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, simple sequential 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 N is programmable and X is unsigned number.
3. Write a programmable delay routine.
4. Write a program to find out largest number in a block.
5. Experiment on string instructions.
6. Write a programme to multiply 32 bit number.

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 pattern 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 block code, decoding mechanism, hamming codes, extended hamming codes, shortened hamming codes, systematic for of H matrix, cyclic codes, 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, 3rdedi
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 - 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 NAND gate 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.
The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

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