UNIVERSITY OF MUMBAI

I. SCHEME OF INSTRUCTIONS AND EXAMINATIONS

at

B.E. (Electronics and Telecommunication Engineering)

(R-2001)

(Revised Scheme considering 60 Minutes' Period as per AICTE Guide – lines)

SEMESTER-VII

Sr.No.	Subjects	No. of Periods per week			Duration of Theory Paper(Hrs)	Marks				
		Lectures	Practicals	Tutorials		Theory Paper	Term Work	Practical	Oral	Total
1	* Digital Communication	3	2	-	3	100	25	-	25	150
2	Mobile Communication System	4	-	1	3	100	25	-	-	125
3	Microwave Devices and Circuits	4	2	-	3	100	25	-	25	150
4	Discrete Time Signal Processing	4	2	-	3	100	25	-	25	150
5	Elective I	4	2	-	3	100	25	-	25	150
6	Project-A	-	-	4	-	-	25	-	-	25
Total		**19**	**8**	**5**	**-**	**500**	**150**	**-**	**100**	**750**

*Subject common with Electronics Engineering branch.

Elective I (Any one)

1) Image Processing (Pr)
2) Data compression and encryption (Pr)
3) Radar Engineering(Tut)
4) Microwave Integrated Circuits(Tut)
5) Simulation of Communication Systems(Tut)

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Class: B.E.(Electronics and Telecommunication Engg.)		Semester VII	
Sub: Digital Communication			
Periods per week 1 period of 60 min.	Lecture	3	
	Practical	2	
	Tutorial	-	
		Hours	Marks
Evaluation System	Theory Examination	3	100
	Practical	-	-
	Oral Examination	-	25
	Term Work	-	25
Detailed Syllabus			

1. **Information theory:**
   Entropy, Shannon Theorem, Shannon Hartley theorem
2. **Baseband Transmission:**
   Discrete PAM Signals, power of discrete PAM signals, intersymbol interference, Nyquist's criterion for distorrtionless baseband transmission, Pulse shaping, line codes, correlative coding, eye diagram, equalization.
3. **Digital Modulation:**
   Representation of bandpass modulated signal, vector space representation, Gram, Schmidt procedure, signal energy and correlation, ASK, FSK, PSK, DPSK, M-ary FSK, QPSK, OQPSK, MSK, QAM-Introduction, Modulation, demodulation, signal space diagram, spectrum, bandwidth efficiency, power efficiency, probability of error, applications, carrier and timing recovery circuits.
4. **Baseband Detection:**
   Detection of binary signals- Matched filters, decision threshold in matched filters, error probability, maximum likelihood receiver structure, correlation realization of matched filter.
5. **Error Control Systems:**
   Overview, power and band limited channels, optimum decoding, decoded error rate.

6. 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 form of H matrix, cyclic codes, practical systematic encoders, binary BCH codes, shorthand cyclic codes, cyclic redundancy check (CRC) codes, interleaving, Non algebraic decoding of cyclic codes, Meggit decoding, shortened cyclic codes, brust detection, brust correction(error trapping), application areas.

7. Convolutional 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.

8. Spread Spectrum Techniques:

Basic techniques, direct sequence spread spectrum, frequency hop spread spectrum, spreading sequences-m-sequences, Walsh Hanamard wepuences, variable length orthogonal codes, correlation of sequences, PSD of DS spread spectrum, performance of DS/QPSK in tone interference, DS spread spectrum on frequency selective fading channels, error probability for DS CDMA on AWGN channels.

Review:

Mathematical definition and proof of sampling theorem for base band and band pass signals, flat top samples and their spectrum, signal distortion. PCM- Principles, bandwidth, channel capacity, DPCM- Principles, Quantizer design, predictor design, coding gain, Adaptive DPCM – Principle, Delta Modulation(DM).

List of Experiments:

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

Term Work:

Each student has to appear for at least one written test during the term. Report on experiments (at least eight from the list of suggested experiments) and assignments along with a graded answer paper shall be submitted as termwork.

The distribution of term work will be as follows:

Report on experiments –15 marks.
Written Test-10 marks.

Text Books:

1. Digital Communications- Simon Haykin
   John Willey & Sons publication.
2. Coding Techniques: An Introduction to Compression and Error Control- Graham wade, Palgrave
3. Principles of Mobile Communications 2nd Edition- Gordon Stuber
   Kluwer Academic Publication.

Reference Books:

1. Digital Communications 2nd Edition- Bernard Sklar
   Pearson Education Asia publication
2. Communication Systems – B.P.Lathi,
   BS Publications (Hyderabad)

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Class: B.E.(Electronics and Telecommunication Engg.)		Semester VII	
Sub: Mobile Communication System			
Periods per week 1 period of 60 min.	Lecture	4	
	Practical	-	
	Tutorial	1	
		Hours	Marks
Evaluation System	Theory Examination	3	100
	Practical	-	-
	Oral Examination	-	-
	Term Work	-	25
Detailed Syllabus			

1. **Introduction:**
   Introduction to wireless communication systems.
2. **The cellular concept:**
   Frequency reuse handoff, interference, trunking and grade of service, improving the capacity of cellular system.
3. **Mobile radio propagation:**
   Large scale path loss, reflection, ground reflection, model(2 ray model), diffraction, practical link budget design using path loss models, small scale fading and multi-path, small-scale multipath propagation, parameter of multi-path channels, types of small scale fading, Raleigh and ricean distribution, diversity.
4. **Analog cellular mobile system:**
   AMPS and ETACS system (overview call handling, air interface, N-AMPS)
5. **Digital cellular mobile system:**
   GSM-services, features, system architecture, radio subsystem, channel types, frame structure, signal processing security aspects, network operations.
6. **Low power wireless communication systems:**
   Cordless telephone, CT2, DECT, PHS, PACS
7. **CDMA digital cellular standard (IS-95):**
   Frequency and channel specifications, forward and reverse CDMA channel.
8. **Mobile terminals:**
   Over view, types power, functional architecture, encryption, subscriber identity module.
9. **Global mobile satellite system:**
   Introduction to iridium system, global star system, ICO system, telederic system.
10. **Third generation mobile communication:**
    System IMT-2000, Introduction, radio aspects, network aspects.

Term Work:

Each student has to appear for at least one written test during the term. Report on eight assignments covering all the topics along with a graded answer paper shall be submitted as termwork.

The distribution of term work will be as follows:

Report on assignments-15 marks.
Written Test – 10 marks.

Test Books:

1. Wireless Communication - Throdore S. Rappaport Prentice Hall of India, PTR publication
2. Wireless personal Communication system – David J. Goodman Addison Wesley publication
3. GSM Cellur Radio- Joachim

Reference Books:

1. Mobile and personal communication system and services- Raj Pandya Prentice Hall of India Publication.

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Class: B.E.(Electronics and Telecommunication Engg.)		Semester VII	
Sub: Microwave Devices and Circuits			
Periods per week 1 period of 60 min.	Lecture	4	
	Practical	2	
	Tutorial	-	
		Hours	Marks
Evaluation System	Theory Examination	3	100
	Practical	-	-
	Oral Examination	-	25
	Term Work	-	25
Detailed Syllabus			

1. Introduction:
Microwave bands, microwave characteristics, microwave system, traditional, industrial and biomedical applications, microwave hazards.

2. Transmission line theory:
Circuit representation of transmission line, transmission line equations, sinusoidal excitation of transmission line, impedance and its transformation, Simth Chart and its applications, impedance matching techniques. Each student has to appear for at least one written test during the term. Report on experiments (at least eight from the list of suggested experiments) and assignments along with a graded answer paper shall be submitted as termwork.
The distribution of term work will be as follows:
Report on experiments –15 marks.
Written Test-10 marks.

3. Microwave Transmission lines:
Co-axial line, rectangular and circular wave guides, introduction to strip lines, microstrip lines and co-planar wave-guides.

4. Wave guide components:
Transmission line resonators, Rectangular and circular cavity resonators, introduction of s-parameters, Hybrid junctions, Directional couplers, circulators, isolators, wave-guide terminations, Attenuators, Phase-shifter

5. Microwave tubes:
Reflex klystrons, Multi cavity klystron, Helix TWT, Coupled cavity TWT, Backward wave oscillator, magnetron, Forward wave cross field Amplifiers.

6. Microwave semiconductor devices:
Point contact diodes, Schottky barrier diodes, PIN diodes, varactor diodes, tunnel diodes, Gunn devices, IMPATT diode, parametric devices, Detectors and Mixers.

7. Microwave measurements:
VSWR, Frequency, Power, Noise, Q Factor, Impedance, Attenuation, Dielectric Constant, antenna Gain.

List of Experiments:

1. Measurement of power using Bolo meters.
2. Measurement of attenuation by substitution method.
3. Measurement of impedance using slotted wave guide.
4. Measurement of scattering parameters.
5. Measurement of noise.
6. Measurement of frequency using slotted wave guide.
7. Measurement of impedance using reflectometer.
8. Measurement of wavelength using reflectometer.
9. Measurement of gain of horn antenna form radiation pattern.

Term Work:

Each student has to appear for at least one written test during the term. Report on experiments (at least eight from the list of suggested experiments) and assignments along with a graded answer paper shall be submitted as termwork.
The distribution of term work will be as follows:

Report on experiments –15 marks.
Written Test-10 marks.

Text Books:

1. Microwave engineering passive circuits – Peter A.Rizzi
PHI Publication.
2. Microwave Devices and circuits- Samuel Liao
PHI Publication.
3. Microwave Engineering – David Pozar
John Wiley and Sons publication.
4. Microwave Engineering and Applications- O.P. Gandhi
Paragamon Press publication

Reference Books:

1. Basic Microwave Techniques and laboratory manual –
M.L.Sisodia, G.S.Raghuvanshi
Wiley eastern Limited publication

2. Electromagnetic Field theory fundamentals – Guru & Hisiroglu
Thomson learning publication.

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Class: B.E.(Electronics and Telecommunication Engg.)		Semester VII	
Sub: -Discrete Time Signal Processing			
Periods per week 1 period of 60 min.	Lecture	4	
	Practical	2	
	Tutorial	-	
		Hours	Marks
Evaluation System	Theory Examination	3	100
	Practical	-	-
	Oral Examination	-	25
	Term Work	-	25
Detailed Syllabus			

1. **Transform analysis of LTI systems:**
   Frequency response of LTI systems, phase distortion and delay, all pass systems, minimum, maximum mixed phase system, linear phase filters, causal generalized linear phase system (pole zero plots) symmetric anti-symmetric filters low pass, high pass, band pass filters, digital resonator, comb filters, notch filters, all pass filters, digital sinusoidal oscillator.
2. **Discrete fourier transform:**
   DFT and its properties, linear filtering based on DFT, frequency analysis of signal using DFT, long data filtering overlap and save, overlap and add method.
3. **Discrete cosine transform(DCT):**
   Definition of DCT, DCT-1 and DCT-2 , relationship between DFT and DCT-1 and DCT-2, energy competition property of DCT-2, application of DCT.
4. **Computation of DFT:**
   Fast fourier transform radix 2, radix4,application of FFT algorithm, efficient computation of DFT of 2N point real sequences, linear filtering, correlation, Goertzel algorithm, chripZ transform, DIT-FFT, DIF, FFT,IFFT split radix FFT degradation from finite word length, effects of quantization , round off noise in FFT and IFFT.
5. **Design of filters:**
   Design of FIR filters- windowing method frequency sampling method, optimum equiripple linear phase FIR, FIR differentiator, optimum approximation of FIR filters, Hilbert transformers, relationship between no.

6. Structures of discrete time systems:

FIT structures (direct form, cascade form, frequency sampling and Lattice), structures for linear phase filters, structure for IIR systems, direct form (cascade, parallel, lattice and lattice ladder), basic structure of phase shifters, effect of coefficient quantization in IIR and FIR systems, effect of round off noise in digital filters analysis of the direct form IIR structures, scaling in fixed point implementation of IIR systems, analysis of a cascade IIR structures, and FIR structures.

7. Digital ladder filters:

Properties of two port circuits, simulated ladder filters, switched capacitor filters, wave filters, lattice filters, comparison elements.

8. Introduction to programmable digital signal processors:

Multiplier and multiplier accumulator modified bus structures and memory, VLIW architecture, pipelining, special addressing modes, in P-DSPs, on chip peripherals.

List of Experiments:-

1. Magnitude and phase response of a system.
2. Pole zero diagram and phase response of a linear phase filter.
3. Computation of DFT and at least one application.
4. Discrete cosine transform and its application
5. Design of Butterworth IIR filter.
6. Design of chebyshev IIR filter
7. Design of FIR filter.
8. Design of digital filter using least square method
9. Real time signals and its processing uning digital signal processors.
10. Implementation of multi-rate signal processing.

Term Work:

Each student has to appear for at least one written test during the term. Report on experiments (at least eight from the list of suggested experiments) and assignments along with a graded answer paper shall be submitted as termwork.

The distribution of term work will be as follows:

Report on experiments –15 marks.
Written Test-10 marks.

Text Books:

1. Digital Signal Processing – John Proakis
   Prentice Hall of India Publication.
2. Discrete time signal processing – Alan V. Oppenheim & Ronald
   Prentice Hall of India Publication
3. Digital Signal Processors – B. Venkatramani, M.Bhaskar
   Tata Mc-Graw Hill Publication

Reference Books:

1. Digital Processing of signals – Maurice Bellanger
   John wlley publication
2. Digital Filters- Analysis and Design – Iffecho R.
   Pearson Education Assia Publication

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Class: B.E.(Electronics and Telecommunication Engg.)		Semester VII	
Sub: -Elective I (1):Image Processing			
Periods per week 1 period of 60 min.	Lecture	4	
	Practical	2	
	Tutorial	-	
		Hours	Marks
Evaluation System	Theory Examination	3	100
	Practical	-	-
	Oral Examination	-	25
	Term Work	-	25
Detailed Syllabus			

1 Introduction:
Digital image representation, steps in image processing, elements of digital image processing systems.

2 Digital Image Fundamentals:
Elements of visual perception, simple image model, sampling and quantisation, basic relationships between pixel, basic transformations

3 Image Transforms:
Review of DFT, two-dimensional DFT and its properties, walsh transform, Hadamard transform, descrete cosine transform, the hotelling transform.

4. Image Enhancement:
Spatial domain methods, frequency domain methods, enhancement by point processing, spatial filtering, enhancement, in the frequency domain, generation of spatial masks from frequency domain specification, colour image processing.

5. Image Compression:
Fundamentals, image compression models, using information theory for image compression, error free compression, lossy compression, image compression standard.

6. Image Segmentation:
Detection of discontinuities, edge linking and boundary detection, thresholding, region oriented segmentation, the use of motion in segmentation.

7. Image Representation and description:
Representation schemes, boundary descriptors, regional descriptors, morphology, relational descriptors.

List of Experiments:

1. Read on Input image and manipulate its resolution in the spatial and gray domains.
2. Arithmetic and logical operations on images.
3. Image rotaion, scaling, translation.
4. Image Transforms – I For a 4X4 image, determine its forward and inverse transforms and compare the inverse transforms with the original image data.
5. Image Transforms – II
6. Histogram and Histogram equalization of an image.
7. Smoothening filters
8. Sharpening filters
9. Compression codes
10. Image differentiation
11. Thresholding
12. Functions to determine boundary descriptors like boundary length, curvature
13. Functions to determine regional descriptors like area, perimeter, compactness, Eular number
14. Functions to compute texture descriptors in an image.

Term Work:

Each student has to appear for at least one written test during the term. Report on experiments (at least eight from the list of suggested experiments) and assignments along with a graded answer paper shall be submitted as termwork.
The distribution of term work will be as follows:

Report on experiments –15 marks.
Written Test-10 marks.

Reference Books:

1. Digital Image Processing – Ganzalez R.C.
   Pearson Education Asia Publication
2. Image processing , Analysis, and Machine vision – Milan Sonka, Vaclav Hivac, Roger Boyle
   Thomson Learning publicaion
3. Fundamentals of Image Processing – Anil K. Jain
   Prentice Hall of India Publication.

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Class: B.E.(Electronics and Telecommunication Engg.)		Semester VII	
Sub:-Elective I(2):Data Compression and Encryption			
Periods per week 1 period of 60 min.	Lecture	4	
	Practical	2	
	Tutorial	-	
		Hours	Marks
Evaluation System	Theory Examination	3	100
	Practical	-	-
	Oral Examination	-	25
	Term Work	-	25

1. Detailed Syllabus

Data Compression and Encryption:
Need for Data Compression, Lossy / loss less compression, symmetrical compression and compression ratio, run length encoding (RLE) for text and image compression , relative encoding and its applications in facsimile data compression and telemetry, scalar quantization.

2. **Statistical Methods:**
Statistical modeling of ingormation source, coding redundancy, variable size codes prefix codes, Shannon-Fano coding, Huffman coding, adaptive arithmetic coding and adaptive arithmetic coding, text compression using PPM method.

3. **Dictionary Methods:**
String compression, sliding window compression, LZ77, LZ78 and LZW algorithms and applications in text compression, Zip and Gzip, ARC and Redundancy code.

4. **Image compression:**
Loss less techniques of image compression, gray codes, two dimensional image transforms, descrete cosine transform and its application in lossy image compression, quantization, zig-zag coding sequences, JPEG and JPEG-LS compression standards, pulse code modulation and differential pulse code modulation methods of image compression, video compression and MPEG industry standard.

5. **Audio Compression:**
Digital Audio, Lossy sound compression, M-law and A-law compounding, DPCM and ADPCM audio compression, MPEG audio standard, frequency domain coding, format of compressed data.

6. **Conventional Encryption:**
Security of information, security attacks, classical techniques, Caesar cipher, block cipher principles, data encryption standard, key generation for DES, block cipher principle, design and modes of operation, S-box design, triple DES with two three keys, introduction to international data encryption algorithm, key distribution.

7. **Number Theory and public encryption:**
Modular arithmetic, Fermat's and Euler's theorems, Chinese remainder theorem, discrete logarithm, principles of public key cryptosystems, RSA algorithm, key management, Diffie-Hellman key exchange, elliptic curve cryptography.

8. **Message Authentication:**
Authentication requirements and functions, message authentication codes (MAC), hash functions and their security, hash and MAC algorithms, digital signatures and authentication protocols, digital signature standard and algorithms.

Term Work:

Each student has to appear for at least one written test during the term. Report on experiments (at least eight from the list of suggested experiments) and assignments along with a graded answer paper shall be submitted as termwork.
The distribution of term work will be as follows:

Report on experiments –15 marks.
Written Test-10 marks.

Text Books

1. Data Compression – David Salomon ,
Springer Veriag Publication.
2. Cryptography and Network Security – William Stallings
Pearson Education Asia Publication
3. Introduction to Data Compression – Khalid Sayood
Morgan Kaufmann Publication

Reference Books:

1.The Data Compression Book – Mark Nelson.
BPB publication
2. Applied Cryptography – Bruce Schnecer
John Willey & Sons Inc. Publication.

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Class: B.E.(Electronics and Telecommunication Engg.)		Semester VII	
Sub:-Elective I(3):Radar Engineering			
Periods per week 1 period of 60 min.	Lecture	4	
	Practical	-	
	Tutorial	2	
		Hours	Marks
Evaluation System	Theory Examination	3	100
	Practical	-	-
	Oral Examination	-	25
	Term Work	-	25
Detailed Syllabus			

1. **Introduction:**
   Radar set, radar frequencies and radar applications.
2. **Radar Equation:**
   Range performance, minimum detectable signal, receiver noise, transmitter power, pulse repetition frequency, pulse duration, system losses, and propagation effects.
3. **Radar Targets:**
   Radar cross-section, black scatter cross section, complex target cross section fluctuations, frequency agility effects on target detection and tracking.
4. **CW, MTI & Pulse Radars:**
   CW radars, FMCW radar, MFCW radar, MRI radar, Pulse Doppler radar- principles, operation, performance, limitations and applications.
5. **Radar Clutters:**
   Surface clutter radar equations, sea clutter, land clutter, effects of weather on radar angles echoes.
6. **Tracking radars :**
   Sequential lobing, conical scan tracking mono-pulse tracking.
7. **Navigational & Remote Sensing Radars:**
   Airport radars, meterological radars, airborne radars, Doppler navigation, remote sensing radars, pattern synthesis, phased array.
8. **Landing Systems & Hyperbolic Navigation:**
   Instrument landing systems, ground controlled approach, radio altimeter, microwave landing system, loran-A, measurement delay, loran-C, DECCA.

TermWork:

Each student has to appear for at least one written test during the term. Report on eight assignments on all topics along with a graded answer paper shall be submitted as termwork.

The distribution of term work will be as follows:

Report on assignments –15 marks.

Written Test- 10 marks

Text Books:

1. Introduction to Radar System – M.I. Skolnik
   Mc-Graw Hill Publication.
2. Radar Systems and Radio Aids to Navigation- A.K.Sen & A.B.Bhattacharya
   Khanna publication.

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Class: B.E.(Electronics and Telecommunication Engg.)		Semester VII	
Sub:-Elective I(4):Microwave Integrated Circuits			
Periods per week 1 period of 60 min.	Lecture	4	
	Practical	2	
	Tutorial	-	
		Hours	Marks
Evaluation System	Theory Examination	3	100
	Practical	-	-
	Oral Examination	-	25
	Term Work	-	25
Detailed Syllabus			

1. **Hybrid MICs:**
   Definition, characteristics, comparison with conventional circuits, fields of application and limitations and criteria for the choice of substrate material, thin film hybrid circuits, artwork, mask making, photolithography, resister stabilization, sawing, brazing process, wire bonding.
2. **Monolithic MICs:**
   Definition, substrate structure, doping by ion implantation ohmic contact, metal resistive layers, gate metal, dielectric second level metal, dielectric and air bridge vias, substrate vias, final wafer process steps.
3. **Micro strip Lines:**
   Planer wave guides, non-TEM propagation, line impedance definitions, quasi-static approximations, quasi-static line parameters, micro strip open circuits and gaps, micro strip corners, step changes in width, dispersion analysis, micro strip characteristic impedance, symmetric T junction, full wave analysis of micro strip propagation, LSE and LSM potentials, spectral domain analysis, dispersion relation for open micro strip, spectral domain impedance analysis, Green's functions, millimeter wave modeling of micro strip lines.
4. **Coupled Line Propagation:**
   Wave equations for coupled lines, propagation models, coupled line parameters, coupled line parameter variations with frequency, directional couplings, Lange coupler coupled line pair treated as a four port, coupled line pair operated as to a two port assuming 0e=0o, low pass filter design assuming 0e=0o, coupled line pair analysed to a two 0e not equal to 0o, narraw band filter using coupled resonator, narrow band coupled line filters, suspended substrate strip lined filter, suspended substrate strip line design using method 1 and method 2.
5. **Slot Lines:**
   Analysis, design consideration, transistions and applications.

6. **Coplanar Waveguide:**
   Analysis, design considerations and coplanar line circuits.
7. **Devices:**
   GaAs FET, HEMT, gunn diode, varavtor diodes, PIN diodes, YIC resonators, dielectric resonators & their application in oscillator mixer and amplifiers.

Term Work:

Each student has to appear for at least one written test during the term. Report on eight assignments on all topics along with a graded answer paper shall be submitted as termwork.

The distribution of term work will be as follows:
Report on assignments –15 marks.
Written Test- 10 marks

Text Books:

1. Microstrip Circuit Analysis – David H. Schrade, Prentice Hall PTR, New Jersey 07548.
2. Microstrip Lines and Slot Lines- K.C.Gupta, R.Garg and I.J. Bahi, Artech House.
3. MIIC Design: GaAs FETs and HEMTs- Peter Ladbrooke, Artech House.
4. Foundatios for Microstrip Circuit Design- T.C.Edwards, John Wiley and Sons

Reference Books:

1. MIC and MMIC Amplifier and Oscillator Circuit Design- Allen Sweet, Artech House.
2. Handbook of Mocrowave Integrated Circuits- Reinmut K. Hoffman, Artech House.

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<table>
<tr><td colspan="2">Class: B.E.(Electronics and Telecommunication Engg.)</td><td colspan="2">Semester VII</td></tr>
<tr><td colspan="4">Sub:-Elective I(5):Simulation of Communication Systems</td></tr>
<tr><td rowspan="3">Periods per week
1 period of 60 min.</td><td>Lecture</td><td colspan="2">4</td></tr>
<tr><td>Practical</td><td colspan="2">-</td></tr>
<tr><td>Tutorial</td><td colspan="2">2</td></tr>
<tr><td colspan="2"></td><td>Hours</td><td>Marks</td></tr>
<tr><td rowspan="3">Evaluation System</td><td>Theory Examination</td><td>3</td><td>100</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td></tr>
<tr><td>Oral Examination</td><td>-</td><td>25</td></tr>
<tr><td></td><td>Term Work</td><td>-</td><td>25</td></tr>
<tr><td colspan="4">Detailed Syllabus</td></tr>
</table>

1. Basics of Simulation Modeling:

System model and Simulation, Physical and Mathematical models. Analytical solutions and simulation output. Continuous and Discrete silulation models.

Discrete event simulation: Components and organization of discrete event scheduling and time advance approaches

a) Simulation of a single server queuing systems
b) Simulation of an Inventory system

Problem statement, program organization and logic, simulation program, simulation output and Analysis of result.

2. Complex system Simultation:

Steps in simulation study, combined discrete continuous simulation, Monte Carlo Simulation. List processing in Simulation, storing list, linked storage allocation, simple C based Simulation language Simlib. Single server queueing Simulation, Simlib program steps and Simulation output.

3. Simulation software:

Classification of Simulation software general purpose vs Application oriented Simulation packages. Modeling approaches, common modeling elements, entities attributes, resources and queries. Validation of Simulation of Simulation model.

Features of Simulation software, animation and dynamic graphics, statistical capabilities, documentation, output reports and graphics, statistical capabilities, documentation, output reports and graphics, general purpose Simulation package: Arena, Object Oriented Simulation: Modsim III.

4. **Random process:**
Random variables, probability density functions and probability distribution functions. Random members and their properties, Randomness in message arrival time, type and length etc Review of sampling theorem for band limited signal and its representation using MATLAB, generation of random variables for specified probability density function. Gaussian process in communication system, generation of a multivariable gaussian process and its Simulation using MATLAB, Low and Band pass process Simulation.

5. **Analog modulation:**
Amplitude modulation (double sided, single sided and vestigial side band type) of band limited message signal and its modulation, frequency analysis of AM signals. MATLAB Simulation of AM signals Angle modulation (Phase and Frequency) MATLAB Simulation of frequency modulation showing the spectra of message and modulation signals, comparison of demodulated output signals with the original message signal.

6. **Digital signal transmission (Base band and band limited):**
Additive white Guassian noise optimal receiver of AWGN channel, Probality of error. MATLAB Simulation of the above. Monte Carlo Simulation of binary communication system employing correlators of matched filters.
Transmission through band limited channels, power spectrum of pulse amplitude modulation, channel distribution, MATLAB Simulation of band limited channel, modeling as a linear filters(FIR or IIR), characterization of Inter symbolic interface based on transmitter and receiver filters, Communication system design for low ISI, Linear equalizer design using MATLAB.

7. **Digital Transmission via Carrier Modulation:**
Carrier amplitude modulation (ASK), Carrier Phase Modulation(PSK), Differential phase modulation (DPSK) and demodulation, Quadrature, amplitude modulation and demodulation, Carrier frequency modulation(FSK) and demodulation, MATLAB Simulation of above methods

8. **Source coding and channel coding:**
Source coding : Huffman coding, Quantization, pulse code modulation, MATLAB scripts for the above.
Channel coding: Linear block codes, cyclic block codes, Implementation of the above using MATLAB.

Term Work:

Each student has to appear for at least one written test during the term. Report on eight assignments on all topics along with a graded answer paper shall be submitted as termwork.

The distribution of term work will be as follows:

Report on assignments –15 marks.
Written Test- 10 marks

Text Books:

1. Simulation Modelling and Analysis- Averill M. Law & W. David Kelton , McGraw Hill International services
2. Contemporary Communication systems using MATLAB – John G. Proakis & Masoud Salehi Brooks Cole Thomson Learning Publishers

Reference Books:

1. Discrete Event System Simulation-Jerry Banks Pearson Education International Series Publishers
2. Simulation of Communicaiton systems – Jeruelaim Philips Balaban AT & Bell Lab publ.
3. Simulation Modeling & Analysis – Aberilla David Eltron.