


**REGULATIONS FOR ADMISSION,
SCHEME AND SYLLABI
FOR
M. Tech. DEGREE PROGRAMME
IN
APPLIED ELECTRONICS
(2009 ADMISSION ONWARDS)**


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REGULATIONS FOR M. Tech. DEGREE PROGRAMME IN APPLIED ELECTRONICS

1. Conditions for Admission

Bachelor's degree in appropriate branch of Engineering with minimum 55% aggregate or equivalent

2. Duration of the Course

The course leading to the degree of Master of Technology will span over a period of Four Semesters (Two years). Span of a semester will be six months and the total working hours will be 450.

3. Branch of Study

M. Tech. in Applied Electronics

4. Curriculum

The curriculum will comprise the courses of study as given in the scheme in accordance with the prescribed syllabi.

Candidates will be required to undertake a suitable master's research project work and industrial training in consultation with the Head of the Department and the Faculty Advisor and submit the project report & industrial training report there on at the end of the respective semesters, on dates announced by the college / department.

5. Requirements of Attendance and Progress

- i. A candidate will be deemed to have completed the requirements of study of any semester and permitted to appear each University End Semester Examinations (ESE) only if;
 - a) The candidate has kept not less than 75% of attendance in each of the subjects of the total number of working days of the concerned semester.
 - b) His / her progress has been good.
 - c) His / her conduct has been good.
 - d) He / she has minimum of 50% of sessional marks for each subject.

- ii. A student who has an attendance & sessional marks lower than 75% and 50% respectively will not be permitted to appear for the end semester examination and he /she has to redo the semester at the next available opportunity. However, a candidate can repeat a semester only once during the entire programme.

Note: As these are academic prerequisites, no exemption will be granted in these cases whatever may be the causes.

6. Procedure for Completing the Course

- i. The courses of the odd semesters will be conducted only in odd semesters and that of the even semesters only in even semesters.
- ii. A candidate may proceed to the course of study for the next semester only after completing the requirements of attendance and progress (Regulation clause 5) of the previous semester.
- iii. A candidate who has passed in a semester cannot repeat the course.
- iv. A candidate who desires to repeat (only on medical grounds) the course of any semester for want of attendance / progress or who desires to rejoin the course after a period of discontinuance or who upon his / her own request is permitted by the Head of the Institution to repeat the course of any semester, may join the semester which he / she is eligible or permitted to join, only at the time of its normal commencement for a regular batch of students and after obtaining the permission from the University. No student will however be enrolled in more than one semester at any time. In the case of repeaters the earlier assessment in the repeated course will be disregarded.
- v. A candidate is eligible for condonation of shortage of attendance only once in the entire programme subject to the conditions given below.
 - a) His conduct and progress must be good.
 - b) Condonation will be granted only on medical grounds.
 - c) The shortage shall not be more than 10% of actual working days.
 - d) By the recommendation of the Head of the Institution, the condonation shall be granted subject to rules and procedures prescribed by the University from time to time.

- e) It is open to the Vice Chancellor to grant condonation of shortage of attendance on the recommendation of the Head of the Institution.

7. Examination & Valuation

Theory Examination

There will be End Semester Examination (ESE) at the end of all semesters. There is no provision for improvement examinations. The medium of instruction, examinations, seminar and project report, etc. will be English only. To conduct all the theory examinations, a Chief Superintendent and an Assistant Chief Superintendent from senior faculty members of the engineering discipline are to be appointed by the principal.

An external Chief Superintendent from among the senior faculty of engineering discipline of Government Engineering Colleges / Aided Engineering Colleges / Engineering Colleges under Government of Kerala will be appointed by the University as an Observer for conducting all theory examinations.

Duties of the Observer

The Observer along with the Chief Superintendent at the centre has to ensure the smooth conduct of examinations. It is the joint responsibility of the Chief Superintendent and the Observer to:

1. Verify the sealing on the packets containing question papers, prior to the commencement of each of the examination.
2. Note the serial numbers / code of the answer books and additional sheets supplied on each day / examination.
3. Ensure that sufficient numbers of invigilators are deployed in each examination hall.
4. Visit the examination halls during examination to ensure proper invigilation by the invigilators.
5. Report malpractices / irregularities / insufficiencies if any, through proper channel.
6. Verify the number of answer books with the attendance statement, for each examination.

7. Ensure that the bundles of the answer scripts are properly sealed and signed immediately after the examination.
8. Send the answer scripts to the University at the earliest. If there is any delay in sending the answer books, they should be kept in safe custody at the centre till they are sent.

Practical Examinations

The principals of the engineering colleges with the help of chairman / chairperson of all branches should arrange the practical examinations for all semesters with approval from the University. Bonafide laboratory record / Master's project report / industrial training / seminar report, etc. are mandatory for appearing for the practical / viva-voce examinations. To conduct first semester practical examinations, the University will appoint two internal examiners from a panel of faculty of concerned engineering college and to conduct second semester practical examinations, the University will appoint an internal examiner from a panel of faculty of concerned engineering college and an external examiner from Government Engineering Colleges / Aided Engineering Colleges / Engineering Colleges under Government of Kerala. The examiners together will conduct the examination and decide the marks to be awarded to the candidates. The mark list filled and duly signed by the examiners should be forwarded to the chairman by the internal examiner. The internal examiner will be the custodian of the valued answer script till the commencement of the subsequent examination. There is no provision for revaluation.

To conduct third semester industrial training evaluation and fourth semester thesis evaluation and mater's comprehensive viva-voce, the University will appoint a panel of examiners from the faculty of concerned engineering colleges with at least one external examiner from Government Engineering Colleges / Aided Engineering Colleges / Engineering Colleges under Government of Kerala.

Faculty members retired as Professors up to 70 years of age from NIT / Government Engineering Colleges / Aided Engineering Colleges / Engineering Colleges under Government of Kerala will also be appointed as external examiners for the conduct of practical / industrial training evaluation / thesis evaluation / mater's comprehensive viva-voce and End Semester University Examinations.

The University will verify the qualification, field of specialization and experience of all faculty members who are appointed as examiners. The word “faculty” confines only to those who handle theory subjects in the appropriate branch of engineering discipline and have specialization in the concerned discipline.

The chairman / chairperson for examinations will be appointed by the University & selected from among the senior faculty members having specialization in the concerned engineering discipline from Government Engineering Colleges / Aided Engineering Colleges / Engineering Colleges under Government of Kerala.

Valuation

The answer books of University end semester examinations will be valued by faculty members specialized in the concerned disciplines from Government Engineering Colleges / Aided Engineering Colleges / Engineering Colleges under Government of Kerala.

All theory papers of second semester are to be separately valued by two examiners namely internal and external examiners from among the panel of examiners appointed by the University. The candidate will be awarded the average of the marks by the two examiners. All theory papers of first semester are to be valued by two internal examiners and the average marks should be awarded to the candidate.

However if the difference in the marks awarded by the two examiners exceeds 10% of the maximum marks for the subject, a third external examiner will revalue the paper. In such cases, the average of the highest two, among the three marks will be awarded to the candidate. There is no provision for revaluation. The external examiner will be a faculty from Government Engineering Colleges / Aided Engineering Colleges / Engineering Colleges under Government of Kerala.

8. Passing Requirements and Provisions

- i. All 80 credits should be earned by a candidate to be qualified for the degree.
- ii. The candidate should have cleared all dues to the Institute / University.
- iii. No disciplinary action is pending against him / her.
- iv. Passing requirement for a student shall be minimum of 50% (Theory and Sessional put together), subjected to a minimum of 40% for the theory.

- v. A candidate, who is absent or secure a grade U or less than 40% in ESE in any subject carrying sessional marks and ESE marks, will retain the already secured sessional marks for subsequent appearance in the examination of that subject.
- vi. A candidate who fails to submit the report on the project / industrial training within the prescribed date (or whose report is not accepted for reasons of incompleteness or other serious deficiencies) will have to register, redo the project / industrial training and submit the report at the end of the subsequent semester.
- vii. A candidate who successfully completes the course satisfying all the passing requirements of the courses will be declared to be qualified for the award of M. Tech. degree.
- viii. Candidates who have passed all subjects of the four semesters at the first opportunity within four consecutive chances after the commencement of his / her study shall be ranked based on the CGPA obtained.
- ix. A candidate who qualifies for the award of the M. Tech. degree having passed all the subjects of all the four semesters within a period of maximum six consecutive semesters after the commencement of his / her study and secures a CGPA of 8 and above considering all the four semesters, will be declared to have passed the M. Tech. degree in FIRST CLASS with DISTINCTION.
- x. A candidate who qualifies for the award of M. Tech. degree having passed all the subjects of all the four semesters within a period of maximum six consecutive semesters after the commencement of his / her study and secures a CGPA of 6.75 and above considering all four semesters, will be declared to have passed the M. Tech. degree in FIRST CLASS.
- xi. All other successful candidates will be declared to have passed the M. Tech. degree in SEOCND CLASS.
- xii. Candidates shall be declared to have qualified for award of M. Tech. degree provided the candidate has successfully completed the course requirements and has passed all the prescribed subjects of study in the four semesters within a maximum period of five years from the commencement of his / her study.
- xiii. Every candidate shall, based on his / her project work / dissertation, send a paper for publication in a journal or a conference in which all the papers are published after usual review.

9. Leave Rules

All students are eligible for a leave of 15 days per semester and no provision of carry over to subsequent semesters.

10. Teaching Assistanceship

Teaching assistance of 5 hours per week may be assigned to the students.

11. Industrial Training / Thesis Work in Industry or Other Organization

The following details should be submitted to the Head of the Institution through the Head of the Department & Faculty Advisor and should be approved before commencement of the industrial training / thesis work.

A committee appointed by the Head of the Department should go through the request of each of the student and fix in advance;

1. Area of the Industrial Training / Thesis work and organization.
2. An internal guide (Faculty of the post graduate programme or any faculty of concerned engineering college with minimum post graduate degree).
3. The name & designation of the external guide (Scientist or Engineer), if any.

Evaluation of industrial training / master's research project work will be taken up only after the student completes the entire core subjects as well as elective subjects requirements. However the candidates are eligible to appear for the Master's Comprehensive viva-voce only after the successful competition of the first three semesters of the master's programme.

12. Electives

There should be at least 1/3 of the students of the sanctioned strength of class for an elective to be offered.

New electives may be introduced according to the need of emerging fields in technology from time to time. The University should approve the names of electives and its syllabi before the subjects are offered.

13. Temporary Break of Study

If a candidate intends to temporarily discontinue the programme in the middle of a semester and intends to rejoin the programme later in the respective semester, the candidate shall apply to the University for the permission through the Head of the Institution with recommendation from the Head of the Department, before the last date for payment of examination fee of the semester. Exemption under the above clause or under clause 6 (iii, iv) or clause 8 (x) can be availed only once during the entire programme.

A candidate is permitted to rejoin the programme at the respective semester and when it is offered after the break of study, will be governed by the rules & regulations and scheme & syllabi in force at the time of joining, subject to the approval from the University.

14. Scheme of Evaluation

There will be a continuous evaluation system. Various components of evaluation are Teacher's Assessment (TA), Class Tests (CT) and University End Semester Examination (ESE). To make the evaluation more effective, teachers' assessments could be broken into various components like assignments, quizzes, attendance, group discussions, tutorials, seminars, field visit reports, etc. These two components i.e., TA & CT put together will form the sessional components. End semester examination will be conducted by the institute through the University, as per its rules and regulations.

On the basis total marks (TA + CT + ESE), in each subjects obtained, a letter grade should be awarded, where A = 10, B = 9, C = 8, D = 7, E = 6, F = 5 U = 0. 'U' denotes failure in the course.

The letter grade and the grade point are awarded based on percentage of marks secured by a candidate in individual subject as detailed below.

Range of % of total marks	Letter grade	Grade point
90 to 100	A	10
80 to 89	B	9
70 to 79	C	8
60 to 69	D	7
55 to 59	E	6
50 to 54	F	5
0 to 49	U	0

Grade Card

The grade card issued by the University at the end of each semester to each student will contain the following:

1. The sessional, ESE marks & credits for each subject for that semester and the performance in each subject by the letter grade obtained.
2. The total number of credits earned by the student up to the end of that semester.

The grade point average (GPA) will be calculated by the formula for each semester

$$GPA = \frac{\sum g_i c_i}{\sum c_i}$$

where, g_i = Grade point secured corresponding to the subject

c_i = Credit rating of the subject

The Cumulative Grade Point Average (CGPA) will be calculated by the following formula.

$$CGPA = \frac{\sum_{i=1}^n g_i c_i}{\sum_{i=1}^n c_i}$$

where, n = number of semesters completed.

The cumulative grade point average (CGPA) card will be issued by the University after completing the passing requirements & provisions vide regulations clause 8, which consists of credits of all subjects taken from first semester.

- 15.** Notwithstanding all that has been stated above the University has right to modify any of the regulations, scheme of studies, examinations and syllabi from time to time.

SCHEME AND SYLLABI FOR M. Tech. DEGREE PROGRAMME IN APPLIED ELECTRONICS

SEMESTER - I

Sl. No.	Course No.	Subject	Hrs / Week			Evaluation Scheme (Marks)					Credits (C)
			L	T	P	Sessional			ESE	Total	
						TA	CT	Sub Total			
1	MAE 101	Applied Mathematics	4	0	0	25	25	50	100	150	4
2	MAE 102	Analog Integrated Circuit Design	4	0	0	25	25	50	100	150	4
3	MAE 103	Advanced Digital Communication	4	0	0	25	25	50	100	150	4
4	MAE 104	RF System Design	4	0	0	25	25	50	100	150	4
5	MAE 105	Elective – I	3	0	0	25	25	50	100	150	3
6	MAE 106	Elective – II	3	0	0	25	25	50	100	150	3
7	MAE 107	Seminar – I	0	0	2	25	25	50	0	50	1
8	MAE 108	System Design Lab	0	0	3	25	25	50	100	150	2
Total			22	0	5	200	200	400	700	1100	25

Elective – I (MAE 105)		Elective – II (MAE 106)	
MAE 105 - 1	Estimation and Detection	MAE 106 - 1	Information Theory and Coding
MAE 105 - 2	Wireless Communication	MAE 106 - 2	Optical Communication
MAE 105 - 3	Communication Networks	MAE 106 - 3	Spread Spectrum and CDMA System
MAE 105 - 4	Simulation of Communication Systems and Networks	MAE 106 - 4	Secure Communication

L – Lecture, **T** – Tutorial, **P** – Practical

TA – Teacher’s Assessment (Assignments, attendance, group discussion, tutorials, seminars, etc.)

CT – Class Test (Minimum of two tests to be conducted by the Institute)

ESE – End Semester Examination to be conducted by the University

Electives: New Electives may be added by the department according to the needs of emerging fields of technology. The name of the elective and its syllabus should be submitted to the University before the course is offered

SEMESTER - II

Sl. No.	Course No.	Subject	Hrs / Week			Evaluation Scheme (Marks)					Credits (C)
			L	T	P	Sessional			ESE	Total	
						TA	CT	Sub Total			
1	MAE 201	Advanced Digital Signal Processing	4	0	0	25	25	50	100	150	4
2	MAE 202	Advanced Digital System Design	4	0	0	25	25	50	100	150	4
3	MAE 203	Digital Control Systems	4	0	0	25	25	50	100	150	4
4	MAE 204	RF Integrated Circuits	4	0	0	25	25	50	100	150	4
5	MAE 205	Elective – III	3	0	0	25	25	50	100	150	3
6	MAE 206	Elective – IV	3	0	0	25	25	50	100	150	3
7	MAE 207	Seminar – II	0	0	2	25	25	50	0	50	1
8	MAE 208	Signal Processing Lab	0	0	3	25	25	50	100	150	2
Total			22	0	5	200	200	400	700	1100	25

Elective – III (MAE 205)		Elective – IV (MAE 206)	
MAE 205 - 1	Artificial Neural Networks and Fuzzy Systems	MAE 206 - 1	Pattern Recognition and Analysis
MAE 205 - 2	Digital Image Processing	MAE 206 - 2	Speech and Audio Processing
MAE 205 - 3	VLSI Technology	MAE 206 - 3	System Design using Embedded Processors
MAE 205 - 4	Nano Electronics	MAE 206 - 4	Wavelet Theory and Construction

L – Lecture, **T** – Tutorial, **P** – Practical

TA – Teacher’s Assessment (Assignments, attendance, group discussion, tutorials, seminars, etc.)

CT – Class Test (Minimum of two tests to be conducted by the Institute)

ESE – End Semester Examination to be conducted by the University

Electives: New Electives may be added by the department according to the needs of emerging fields of technology. The name of the elective and its syllabus should be submitted to the University before the course is offered

SEMESTER - III

Sl. No.	Course No.	Subject	Hrs / Week			Evaluation Scheme (Marks)					Credits (C)
			L	T	P	Sessional			ESE** (Oral)	Total	
						TA*	CT	Sub Total			
1	MAE 301	Industrial Training	0	0	20	50	0	50	100	150	10
2	MAE 302	Master's Thesis Phase - I	0	0	10						
Total			0	0	30	50	0	50	100	150	10

* TA based on a Technical Report submitted together with presentation at the end of the Industrial Training

** Evaluation of the Industrial Training will be conducted at the end of the third semester by a panel of examiners, with at least one external examiner, constituted by the University

SEMESTER - IV

Sl. No.	Course No.	Subject	Hrs / Week			Evaluation Scheme (Marks)					Credits (C)
			L	T	P	Sessional			ESE** (Oral & Viva)	Total	
						TA*	CT	Sub Total			
1	MAE 401	Master's Thesis	0	0	30	150	0	150	150	300	20
2	MAE 402	Master's Comprehensive Viva							100	100	
Total					30	150	0	150	0	400	20
Grand Total of all Semesters										2750	80

* 50% of the marks to be awarded by the Project Guide and the remaining 50% to be awarded by a panel of examiners, including the Project Guide, constituted by the Department

** Thesis evaluation and Viva-voce will be conducted at the end of the fourth semester by a panel of examiners, with at least one external examiner, constituted by the University

L	T	P	C
4	0	0	4

Module 1: Real Vector Spaces

Vector Spaces and Subspaces, Linear independence, Basis and Dimension, Homogeneous systems, Coordinates and Change of Basis, Orthonormal Bases in \mathbb{R}^n , QR-Factorization, Least squares and Data fitting

Module 2: Linear Transformation and Matrices

Introduction to Linear spaces, Linear Transformation and Isomorphism, the Kernel and range of a Linear Transformation, the Matrix of a Linear Transformation, Eigen values and Eigen vectors, Symmetric Matrices, Quadratic forms, Singular Values.

Module 3: Random Variables and Probability Distributions

Discrete random variables, the Probability Mass function, Distribution functions, the Probability Generating functions, Continuous random variables, the Exponential distribution, Functions of Random Variables, Jointly distributed random variables, expectation of sums of random variables, conditional expectation, Moment Generating Functions, Covariance, Variance of Sums, Correlation.

Module 4: Stochastic Processes

Introduction, Classification of Stochastic Processes, Poisson Process, Markov Chains, Transition Probability Matrix, Classification of states and limiting probabilities, Birth-Death Process, M/M/1 queueing model, Second Order Stochastic Processes, Stationary process, Wide sense stationary process, Spectral density function.

References:

1. Bernard Kolman & David R. Hill, "Introductory Linear Algebra – An Applied First Course, 8th Edition", Pearson Prentice Hall, 2005.
2. Otto Bretscher, "Linear Algebra with Applications", 3rd Edition, Pearson Prentice Hall, 2005.
3. Howard Anton, "Elementary Linear Algebra", 9th Edition, John Wiley & Sons, Inc. 2005.
4. Sheldon Ross, "A First Course in Probability", 7th Edition, Pearson Prentice Hall, 2006.

5. Kishor S. Trivedi, "Probability and Statistics with Reliability, Queueing and Computer Science Applications", 2nd edition, John Wiley & Sons, Inc., 2002.
6. S. Karlin & H. M. Taylor, "A First Course in Stochastic Processes", 2nd Edition, Academic Press, Inc., 1975.
7. Papoulis A. & S. U. Pillai, "Probability, Random Variables and Stochastic Processes", 4th Edition, McGraw Hill, 2002.

L	T	P	C
4	0	0	4

Module 1: MOS Transistors

MOS transistors – modeling in linear, saturation and cutoff, high frequency equivalent circuit, MOS current mirrors-sources, common source, common gate and source follower stages – cascade and folded cascode structures - frequency response

Module 2: MOS Differential Amplifiers

MOS differential amplifiers – frequency response - CMOS operational amplifiers – one stage op-amps and two stage op-amps – Noise in op-amps. First and second order switched capacitor circuits – switched capacitor amplifiers-switched capacitor filters.

Module 3: MOS Oscillators

Feedback-stability and frequency compensation – Nonlinearity and mismatch in MOS differential circuits. CMOS oscillators – ring oscillators, LC oscillators, VCO, CMOS PLLs – non ideal effects in PLLs – Delay locked loops and applications.

Module 4: MOS Data Converters

CMOS data converters – Medium and High-speed CMOS data converters – Over sampling converters, CMOS comparators, multipliers and wave shaping circuits

References:

1. David A. Johns & Ken Martin, “Analog Integrated Circuit Design”, Wiley India Pvt. Ltd., 2008.
2. Behzad Razavi, “Design of Analog CMOS Integrated Circuits”, Tata McGraw Hill, 2008.
3. Philip Allen & Douglas Holberg, “CMOS Analog Circuit Design”, Oxford University Press, 2009.
4. R. Gregorian, G. C. Temes, “Analog MOS ICs for Signal Processing”, John Wiley & Sons Inc., 2004.

L	T	P	C
4	0	0	4

Module 1: Random Variables and Processes

Review of Random variable: Moment generating function, Chernoff bound, Markov's inequality, Chebyshev's inequality, Central limit Theorem, Chi square, Rayleigh and Rician distributions, Correlation, Covariance matrix - Stationary processes, wide sense stationary processes, ergodic process, cross correlation and autocorrelation functions- Gaussian proces

Module 2: Communication over Additive Gaussian Noise Channels

Characterization of Communication Signals and Systems- Signal space representation- Connecting Linear Vector Space to Physical Waveform Space- Scalar and Vector Communication over Memory less Channels.

Optimum waveform receiver in additive white Gaussian noise (AWGN) channels - Cross correlation receiver, Matched filter receiver and error probabilities.

Optimum Receiver for Signals with random phase in AWGN Channels- Optimum receiver for Binary Signals- Optimum receiver for M-ary Orthogonal signals- Probability of error for envelope detection of M-ary Orthogonal signals.

Optimum waveform receiver for coloured Gaussian noise channels- Karhunen Loeve expansion approach, whitening.

Module 3: Digital Communication over Fading Channels

Characterization of Fading Multipath Channels- Statistical Models for Fading Channels- Time Varying Channel Impulse response- Narrow band Fading Models- Wideband Fading Models- Channel Correlation Functions- Key Multi path parameters- Rayleigh and Rician Fading Channels.

Optimum non-coherent receiver in random amplitude, random phase channels- Performance of non-coherent receiver in random amplitude, random phase channels- Performance in Rayleigh and Rician channels- Performance of digital Modulation schemes such as BPSK, QPSK, FSK, DPSK etc over wireless Channels.

Module 4: Communication over Band Limited Channels

Communication over band limited Channels- Optimum pulse shaping- Nyquist criterion for zero ISI, partial response signaling- Equalization Techniques- Zero forcing linear Equalization- Decision feedback equalization.

References:

1. J. G. Proakis, "Digital Communication", 4th Edition, McGraw Hill, 2007.
2. Edward A. Lee & David G Messerschmitt, "Digital Communication", 2nd Edition, Springer Netherlands, 2004.
3. J. Marvin K. Simon, Sami M. Hinedi & William C. Lindsey, "Digital Communication Techniques", Prentice Hall of India Pvt. Ltd., 2002.
4. William Feller, "An introduction to Probability Theory and its applications", 2nd Edition, Volume 2, Wiley India Pvt. Ltd., 2008.
5. Sheldon M. Ross, "Introduction to Probability Models", 9th Edition, Elsevier India Pvt. Ltd., 2007.

L	T	P	C
4	0	0	4

Module 1:**a. RF Issues**

Importance of RF design, Electromagnetic Spectrum, RF behaviour of passive components, Chip components and Circuit Board considerations, Scattering Parameters, Smith Chart and applications.

b. RF Filter Design

Overview, Basic resonator and filter configuration, Special filter realizations, Filter implementations, Coupled filter.

Module 2: Active RF Components and Applications

RF diodes, BJT, RF FETs, High electron mobility transistors; Matching and Biasing Networks – Impedance matching using discrete components, Microstripline matching networks, Amplifier classes of operation and biasing networks.

Module 3: RF Amplifier Design

Characteristics, Amplifier power relations, Stability considerations, Constant gain circles, Constant VSWR circles, Low Noise circuits, Broadband , high power and multistage amplifiers.

Module 4: Oscillators, Mixers and Applications

Basic Oscillator model, High frequency oscillator configuration, Basic characteristics of Mixers ; Phase Locked Loops ; RF directional couplers and hybrid couplers ; Detector and demodulator circuits.

References:

1. Reinhold Ludwig & Powel Bretchko, “RF Circuit Design – Theory and Applications”, 1st Edition, Pearson Education Ltd., 2004.
2. Joseph J. Carr, “Secrets of RF Circuit Design”, 3rd Edition, Tata McGraw Hill, 2004.
3. Mathew M. Radmanesh, “Radio Frequency & Microwave Electronics”, 2nd Edition Pearson Education Asia, 2006.
4. Ulrich L. Rohde & David P. NewKirk, “RF / Microwave Circuit Design”, John Wiley & Sons, 2000.

5. Roland E. Best, "Phase - Locked Loops: Design, simulation and applications", 5th Edition, McGraw Hill, 2003.

L	T	P	C
3	0	0	3

Module 1: Detection Theory: Binary Decisions - Single Observation

Maximum likelihood decision criterion; Neymann-Pearson criterion; Probability of error criterion; Bayes risk criterion; Minimax criterion; Robust detection; Receiver operating characteristics.

Module 2: Binary Decisions - Multiple Observations

Vector observations; the general Gaussian problem; Waveform observation in additive Gaussian noise; The integrating optimum receiver; Matched filter receiver.

Module 3: Estimation Theory

a. Methods

Maximum likelihood estimation; Bayes cost method Bayes estimation criterion - Mean square error criterion; Uniform cost function; absolute value cost function; Linear minimum variance - Least squares method; Estimation in the presence of Gaussian noise - Linear observation; Non-linear estimation.

b. Properties of Estimators

Bias, Efficiency, Cramer Rao bound Asymptotic properties; Sensitivity and error analysis

Module 4:

a. State Estimation

Prediction; Kalman filter.

b. Sufficient Statistics and Statistical Estimation of Parameters

Concept of sufficient statistics; Exponential families of distributions; Exponential families and Maximum likelihood estimation; Uniformly minimum variance unbiased estimation.

References:

1. Harry L. Van Trees, "Detection, Estimation and Modulation Theory, Part 1," John Wiley & Sons, 2001
2. Jerry M. Mendel, "Lessons in Estimation Theory for Signal Processing, Communication and Control," Prentice Hall Inc., 1995.

3. Sophocles J. Orfanidis, "Optimum Signal Processing," 2nd Edition, McGraw Hill, 1988.
4. Monson H. Hayes, "Statistical Digital Signal Processing and Modelling," Wiley India Pvt. Ltd., 2008.
5. James L. Melsa & David L Cohn, "Decision and Estimation Theory," McGraw Hill, 1978.
6. Dimitri Kazakos & P. Papantoni Kazakos, "Detection and Estimation," Computer Science Press, 1990.
7. Steven M. Kay, "Statistical Signal Processing: Vol. 1: Estimation Theory, Vol. 2: Detection Theory," Prentice Hall Inc., 1998.

L	T	P	C
3	0	0	3

Module 1: Fading and Diversity

Wireless Channel Models- path loss and shadowing models- statistical fading models- Narrow band and wideband Fading models- Review of performance of digital modulation schemes over wireless channels - Diversity- Repetition coding and Time Diversity- Frequency and Space Diversity- Receive Diversity- Concept of diversity branches and signal paths- Combining methods- Selective diversity combining - Switched combining- maximal ratio combining- Equal gain combining- performance analysis for Rayleigh fading channels.

Module 2: Cellular Communication

Cellular Networks- Multiple Access: FDM/TDM/FDMA/TDMA- Spatial reuse- Co-channel interference Analysis- Hand over Analysis- Erlang Capacity Analysis- Spectral efficiency and Grade of Service- Improving capacity - Cell splitting and sectorization.

Module 3: Spread spectrum and CDMA

Motivation- Direct sequence spread spectrum- Frequency Hopping systems- Time Hopping.- Anti-jamming- Pseudo Random (PN) sequence- Maximal length sequences- Gold sequences- Generation of PN sequences.- Diversity in DS-SS systems- Rake Receiver- Performance analysis. Spread Spectrum Multiple Access- CDMA Systems- Interference Analysis for Broadcast and Multiple Access Channels- Capacity of cellular CDMA networks- Reverse link power control- Hard and Soft hand off strategies.

Module 4: Fading Channel Capacity

Capacity of Wireless Channels- Capacity of flat and frequency selective fading channels- Multiple Input Multiple output (MIMO) systems- Narrow band multiple antenna system model- Parallel Decomposition of MIMO Channels- Capacity of MIMO Channels. Cellular Wireless Communication Standards

Second generation cellular systems: GSM specifications and Air Interface - specifications, IS 95 CDMA- 3G systems: UMTS & CDMA 2000 standards and specifications

References:

1. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005.

2. Simon Haykin & Michael Moher, “Modern Wireless Communications”, Person Education, 2007.
3. T. S. Rappaport, “Wireless Communication, Principles & Practice”, Dorling Kindersley (India) Pvt. Ltd., 2009.
4. G. L. Stuber, “Principles of Mobile Communications”, 2nd Edition, Springer Verlag. 2007.
5. Kamilo Feher, 'Wireless Digital Communication', Dorling Kindersley (India) Pvt. Ltd., 2006.
6. R. L. Peterson, R. E. Ziemer & David E. Borth, “Introduction to Spread Spectrum Communication”, Prentice Hall, 1995.
7. A. J. Viterbi, “CDMA- Principles of Spread Spectrum”, Prentice Hall, 1995.

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Module 1: Review of Networking Concepts

Services, layered architectures, packet switching, OSI and IP models, IEEE 802.x, ethernet, token ring, fiber distributed data interface (FDDI), distributed-queue dual-bus(DQDB), Frame Relay and switched multimegabit data service(SMDS). Internet and TCP/IP networks, TCP and UDP.

Module 2:

a. TCP / IP Network

Performance of TCP/IP Networks, Circuit switched networks, performance of synchronous optical networking (SONET), Dense wavelength division multiplexing (DWDM)

a. ATM Network

ATM network, features, addressing, signalling, routing, ATM adaptation layer (AAL), management and control, BISDN, internetworking with ATM. Optical networks, WDM systems, cross connects, optical LANs and Networks.

Module 3: Control of Networks

Objectives and methods of control, control methods, time scales, QoS, Circuit switched networks, blocking, routing optimizations, Datagram networks, queuing models for delay analysis, routing optimization, congestion control, ATM networks, deterministic and statistical procedures. Control of networks, theory of Markov chains and queues, analysis of circuit switched networks, datagram networks and ATM networks.

Module 4: Switching

Switching, performance measures, time and space division switching, modular switch designs, packet switching, distributed buffer, shared buffer, output buffer and input buffer switches, attributes of a global multimedia network, challenges in its realization.

References:

1. Jean Walrand & Pravin Varaiya, "High Performance Communication Networks", 2nd Edition, Elsevier India Pvt. Ltd., 2008.

2. Leon Gracia & Indra Widjaja, "Communication Networks", 2nd edition, Tata McGraw Hill, 2003.
3. Sumit Kasera & Pankaj Sethi, "ATM Networks", Tata McGraw Hill, 2005.
4. Behrouz A. Forouzan, "Data Communication and Networking", 2nd Edition, Tata McGraw Hill, 2006.
5. Larry L. Peterson & Bruce S Davie, "Computer Networks", 4th Edition, Elsevier India Pvt. Ltd., 2007.
6. Dimitri P. Bertsekas & Robert G Gallager, "Data Networks", 2nd Edition, Dorling Kindersley (India) Pvt. Ltd., 2006.

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Module 1: Modelling of Communication System

Model of speech and picture signals, Pseudo noise sequences, Non-linear sequences, Analog channel model, Noise and fading, Digital channel model-Gilbert model of bursty channels, HF, Troposcatter and satellite channels, Switched telephone channels, Analog and Digital communication system models, Light wave system models.

Module 2: Simulation of Random Variables and Random Process

Univariate and multivariate models, Transformation of random variables, Bounds and approximation, Random process models-Markov and ARMA Sequences, Sampling rate for simulation, Computer generation and testing of random numbers

Module 3: Estimation of Performance Measures

Quality of an estimator, estimator for SNR, Probability density functions of analog communication system, BER of digital communication systems, Monte Carlo method and Importance of sampling method, estimation of power spectral density

Module 4:

a. Communication Networks

Queuing models, M/M/I and M/M/I/N queues, Little formula, Burke's theorem ,M/G/I queue, Embedded Markov chain analysis of TDM systems, Polling, Random access systems

b. Network of Queues

Queues in tandem, store and forward communication networks, capacity allocation, Congestion and flow chart, Routing model, Network layout and Reliability

References:

1. M. C. Jeruchim, Philip Balaban & K. Sam Shanmugan, "Simulation of Communication Systems", 2nd Edition, Kluwer Academic Publishers, 2002.
2. A. M. Law, "Simulation, Modelling and Analysis", 3rd Edition, Tata McGraw Hill, 2007.
3. J. F. Hayes, "Modeling and Analysis of Computer Communication Networks", Kluwer Academic Publishers, 2002.

4. Jerry Banks, John S. Carson & Barry L Nelson, “Discrete-Event System Simulation”, 4th Edition, Dorling Kindersley (India) Pvt. Ltd., 2007.

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Module 1: Concepts of Information Theory

Entropy, relative entropy and mutual information, asymptotic equipartition property, entropy rate of a stochastic process, data compression, channel capacity, differential entropy, Gaussian channel.

Module 2: Error Detection Codes

Groups, rings, vector spaces, galois fields, polynomial rings, channel models, linear block codes, cyclic codes, BCH codes, reed solomon codes, berlekamp-massey and euclid decoding algorithm, decoding beyond the minimum distance parameter, applications of reed solomon codes.

Convolutional codes, decoding algorithms for convolutional codes, viterbi, stack and fano algorithms, application of convolutional codes.

Module 3: Uses of Fourier Transform

Codes based on the Fourier Transform, Algorithms based on the Fourier Transform, Trellis coded modulation, Combinatorial description of Block and Convolutional codes, Algorithms for the construction of minimal and tail biting trellises.

Module 4: Decoding Algorithms

Soft decision decoding algorithms, Iterative decoding algorithms, Turbo-decoding, Two-way algorithm, LDPC codes, Use of LDPC codes in digital video broadcasting, belief propagation (BP) algorithms, Space Time codes.

References:

1. T M Cover and Joy A Thomas, "Elements of Information Theory", Wiley India Pvt. Ltd., 2006.
2. Shu Lin and Daniel J Costello Jr., "Error Control Coding: Fundamentals and Applications", Prentice Hall, 2004.
3. R. E. Blahut, "Principles and Practice of Information Theory", Addison Wesley, 1987.
4. S. B. Wicker, "Error Control Systems for Digital Communication and Storage", Prentice Hall, 1995.
5. Blahut R. E., "Theory and Practice of Error Control Codes", Addison Wesley, 1983.

6. V. S. Pless, W. C. Huffman & R A Brualdi, "Trellis Structure of Codes", Chapter 24 of Handbook of Coding Theory, Volume 2, North-Holland, 1998.

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Module 1: Introduction

Solution to Maxwell's equation in a circularly symmetric step index optical fiber, linearly polarized modes, single mode and multimode fibers, concept of V number, graded index fibers, total number of guided modes (no derivation), attenuation mechanisms in fibers, dispersion in single mode and multimode fibers, dispersion shifted and dispersion flattened fibers, attenuation and dispersion limits in fibers, Kerr nonlinearity, self phase modulation, combined effect of dispersion and self phase modulation.

Module 2: Optical Sources and Detectors

Optical sources - LED and laser diode - Principles of operation, concepts of line width, phase noise, switching and modulation characteristics . Optical detectors - pn detector, pin detector, avalanche photodiode - Principles of operation, concepts of responsivity, sensitivity and quantum efficiency, noise in detection, typical receiver configurations (high impedance and trans-impedance receivers).

Module 3: Modulation Systems

Coherent systems - Homodyne and heterodyne systems, coherent systems using PSK, FSK, ASK and DPSK modulations, related noise effects, performance degradation induced by laser phase and intensity noise, degradation due to fiber dispersion, degradation induced by nonlinear effects in fiber propagation.

Module 4: Optical Amplifiers

Optical amplifiers - semiconductor amplifier, rare earth doped fiber amplifier (with special reference to erbium doped fibers), Raman amplifier, Brillouin amplifier - principles of operation, amplifier noise, signal to noise ratio, gain, gain bandwidth, gain and noise dependencies, intermodulation effects, saturation induced crosstalk, wavelength range of operation.

References:

1. Leonid Kazovsky, Sergio Benedetto & Alan Willner, "Optical Fiber Communication Systems", Artech House Publishers, 1996.

2. John Senior, "Optical Fiber Communications", 2nd Edition, Dorling Kindersley (India) Pvt. Ltd., 2006.
3. Silvello Betti, Giancarlo De Marchis & Eugenio Iannone, "Coherent Optical Communications Systems", Wiley Interscience, 1995.
4. G. P. Agrawal, "Nonlinear Fiber Optics", 4th Edition, Elsevier India Pvt. Ltd., 2008.
5. Gerd Keiser, "Optical Fibre Communications", 3rd Edition, Tata McGraw Hill, 2007.
6. John Gowar, "Optical Communication Systems", 2nd Edition, Prentice Hall of India, 2001.
7. Govind P. Agrawal, "Fiber-Optic Communication Systems", 3rd Edition, Wiley India Pvt. Ltd., 2007.
8. C. DeCusatis, "Fibre Optic Data Communication: Technological Trends and Advances", Elsevier India Pvt. Ltd., 2006.
9. Karminvov & T. Li, "Optical Fibre Telecommunications V", Vol. A & B, Academic Press, 2008.

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Module 1: Fundamentals of Spread Spectrum

Introduction to spread spectrum communication, pulse noise jamming, low probability of detection, direct sequence spread spectrum, frequency-hopping and time-hopping spread spectrum systems, correlation functions, spreading sequences- maximal-length sequences, gold codes, Walsh orthogonal codes- properties and generation of sequences Synchronization and Tracking: delay lock and tau-dither loops, coarse synchronization- principles of serial search and match filter techniques.

Module 2: Performance Analysis of SS system

Performance of spread spectrum system under AWGN, multi-user Interference, jamming and narrow band interferences. Low probability of intercept methods, optimum intercept receiver for direct sequence spread spectrum, Error probability of DS-CDMA system under AWGN and fading channels, RAKE receiver

Module 3: Capacity, Coverage and Control of Spread Spectrum Multiple Access Networks

Basics of spread spectrum multiple access in cellular environments, reverse Link power control, multiple cell pilot tracking, soft and hard handoffs, cell coverage issues with hard and soft handoff, spread spectrum multiple access outage, outage with imperfect power control, Erlang capacity of forward and reverse links. Multi-user Detection -MF detector, decorrelating detector, MMSE detector. Interference Cancellation: successive, Parallel Interference Cancellation, performance analysis of multiuser detectors and interference cancellers.

Module 4: CDMA Systems

General aspects of CDMA cellular systems, IS-95 standard, Downlink and uplink, Evolution to Third Generation systems, WCDMA and CDMA-2000 standards, Principles of Multicarrier communication, MCCDMA and MC-DS-CDMA.

References:

1. M. K. Simon, J. K. Omura, R. A. Scholtz & B. K. Levitt, “ Spread Spectrum Communications Handbook”, McGraw Hill, 1994.

2. Cooper & McGillem, "Modern Communications and Spread Spectrum" McGraw Hill, 1985.
3. J. G. Proakis, "Digital Communication", 4th Edition, McGraw Hill, 2007.
4. S. Glisic & B. Vucetic, "Spread Spectrum CDMA Systems for Wireless Communications," Artech House Publishers, 1997.
5. R. L. Peterson, R. Ziemer and D. Borth, "Introduction to Spread Spectrum Communications," Prentice Hall, 1995.
6. J. Viterbi, "CDMA - Principles of Spread Spectrum Communications," Addison-Wesley, 1997.
7. Vijay K. Garg, Kenneth Smolik & Joseph E Wilkes, "Applications of CDMA in Wireless / Personal Communications", Prentice Hall, 1995.
8. S. Verdu, "Multiuser Detection", Cambridge University Press, 1998.

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Module 1: Introduction

Rings and fields - Homomorphism- Euclidean domains - Principal Ideal Domains - Unique Factorization Domains -- Field extensions- Splitting fields - Divisibility- Euler theorem - Chinese Remainder Theorem - Primality

Module 2: Encryption Techniques

Basic encryption techniques - Concept of cryptanalysis - Shannon's theory - Perfect secrecy - Block ciphers - Cryptographic algorithms - Features of DES - Stream ciphers - Pseudo random sequence generators – linear complexity - Non-linear combination of LFSRs - Boolean functions

Module 3: Cryptography

Private key and Public key cryptosystems - One way functions - Discrete log problem – Factorization problem - RSA encryption - Diffie Hellmann key exchange - Message authentication and hash functions -Digital signatures - Secret sharing - features of visual cryptography - other applications of cryptography

Module 4: Elliptic Curve Cryptography

Elliptic curves - Basic theory - Weirstrass equation - Group law - Point at Infinity -Elliptic curves over finite fields - Discrete logarithm problem on EC - Elliptic curve cryptography - Diffie Hellmann key exchange over EC - Elgamal encryption over EC - ECDSA

References:

1. Douglas A. Stinson, “Cryptography, Theory and Practice”, 2nd Edition, Chapman & Hall, CRC Press Company, Washington, 2005.
2. William Stallings, “Cryptography and Network Security”, 4th Edition, Dorling Kindersley (India) Pvt. Ltd., 2009.
3. Lawrence C. Washington, “ Elliptic Curves: Theory and Cryptography”, Chapman & Hall, CRC Press Company, Washington, 2008.
4. David S. Dummit & Richard M Foote, “ Abstract Algebra”, 2nd Edition, Wiley India Pvt. Ltd., 2008.
5. Evangelos Kranakis, “ Primality and Cryptography”, John Wiley & Sons, 1991.

MAE 107

SEMINAR – I

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Each student shall present a seminar on any topic of interest related to the core / elective courses offered in the first semester of the M. Tech. programme. He / she shall select the topic based on the references from international journals of repute, preferably IEEE journals. They should get the paper approved by the Programme Co-ordinator / Faculty member in charge of the seminar and shall present it in the class. Every student shall participate in the seminar. The students should undertake a detailed study on the topic and submit a report at the end of the semester. Marks will be awarded based on the topic, presentation, participation in the seminar and the report submitted.

MAE 108

SYSTEM DESIGN LAB

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System simulation experiments based on the courses MAE 102, MAE 103 and MAE 104 and the elective courses opted by the student in the first semester.

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Module 1: Time, Frequency Signal Analysis

DFT and chirp z-transform, 2-D continuous space signals and systems, Superposition Integral, convolution and resolution, 2-D Fourier series, 2-D Discrete Fourier series (2D-DFS), definition and relationship to continuous Fourier series, 2-D Discrete Space Fourier Transform (2D-DSFT) and 2D Discrete Fourier Transform, 2-D Sampling and Nyquist criteria, 2D z-transform, properties, 2-D Filter Design Concepts, Wavelet Analysis, Continuous and Discrete wavelets, Bio-orthogonal wavelets, Lifting Scheme of wavelets.

Module 2: Adaptive Signal Processing

Adaptive systems, Definition and characteristics, General properties, open and closed loop adaptation. The performance function and performance surface, gradient and minimum MSE. Simple gradient search algorithms- Newton's method, method of steepest descent, adaptive algorithms- The LMS algorithm, Basic Wiener filter theory. RLS Adaptive Filters- Exponentially weighted and sliding window RLS, Adaptive recursive filters, Adaptive modeling in FIR Digital filter synthesis.

Module 3: Multirate Digital Signal Processing

Concepts, Sampling rate reduction, sampling rate increase, conversion by non-integer factors, multi-stage approach to sampling rate conversions, decimators and interpolators, design of sampling rate convertors, filter specification, sampling rate conversion using polyphase filter structure, Implementation of digital filter bank.

Module 4:**a. Digital Signal Processors**

Introduction to Programmable DSPs- Harvard architecture, Multiplier and Multiplier Accumulator(MAC), modified bus structure and Memory access scheme in P-DSP, Addressing modes, multiple access memory, Very large instruction word (VLIW) architecture, pipelining. Architecture of TMS320C5X, TMS320C54X and TMS320C6X DSP.

b. Applications of DSP

Adaptive multipath compensation and adaptive jammer suppression, Radar signal processing, adaptive filter as a noise canceller. Multirate narrow band digital filtering, high resolution narrow band spectral analysis, equalization of digital audio signals, High quality analog to digital conversion of digital audio.

References:

1. John G. Proakis & Dimitris G. Manolakis ,“Digital Signal Processing, Principles, Algorithm and Applications”, Dorling Kindersley (India) Pvt. Ltd., 2008.
2. Emmanuel C. Ifeachor & Barrie W. Jervis, “Digital Signal Processing, A Practical Approach”, 2nd Edition, Dorling Kindersley (India) Pvt. Ltd., 2008.
3. Bernard Widrow & Samuel D. Stearns, “Adaptive Signal Processing”, Dorling Kindersley (India) Pvt. Ltd., 2007.
4. B. Venkataramani & M. Bhaskar, “Digital Signal Processors”, Tata McGraw Hill, 2006.
5. B. Somanathan Nair, “Digital Signal Processing: Theory, Analysis and Filter Design”, Prentice Hall of India Pvt. Ltd., 2009.

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Module 1: Sequential Logic Optimization

Sequential Circuit Optimization Using State Based Models, Sequential Circuit Optimization Using Network Models, Implicit Finite State machine Traversal Methods, Testability Considerations for Synchronous Circuits.

Module 2: Asynchronous Finite State Machines

Scope, Asynchronous Analysis, Design of Asynchronous Machines, Cycle and Races, Plotting and Reading the Excitation Map, Hazards, Essential Hazards Map Entered Variable, MEV Approaches to Asynchronous Design, Hazards in Circuit Developed by MEV Method.

Module 3: High Speed Digital Design

Frequency, Time and Distance, Capacitance and Inductance Effects, High Speed Properties of Logical Gates, Speed And Power, Measurement Techniques, Rise Time and Bandwidth of Oscilloscope probes, Self Inductance , Signal pickup and loading effects of probes, clock distribution, clock skew and methods to reduce skew, Controlling crosstalk on clock lines, Delay adjustments, Clock oscillators and clock jitter.

Module 4: System Design using VHDL

Specification of combinational systems using VHDL, Basic language element of VHDL, Types of Modeling, Design of serial adder with accumulator, State graph for Control network, Design of Binary Multiplier and Binary Divider, Flip-Flops, Registers, Counters, Sequential Machines, Combinational Logic Circuits.

References:

1. Fletcher, "An Engineering Approach to Digital Design", Prentice Hall of India Pvt. Ltd., 2007.
2. Howard Johnson & Martin Graham, "High Speed Digital Design: Handbook of Black Magic", Dorling Kindersley (India) Pvt. Ltd., 2008.
3. Masakazu Shoji, "High Speed Digital Circuits", Addison Wesley, 1996.
4. J. Bhaskar, "A VHDL Primer", 3rd Edition, Dorling Kindersley (India) Pvt. Ltd., 2006.
5. C. H. Roth, "Digital System using VHDL", Thomson Business Information, 2006.

6. Z. Navabi, "VHDL: Analysis and Modeling of Digital Systems", McGraw Hill, 1997.

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Module 1: Introduction to Digital Control systems

Data conversion and quantization- Sampling process- Mathematical modeling- Data reconstruction and filtering of sampled signals- Hold devices- z transform and inverse z transform. Relationship between s - plane and z – plane – Difference equation, Solution by recursion and z-transform

Module 2: Analysis of Digital Control Systems

Digital control systems - Pulse transfer function. z transform analysis of closed loop open loop systems - Modified z - transfer function - Stability of linear digital control systems- Stability tests - Steady . State error analysis - Root loci - Frequency domain analysis - Bode plots - Gain margin and phase margin

Module 3: Classical Design of Digital Control Systems

Cascade and feedback compensation by continuous data controllers - Digital controllers - Design using bilinear transformation - Root locus based design - Digital PID controllers - Dead beat control design- Case study examples using MATLAB.

Module 4: Advanced Design of Digital Control Systems

State variable models - Interrelations between z - transform models and state variable models - Controllability and Observability - Response between sampling instants using state variable approach - Pole placement using state feedback. Dynamic output feedback - Effects of finite word length on controllability and closed loop pole placement - Case study examples using MATLAB

References:

1. B. C. Kuo, “Digital Control Systems”, 2nd Edition, Oxford University Press, 2007.
2. G. F. Franklin, J. D. Powell & M. L. Workman, “Digital control of Dynamic Systems”, Addison Wesley, 1998.
3. M. Gopal, “Digital Control and State Variable Methods”, Tata McGraw Hill, 2008.
4. John F. Walkerly, “Microcomputer Architecture and Programming: The 68000 Family”, John Wiley & Sons, 1989.

5. K. Ogata, "Discrete Time Control Systems", 2nd Edition, Pearson Education Ltd., 2006.
6. C. H. Houpis & G. B. Lamont, "Digital Control Systems", McGraw Hill, 1985.

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Module1: Microstrip Lines

Introduction, types of microstrip lines and their technology, propagating models, analysis of microstrip lines by conformal transformation, numerical analysis, hybrid mode analysis, losses in microstrip, introduction to slot line and coplanar wave guide.

Module2: Coupled Microstrip, Directional Couplers and Lumped Elements for MICs

Introduction to coupled microstrip, even and odd mode analysis, directional couplers, branch line couplers, design and fabrication of lumped elements for MICs, comparison with distributed circuits.

Module 3: Non-Reciprocal Components and Active Devices for MICs

Ferromagnetic substrates and inserts, microstrip circulators, phase shifters, microwave transistors, parametric diodes and amplifiers, PIN diodes, transferred electron devices, IMPATT, BARITT, avalanche diodes.

Module 4: Microstrip Circuit Design and MMIC Technology

Introduction, impedance transformers, filters, high power circuits, low power circuits,

Fabrication process of MMIC, hybrid MICs, configuration, dielectric substances, thick and thin film technology, testing methods, encapsulation and mounting of devices.

References:

1. T. C. Edwards & Mickey Edwards, "Foundations of Interconnect and Microstrip Design", John Wiley & Sons, 2001.
2. Jia-Sheng Hong, M. J. Lancaster & Waun Ed. Hong, "Microstrip Filters for RF / Microwave Applications", Wiley Interscience, 2001.
3. Hoffman R. K., "Handbook of Microwave Integrated Circuits", Artech House Publishers, 1987.
4. Gupta K. C. & Amarjit Singh, "Microwave Integrated Circuits" John Wiley & Sons, 1975.

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Module 1: Biological Foundations

Biological foundations, ANN models, Types of activation function, Introduction to Network architectures: Multi Layer Feed Forward Network (MLFFN), Radial Basis Function Network (RBFN), Recurring Neural Network (RNN)

Module 2: Learning Process

Learning process. Supervised and unsupervised learning. Error-correction learning, Hebbian learning, Boltzmen learning, Single layer and multilayer percepturs, Least mean square algorithm, Back propagation algorithm, Applications in forecasting and pattern recognition and other engineering problems.

Module 3: Fuzzy Sets

Fuzzy sets. Fuzzy set operations. Properties, Membership functions, Fuzzy to crisp conversion. fuzzification and defuzzification methods, applications in engineering problems.

Module 4: Fuzzy Control Systems

Fuzzy control system: Introduction, simple fuzzy logic controllers with examples, special forms of fuzzy logic models, classical fuzzy control problems. inverted pendulum, image processing, home heating system. Adaptive fuzzy systems, hybrid systems.

References:

1. J. M. Zurada, "Introduction to Artificial Neural Systems", Jaico Book House, 2006.
2. Simon Haykins, "Neural Networks: A Comprehensive Foundation", 2nd Edition, Prentice Hall of India Pvt. Ltd., 2007.
3. Driankov, H. Hellendorn & M Reinfrank, "An Introduction to Fuzzy Control", Narosa Book Distributors Pvt. Ltd., 2001.
4. H. J. Zimmermann, "Fuzzy Set Theory and its Applications", 4th Edition, Springer, 2006.
5. G. J. Klir, Bo Yuan, "Fuzzy Sets and Fuzzy Logic: Theory and Applications", Prentice Hall of India Pvt. Ltd., 2007.

6. Stamatios V. Kartalopoulos, “Understanding Neural Networks and Fuzzy Logic: Basic Concepts and Applications”, Prentice Hall of India Pvt. Ltd., 2002.
7. Timothy .J Ross, “Fuzzy Logic with Engineering Applications”, 2nd Edition, Wiley India Pvt. Ltd., 2007.
8. Suran Goonatilake & Sukhdev Khebbal, “Intelligent Hybrid Systems”, John Wiley & Sons, 1995.

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Module 1:**a. Digital Image Fundamentals**

Elements of digital image processing systems, Elements of visual perception, psycho visual model, brightness, contrast, hue, saturation, mach band effect, Color image fundamentals -RGB,HSI models, Image acquisition and sampling, Quantization, Image file formats, Two-dimensional convolution, correlation, and frequency responses.

b. Image Transforms

1D DFT, 2D transforms – DFT, DCT, Discrete Sine, Walsh, Hadamard, Slant, Haar, KLT, SVD, Radon, and Wavelet Transform.

Module 2: Image Enhancement and Restoration

Histogram modification and specification techniques, Noise distributions, Spatial averaging, Directional Smoothing, Median, Geometric mean, Harmonic mean, Contra harmonic filters, Homomorphic filtering, Color image enhancement. Image Restoration – degradation model, Unconstrained and Constrained restoration, Inverse filtering, Wiener filtering, Geometric transformations – spatial transformations, Gray- Level interpolation,

Module 3: Image Segmentation and Recognition

Edge detection. Image segmentation by region growing, region splitting and merging, edge linking, Morphological operators: dilation, erosion, opening, and closing. Image Recognition – Patterns and pattern classes, matching by minimum distance classifier, Statistical Classifier. Matching by correlation, Neural network application for image recognition.

Module 4: Image Compression

Need for image compression, Huffman, Run Length Encoding, Arithmetic coding, Vector Quantization, Block Truncation Coding. Transform Coding – DCT and Wavelet. Image compression standards.

References:

1. Rafael C. Gonzalez & Richard E Woods, “Digital Image Processing”, 3rd Edition, Dorling Kindersley (India) Pvt. Ltd., 2008.

2. Anil K. Jain, “Fundamentals of Digital Image Processing”, Dorling Kindersley (India) Pvt. Ltd., 2008.
3. David Salomon, “Data Compression – The Complete Reference”, Asian Books Pvt. Ltd., 2005.
4. Rafael C. Gonzalez, Richard E. Woods & Steven Eddins, “Digital Image Processing using MATLAB”, Dorling Kindersley (India) Pvt. Ltd., 2006.
5. William K. Pratt, “Digital Image Processing”, John Wiley & Sons, 2006.
6. Milman Sonka, Vaclav Hlavac & Roger Boyle, “Image Processing Analysis and Machine Vision”, 2nd Edition, Thomson Business Information, 2007.
7. Sid Ahmed M. A., “Image Processing Theory, Algorithms and Architectures”, McGraw Hill, 1995.
8. Lim J. S., “Two Dimensional Signal and Image Processing”, Prentice Hall, 1990.

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Module 1: Environment for VLSI Technology

Material properties - phase diagram and solid solubility - Clean room and safety requirements - Crystal growth - wafer cleaning - Epitaxy

Module 2: Oxidation

Oxidation technologies in VLSI and ULSI - Kinetics of Silicon dioxide growth both for thick, thin and ultra thin films - Characterization of oxide films - High k and low k dielectrics for ULSI - Solid State diffusion modeling and technology; Ion Implantation modeling, damage annealing

Module 3: Fabrication Techniques

Photolithography, E-beam lithography and newer lithography techniques for VLSI/ULSI. CVD techniques for deposition of films; Etching - Evaporation and sputtering techniques - metal interconnects; Multi-level metallization schemes. Plasma etching and RIE techniques

Module 4: Process Integration

Process integration - NMOS, CMOS and Bipolar process.

References:

1. S. K. Gandhi, "VLSI Fabrication Principles: Silicon and Gallium Arsenide", 2nd Edition, John Wiley, 2003.
2. S. M. Sze (Ed), "VLSI Technology", 2nd Edition, Tata McGraw Hill, 2008.
3. James Plummer, M. Deal & P. Griffin, "Silicon VLSI Technology: Fundamentals, Practice and Modeling", Prentice Hall, 2000.
4. Stephen Campbell, "The Science and Engineering of Microelectronic Fabrication", Oxford University Press, 2008.
5. C. Y. Chang & S. M. Sze (Ed), "VLSI Technology", McGraw Hill, 1996.

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Module 1: Introduction

Challenges going to sub-100 nm MOSFETs – Oxide layer thickness, tunneling, power density, non uniform dopant concentration, threshold voltage scaling, lithography, hot electron effects, sub-threshold current, velocity saturation, interconnect issues, fundamental limits for MOS operation.

Module 2: MOS Based Devices

Novel MOS-based devices – Multiple gate MOSFETs, Silicon-on-insulator, Silicon-on-nothing, FinFETs, vertical MOSFETs, strained Si devices

Module 3: Quantum Structures

Quantum structures – quantum wells, quantum wires and quantum dots, Single electron devices – charge quantization, energy quantization, Coulomb blockade, Coulomb staircase, Bloch oscillations. Heterostructure based devices – Type I, II and III heterojunctions, Si-Ge heterostructure, heterostructures of III-V and II-VI compounds - resonant tunneling devices

Module 4: Nano Devices

Carbon nanotubes based devices – CNFET, characteristics, Spin-based devices – spinFET, characteristics.

References:

1. Mircea Dragoman & Daniela Dragoman, “Nanoelectronics – Principles & Devices” Artech House Publishers, 2008.
2. Karl Goser, “Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum Devices”, Springer 2005.
3. Mark Lundstrom & Jing Guo, “Nanoscale Transistors: Device Physics, Modeling and Simulation”, New Age International Pvt. Ltd., 2008.
4. Vladimir V. Mitin, Viatcheslav A. Kochelap & Michael A Stroscio, “Quantum Heterostructures”, Cambridge University Press, 1999.
5. S. M. Sze (Ed), “High Speed Semiconductor Devices”, Wiley Interscience, 1990.

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Module 1: Introduction

Introduction - features, feature vectors and classifiers, Supervised versus unsupervised pattern recognition. Classifiers based on Bayes Decision theory- introduction, discriminant functions and decision surfaces, Bayesian classification for normal distributions, Estimation of unknown probability density functions, the nearest neighbour rule. Linear classifiers,- Linear discriminant functions and decision hyper planes, The perceptron algorithm, MSE estimation, Logistic determination, Support Vector machines.

Module 2: Non Linear Classifiers

Non Linear classifiers - Two layer and three layer perceptrons, Back propagation algorithm, Networks with Weight sharing, Polynomial classifiers, Radial Basis function networks, Support Vector machines-nonlinear case, Decision trees, combining classifiers, Feature selection, Receiver Operating Characteristics (ROC) curve, Class separability measures, Optimal feature generation, The Bayesian information criterion.

Module 3: Feature Generation

Feature Generation 1 - Linear transforms-KLT, SVD, ICA, DFT, DCT, DST, Hadamard Transform, Wavelet Transform, Wavelet Packets etc- Two dimensional generalizations - Applications. Feature Generation 2 - regional features, features for shape and characterization, Fractals, typical features for speech and audio classification, Template Matching, Context dependent classification-Bayes classification, Markov chain models, HMM, Viterbi Algorithm. System evaluation - Error counting approach, Exploiting the finite size of the data.

Module 4: Clustering

Clustering- Cluster analysis, Proximity measures, Clustering Algorithms - Sequential algorithms, Neural Network implementation. Hierarchical algorithms - Agglomerative algorithms, Divisive algorithms. Schemes based on function optimization - Fuzzy clustering algorithms, Probabilistic clustering, K - means algorithm. Clustering algorithms based on graph theory , Competitive learning algorithms, Binary Morphology Clustering Algorithms Boundary detection methods, Valley seeking clustering, Kernel clustering methods. Clustering validity.

References:

1. Sergios Theodoridis & Konstantinos Koutroumbas, "Pattern Recognition", Academic Press, 2008.
2. Duda & Hart P. E., "Pattern Classification and Scene Analysis", Wiley India Pvt. Ltd., 2007.
3. Earl Gose, Richard Johnsonbaugh, & Steve Jost, "Pattern Recognition and Image Analysis", Dorling Kindersley (India) Pvt. Ltd., 2008.
4. Fu K. S., "Syntactic Pattern Recognition and Applications", Prentice Hall, 1982.
5. Rochard O. Duda, Hart P. E., & David G Stork, "Pattern classification" , 2nd Edition, Wiley India Pvt. Ltd., 2007.
6. Andrew R. Webb, "Statistical Pattern Recognition", John Wiley & Sons, 2002.

L	T	P	C
3	0	0	3

Module I: Digital Models for the Speech Signal

Digital models for the speech signal - mechanism of speech production - acoustic theory - lossless tube models - digital models - linear prediction of speech - auto correlation - formulation of LPC equation - solution of LPC equations - Levinson Durbin algorithm - Levinson recursion - Schur algorithm – lattice formulations and solutions - PARCOR coefficients - Spectral analysis of speech - Short Time Fourier analysis - filter bank design. Auditory Perception : Psychoacoustics- Frequency Analysis and Critical Bands – Masking properties of human ear :

Module 2: Speech Coding

Speech coding -subband coding of speech - transform coding - channel vocoder - formant vocoder – cepstral vocoder - vector quantizer coder- Linear predictive Coder. Speech synthesis - pitch extraction algorithms - gold rabiner pitch trackers - autocorrelation pitch trackers - voice/unvoiced detection - homomorphic speech processing - homomorphic systems for convolution - complex cepstrums - pitch extraction using homomorphic speech processing. Sound Mixtures and Separation - CASA, ICA & Model based separation.

Module 3: Speech Transformations

Speech Transformations - Time Scale Modification - Voice Morphing. Automatic speech recognition systems - isolated word recognition - connected word recognition -large vocabulary word recognition systems - pattern classification - DTW, HMM - speaker recognition systems - speaker verification systems – speaker identification Systems.

Module 4: Audio Processing

Audio Processing: Non speech and Music Signals - Modeling -Differential, transform and subband coding of audio signals & standards - High Quality Audio coding using Psychoacoustic models - MPEG Audio coding standard. Music Production - sequence of steps in a bowed string instrument - Frequency response measurement of the bridge of a violin. Audio Data bases and applications - Content based retrieval.

References:

1. Rabiner L. R. & Schafer R. W., “Digital Processing of Speech Signals”, Dorling Kindersley (India) Pvt. Ltd., 2008.
2. Shaughnessy D., “Speech Communication: Human and Machine”, University Press, 2001.
3. Thomas F. Quatieri, “Discrete-time Speech Signal Processing: Principles and Practice” Dorling Kindersley (India) Pvt. Ltd., 2006.
4. Deller J, J. Proakis & J. Hansen, “Discrete-Time Processing of Speech Signals.” IEEE Computer Society Press, 1999.
5. Ben Gold & Nelson Morgan, “Speech and Audio Signal Processing: Processing and Perception of Speech and Music”, Wiley India Pvt. Ltd., 2006.
6. Rabiner L. R. & Gold, “Theory and Applications of Digital Signal Processing”, Prentice Hall of India, 2009.
7. Chris Rowden, “Speech Processing”, McGraw Hill, 1992.
8. Moore B., “An Introduction to Psychology of Hearing”, Academic Press, 1997.
9. E. Zwicker & L. Fastl, “Psychoacoustics-Facts and Models”, Springer Verlag, 1990.

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Module 1: Microcontrollers

Brief review of the 8 bit microcontroller 8051 - Programming, CPU Block diagram, Memory Organization, SFR s, Ports and Interfacing -Introduction to a 16 bit micro controller 80186

High Speed Input, High Speed Output, Interrupts, ADC, PWM, Timers, Watch Dog Timer, Serial Port, I/O Port

Module 2: Introduction to Embedded Systems

Characteristics of Embedded systems , Software embedded into a system .-General ideas of Processor and Memory organization - Processor and memory selection ,Interfacing to Memory and I/O devices- Devices and Buses- Device Drivers and Interrupt Servicing mechanisms

Module 3:**a. Inter-process Communication and Synchronisation of Processes, Tasks and Threads**

Multiple Processes in an Application - Data sharing by multiple tasks and routines- Inter Process Communication

b. Real Time Operating Systems

Operating System Services , I/O Subsystems - Network Operating Systems - Real Time and Embedded System Operating systems. Interrupt routines in RTOS Environments - RTOS Task Scheduling models , Interrupt Latency and response Times - Standardisation of RTOS - Ideas of Embedded Linux

Module 4: Case Studies

Study of Vx works - Case Studies of programming with RTOS - Case study /design using ARM processor/PIC microcontroller

References:

1. Ajay V. Deshmukh, “ Microcontrollers: Theory and Applications”, Tata McGraw Hill, 2008.

2. Rajkamal, "Embedded Systems Architecture: Programming and Design", 2nd Edition
Tata McGraw Hill, 2008.
3. Predko Myke, "Programming and Customizing the 8051 microcontroller", Tata
McGraw Hill, 2000.
4. Ayala Kenneth J, "8051 microcontroller: Architecture, Programming & Applications",
Thompson, 2008.
5. Phillip A. Laplante, "Real-Time Systems Design and Analysis: An Engineer's
Handbook", 3rd Edition, Wiley India Pvt. Ltd., 2006.
6. Ward Paul T. & Mellor Stephen J, "Structured Development for Real - Time Systems
Vol.1: Introduction and Tools", Prentice Hall, 1986.
7. Simon David E., "Embedded Software Primer", Dorling Kindersley (India) Pvt. Ltd.,
2005.
8. Intel Manual for 80186
9. Vx Works Programmers Guide
10. Vx Works Reference Manual
11. Tornado API Programmers Guide
12. Tornado Users Guide

L	T	P	C
3	0	0	3

Module 1:**a. Fourier and Sampling Theory**

Generalized Fourier theory, Fourier transform, Short-time (windowed) Fourier transform, Time-frequency analysis, Fundamental notions of the theory of sampling.

b. Theory of Frames

Bases, Resolution of unity, Definition of frames, Geometrical considerations and the general notion of a frame, Frame projector, Example – windowed Fourier frames.

Module 2:**a. Wavelets**

The basic functions, Specifications, Admissibility conditions, Continuous wavelet transform (CWT), Discrete wavelet transform (DWT).

b. Multi Resolution Analysis

The MRA axioms, Construction of an MRA from scaling functions - The dilation equation and the wavelet equation, Compactly supported orthonormal wavelet bases - Necessary and sufficient conditions for orthonormality.

Module 3:**a. Regularity and Selection of Wavelets**

Smoothness and approximation order - Analysis in Sobolev space, Criteria for wavelet selection with examples.

b. Construction of Wavelets (1)

Splines, Cardinal B-spline MRA, Subband filtering schemes, Compactly supported orthonormal wavelet bases.

Module 4:**a. Wavelet Transform**

Wavelet decomposition and reconstruction of functions in $L^2(\mathbb{R})$. Fast wavelet transform algorithms – Relation to filter banks, Wavelet packets – Representation of functions, Selection of basis.

b. Construction of Wavelets (2)

Biorthogonality and biorthogonal basis, Biorthogonal system of wavelets - construction, The Lifting scheme.

References:

1. Stephen G. Mallat, "A wavelet tour of signal processing" 2nd Edition, Elsevier India Pvt. Ltd., 2009.
2. M. Vetterli & J. Kovacevic, "Wavelets and subband coding" Prentice Hall Inc, 1995
3. Gilbert Strang & Truong Q. Nguyen, "Wavelets and Filter Banks" 2nd Edition Wellesley-Cambridge Press, 1998.
4. Gerald Kaiser, "A Friendly Guide to Wavelets", Springer India Pvt. Ltd., 2005.
5. L. Prasad & S. S. Iyengar, "Wavelet Analysis with Applications to Image Processing" CRC Press, 1997.
6. J. C. Goswami & A. K. Chan, "Fundamentals of Wavelets: Theory, Algorithms and Applications" Wiley India Pvt. Ltd., 2006.
7. Mark A. Pinsky, "Introduction to Fourier Analysis and Wavelets", Cengage Learning (Thompson), 2008.
8. Christian Blatter, "Wavelets: A primer", University Press, 2003.
9. M. Holschneider, "Wavelets: An analysis Tool", Oxford Science Publications, 1998.
10. R. M. Rao & A. Bopardikar, "Wavelet Transforms: Introduction to Theory and Applications", Pearson Education Ltd., 2007.
11. Ingrid Daubechies, "Ten Lectures on Wavelets", Society for Industrial and Applied Mathematics, 1990.
12. H. L. Resnikoff & R. O. Wells Jr., "Wavelet Analysis: The Scalable Structure of Information" Springer, 2004.
13. P. P. Vaidyanathan, "Multirate Systems and Filter Banks", Dorling Kindersley (India) Pvt. Ltd., 2008.
14. P. Wojtaszczyk, "A Mathematical Introduction to Wavelets", Cambridge University Press, 1997.
15. Michael W. Frazier, "An Introduction to Wavelets through Linear Algebra", Springer, 2004.
16. Anthony N. Michel & Charles J. Herget, "Algebra and Analysis for Engineers and Scientists", Springer Verlag, 2007.

MAE 207

SEMINAR – II

L	T	P	C
0	0	2	1

Each student shall present a seminar on any topic of interest related to the core / elective courses offered in the second semester of the M. Tech. programme. He / she shall select the topic based on the references from international journals of repute, preferably IEEE journals. They should get the paper approved by the Programme Co-ordinator / Faculty member in charge of the seminar and shall present it in the class. Every student shall participate in the seminar. The students should undertake a detailed study on the topic and submit a report at the end of the semester. Marks will be awarded based on the topic, presentation, participation in the seminar and the report submitted.

MAE 208

SIGNAL PROCESSING LAB

L	T	P	C
0	0	3	2

System simulation experiments based on the courses MAE 201, MAE 202, MAE 203 and the elective courses opted by the student in the second semester.

MAE301

INDUSTRIAL TRAINING

L	T	P	C
0	0	20	10

The student shall undergo an industrial training of 12 weeks duration in an industry / company approved by the institution and under the guidance of a staff member in the concerned field. At the end of the training he / she have to submit a report on the work being carried out.

MAE 302

MASTER'S THESIS PHASE - I

L	T	P	C
0	0	10	0

The thesis (Phase - I) shall consist of research work done by the candidate or a comprehensive and critical review of any recent development in the subject or a detailed report of project work consisting of experimentation / numerical work, design and or development work that the candidate has executed.

In Phase - I of the thesis, it is expected that the student should decide a topic of thesis, which is useful in the field or practical life. It is expected that students should refer national & international journals and proceedings of national & international seminars. Emphasis should be given to the introduction to the topic, literature survey, and scope of the proposed work along with some preliminary work / experimentation carried out on the thesis topic. Student should submit two copies of the Phase - I thesis report covering the content discussed above and highlighting the features of work to be carried out in Phase – II of the thesis. Student should follow standard practice of thesis writing. The candidate will deliver a talk on the topic and the assessment will be made on the basis of the work and talks there on by a panel of internal examiners one of which will be the internal guide. These examiners should give suggestions in writing to the student to be incorporated in the Phase – II of the thesis.

MAE 401

MASTER'S THESIS

L	T	P	C
0	0	30	20

In the fourth semester, the student has to continue the thesis work and after successfully finishing the work, he / she have to submit a detailed thesis report. The work carried out should lead to a publication in a National / International Conference. They should have submitted the paper before M. Tech. evaluation and specific weightage should be given to accepted papers in reputed conferences.

MAE 402

MASTER'S COMPREHENSIVE VIVA

A comprehensive viva-voce examination will be conducted at the end of the fourth semester by an internal examiner and external examiners appointed by the university to assess the candidate's overall knowledge in the respective field of specialization.

MAE 401

MASTER'S THESIS


L	T	P	C
0	0	30	20

In the fourth semester, the student has to continue the thesis work and after successfully finishing the work, he / she have to submit a detailed thesis report. The work carried out should lead to a publication in a National / International Conference. They should have submitted the paper before M. Tech. evaluation and specific weightage should be given to accepted papers in reputed conferences.

MAE 402

MASTER'S COMPREHENSIVE VIVA

A comprehensive viva-voce examination will be conducted at the end of the fourth semester by an internal examiner and external examiners appointed by the university to assess the candidate's overall knowledge in the respective field of specialization.


SANKARIAMMA K.R.,
JOINT REGISTRAR
ADMN. - II
AUTHENTICATION OFFICER



Verified
B
16/2/10
Asst.