** **Voice over ATM, ATM cell format, ATM protocol stack, ATM adaptation layer, IP over ATM, frame relay over ATM.**	**6**

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

Oral Examination:

Oral Examination will be based on any experiment/ Tutorial performed from the entire syllabus.

Term work:

Term work shall consist of minimum six experiments/ Tutorials and a written test. The distribution of marks for term work shall be as follows,

Laboratory work (Experiments 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. Digital Telephony—JOHN BELLAMY—Wiley Series
2. ISDN and Broadband ISDN with Frame Relay and A TM - William Stalling. 4th Edition, Pearson education Asia publication
3. Telecommunication Switching and Networks—Thiagrajan Viswanathan—PHI Publication
4. Voice over packet n/w, David J Wright,John wiley and sons,Ltd.
5. Telecommunication swithing and n/ws Gnanasivam p, New Age Inernation,second edition.
6. IP Telephony - Oliver Hersent, David Gurle & Jean - Pierre Petit. Pearson Education Asia publication

University of Mumbai			
CLASS: T.E. (Electronics & Telecommunication Engineering)		**Semester - V**	
Elective SUBJECT: NEURAL NETWORKS & FUZZY LOGIC			
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**

Module	Contents	Hours
Objective	**This course attempts to provide a thorough understanding of neural networks and fuzzy logic that are key components of soft computing.**	**-**
1	**Fuzzy logic and Neural Networks, Approximations of Multivariate functions, Non – linear Error surface and optimization.**	**6**
2	**Fuzzy Logic Systems: Basics of fuzzy logic theory, Crisp and fuzzy sets. Basic set operations. Fuzzy relations, Compositin of Fuzzy relations, Fuzzy inference, Fuzzification and Defuzzification.** **Fuzzy logic control: Mamdani and Takagi and Sugeno architectures. Applications to pattern recognition.**	**9** **5**
3	**Neuralnetworks:Singlelayernetworks, Perceptron. Activation functions. Adaline: its training and capabilities, weights learning,** **Multilayer perceptrons : error back propagation, generalized delta rule. Radial basis function networks and least square training algorithm.**	**6**
4	**Kohenen self – organizing map and learning vector quantization networks. Recurrent neural networks, Simulated annealing neural networks. Adaptive neuro-fuzzy information systems (ANFIS), Applications to control and pattern recognition.**	**10**
5	**Evolutionary Computing : Genetic algorithms : Basic concepts, encoding , fitness function, reproduction. Differences of GA and traditional optimization methods. Basic genetic programming concepts Applications.**	**9**

6	**Neuro-dynamics** **Attractors, Neurodynamical model, Hopfield Models, Brain-state-in- a-box model,**	**7**

Theory Examination:

1. Question paper will comprise of total 7 questions, each of 20 marks.
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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.

Oral Examination:

Oral Examination will be based on any experiment/ Tutorial performed from the entire syllabus.

Term work:

Term work shall consist of minimum six experiments/ Tutorials and a written test.
The distribution of marks for term work shall be as follows,
Laboratory work (Experiments/Tutorials 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. Timothy J. Ross, Fuzzy Logic with Engineering Applications, MacGraw-Hill
2. Shivanandam and Deepa, Principles of Soft Computing, Wiley
3. Jang JSR, Sun CT, Mizutani E, Neuro-Fuzzy and Soft Computing, PHI
4. Kosko,Neural Networks and Fuzzy Systems, Pearson edu
5. Simon Haykin, Neural Networks A comprehensive foundation, 2e,Pearson edu
1. Rajsekaran S, Vijaylakshmi Pai, Neural Networks, Fuzzy Logic, and Genetic Algorithms, PHI
2. Hagan, Demuth, Beale, 'Neural Network Design', Thomson Learning