DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD.

Revised Syllabus of

M.E. (ELECTRONICS & TELE-

COMMUNICATION ENGINEERING)

[Effective from -2013 – 2014]

Dr. Babasaheb Ambedkar Marathwada University Aurangabad.

Faculty of Engineering & Technology

Rules and Regulations for M.E. & M.Tech. Courses

- **What is a credit system**

  A credit system is a systematic way of describing an educational program by attaching credits to its components. The definition of credits in higher education systems may be based on different parameters, such as student workload, learning outcomes and contact hours.

- **Advantages of the Credit System**
  - Represents a much-required shift in focus from teacher-centric to learner-centric education since the work load estimated is based on the investment of time in learning, not in teaching.
  - Helps to record course work and to document learner work load realistically since all activities are taken into account-not only the time learners spend in lectures or seminars but also the time they need for individual learning and the preparation of examinations etc.
  - Segments learning experience into calibrated units, which can be accumulated in order to gain and academic award.
  - Helps self-paced learning. Learners may undertake as many credits as they can cope with without having to repeat all the courses in a given semester if they fail in one or more courses. Alternatively, they can choose other courses and continue their studies.

- **What is Grading?**

  The word Grade derived from the Latin word gradus, meaning, step. Grading, in the educational context is a method of reporting the result of a learner's performance subsequent to his evaluation. It involves a set of alphabets which are clearly defined and designated and uniformly understood by all the stake holders. A properly introduced grading system not only provides for a comparison of the learner's performance but it

also indicate the quality of performance with respect to the amount of efforts put in and the amount of knowledge acquired at the end of the courses by the learners.

- **CURRICULUM:**

1.1 Curriculum:

Every program with specialization has a prescribed course structure which in general terms is known as Curriculum. It prescribes course to be studied in each semester; the relevant information containing course structure along with detail syllabus for each course of each program is updated periodically and is uploaded on the website.

1.2 Semesters:

The Faculty of Engineering & Technology implements a credit based curriculum and grade based evolution system for P.G. program is of four semesters. The academic courses are delivered in the first two semesters. Dissertation work is carried out by a student in the third and fourth semester. The first semester begins in the last week of July ends by the last week of November while the second semester begins in the first week of January and ends by the second week of May. Total duration for each semester is generally of 20 weeks including the period of examination, evaluation and grade declaration.

1.3 Course Credit:

Education is organized around the semester-based credit system of study. The prominent features of the credit system are a process of continuous evaluation of a student's performance/progress and flexibility to allow a student to progress at an optimum pace suited to his/her ability or convenience, subject to fulfilling minimum requirements for continuation.

A student's performance/progress is measured by the number of credits that he/she has earned, i.e. completed satisfactorily. Based on the course credits and grades obtained by the student, grade point average is calculated. A minimum grade point average is required to be maintained for satisfactory progress and continuation in the program. Also a minimum number of earned credits and a minimum grade point average should be acquired in order to qualify for the degree. All programmers are defined by the total credit requirement and a pattern of credit distribution over courses of different categories.

1.4 Course credits assignment

Each courses, except a few special courses, has a certain number of credits assigned to it depending upon its lecture, tutorial and laboratory contact hours in a week. This weightage is also indicative of the academic expectation that includes in-class contact and self-study outside of class hours.

Lectures and Tutorials: One lecture or tutorial hour per week per semester is assigned one credit.

Practical/Laboratory: One laboratory hour per week per semester is assigned one credit.

Example: Course: XYZ Engg: 4 credits (3-1-2)

The credits indicated for this course are computed as follows:

3 hours/week lectures = 3 credits

1 hours/week tutorial = 1 credit

2 hours/week practical = 2 x 0.5 = 1 credit

2 hours/week seminar = 2 x 0.5 = 1 credit

Dissertation seminar = 2 x 1= 2 credit

(3-1-2) 3 credit course = (**3** h Lectures + **1** h Tutorial + **2** h Practical) per week

= 6 Contact hours per week

1.5 Earning Credits

At the end of every course, a letter grade is awarded in each course for which a student had registered. On obtaining a pass grade, the student accumulates the course credits as earned credits. A student's performance is measured by the number of credits that he/she has earned and by the weighted grade point average.

The credit system enables continuous evaluation of a student's performance, and allows the students to progress at an optimum pace suited to individual ability and convenience, subject to fulfilling minimum requirement for continuation.

1.6 Evaluation System

1. Semester Grade Point Average (SGPA) =

   SUM (course credits in passed courses X earned grade points)

   SUM (Course credits in registered courses)

2. Cumulative Grade Point Average (CGPA) =

   SUM (course credits in passed courses X earned grade points) of all Semester
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   SUM (Course credits in registered courses) of all Semester

3. At the end of M.E & M. Tech Program, student will be placed in any one of the divisions as detailed below.(According to AICTE Handbooks)

   Ist Division with distinction : CGPA $\geq$ 8.25 and above

   Ist Division : CGPA $\geq$ 6.75 and < 8.25

   IInd Division : CGPA $\geq$ 6.75 and < 6.25

As per AICTE Handbook (2013-14), new gradation suggested as follows,

Table 1

Grade Point	Equivalent Range
6.25	55%
6.75	60%
7.25	65%
7.75	70%
8.25	75%

Conversion of CGPA to percentage marks for CGPA $\geq$ 5.0 can be obtained using equations.

Percentage marks = (CGPA X10) – 7.5

An example of these calculations is given below:

Typically one example for academic performance calculations of semester -I

Table 2

Course No. (1)	Course Credit (2)	Grade Awards (3)	Earned Credit (4)	Grade Points (5)	Points Secured (6)=(4) x (5)
Subject 1	4	B	4	6	24
Subject 2	4	C	4	5	20
Subject 3	4	O	4	10	40
Subject 4	4	A+	4	8	32
Subject 5	4	C	4	5	20
Seminar	2	A++	2	9	18
Total	22		22	38	134

1. Semester Grade Point Average (SGPA) = $\frac{(134)}{(22)} = 6.09$

2. Cumulative Grade Point Average (CGPA) =
   Cumulative points earned in all passed courses = 134 (past semester) + 134 (this sem.) = 268

   Cumulative earned credits = 22 (past semesters) +22 (this sem) = 44

   $$\frac{\sum (134 + 134)}{\sum (22 + 22)} = 6.09$$

System Evaluation Table

Table 3

Grade	Grade Points	Marks Obtained (%)			Description Performance
		Regular Semester	Re-Examination	Summer Semester Examination/Re-appear	
O	10	91-100	--	--	Outstanding
A++	09	86-90	91-100	91-100	Excellent
A+	08	76-85	86-90	81-90	Very Good
A	07	66-75	76-85	71-80	Good
B	06	56-65	66-75	61-70	Fair
C	05	46-55	56-65	51-60	Average
D	04	40-45	40-55	40-50	Poor
F	00	Below 40	Below 40	Below 40	Fail
EE					Incomplete
WW					Withdrawal
XX	--	--	--	--	Detained
ABSENT	--	--	--	--	Absent
PP	--	--	--	--	Passed (Audit Course)
NP	--	--	--	--	Not Passed (Audit Course)

Grade Awards:

i) A ten point rating scale shall be used for the evaluation of the performance of the student to provide letter grade for each course and overall grade for the Master's Programme. Grade points are based on the total number of marks obtained by him/her in all the heads of examination of the course. These grade points and their equivalent range of marks are shown separately in Table-4.

Table 4: Ten point grades and grade description

Sr.No.	Equivalent Percentage	Grade Points	Grade	Grade Description
1	90.00 – 100	10	O	Outstanding
2	80.00 – 89.99	9	A++	Excellent
3	70.00 – 79.99	8	A+	Exceptional
4	60.00 – 69.99	7	A	Very Good
5	55.00 – 59.99	6	B+	Good
6	50.00 – 54.99	55	B	Fair
7	45.00 – 49.99	5	C+	Average
8	40.01 – 44.99	4.5	C	Below Average
9	40	4.00	D	Pass
10	<40	0.00	F	Fail

ii) Non appearance in any examination/assessment shall be treated as the student have secured zero mark in that subject examination/assessment.

iii) Minimum D grade (4.00 grade points) shall be the limit to clear/pass the course/subject. A student with F grade will be considered as 'failed' in the concerned course and he/she has to clear the course by reappearing in the next successive semester examinations. There will be no revaluation or recounting under this system.

iv) Every student shall be awarded Grade points out of maximum 10 points in each subject (based on 10 Point Scale). Based on the Grade points obtained in each subject, Semester Grade Point Average (SGPA) and then Cumulative Grade Point Average (CGPA) shall be computed. Results will be announced at the end of each semester and cumulative Grade card with CGPA will be given on completion of the course.

Proposed Coding System of M.E/M.Tech Subjects

Six Digit Code for a subject (PG Course)

	Digits →	1 2 3	4	5 6
Sr. No.	**Branch** ↓	**Branch code**	**Year**	**Subject**
1	Electronics	MEX	PG I year – 6	**Semester –I/III**
2	Electronics & Communication	MEC	PG II Year - 7	1-20 Theory
3	Electronics & Telecom.	MET		21-30 Practical
4	Digital Communications	MDC		31 Dissertation-I
5	Embedded System	MES		41-49 Electives
6	Structure Engineering	MSE		**Semester –II/IV**
7	Environmental Engineering	MEV		51-70 Theory
8	Water Resource Engineering	MWR		71-80 Practical
9	Computer Engineering	MCE		81 Dissertation-II
10	Computer Network	MCN		91-99 Electives
11	Software Engineering	MSW		
12	Mechanical Engineering	MME		
13	Thermal Engineering	MTE		
14	CAD/CAM	MCC		
15	Manufacturing	MMF		
16	Heat Power	MHP		
17	Machine Design	MMD		
18	M.Tech Mechanical	MTM		
19	CSE & IT	MCI		
20	Manufacturing Processing Engineering	MMP		

Note: - Kindly, Allot Same Code for same Electives/ subjects for different branches to avoid repetitions of Question papers/settings/assessments.

DEGREE OF MASTAR OF ENGINEERING
(Course with effective from academic year: 2013-2014)

I	**1**	The examination for the Degree of Master of Engineering will be held in four semesters, M.E. Semester-I, M.E. Semester-II, M.E. Semester-III, and M.E. Semester-IV in case of full time course.
II	**Rules & Eligibility**	
	1	Rule for admission to P.G. Degree course in Engineering and Technology as per rules and regulation of AICTE/DTE & Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.
III	**Evaluation method**	
	1	Each theory course will be of 100 marks and be divided in to internal examination of 20 marks and semester examination of 80 marks (20+80=100 marks). Each practical course will be of 50 marks
	2	There shall be two class tests within a semester. First based on 40% syllabus taught and second based on 60% syllabus taught. The setting of question paper and assessment will be done by the concerned teacher who has taught the syllabus. Average marks obtained out of two examinations will be considered for the preparation of final sectional marks/ grade.
	3	The Question papers in theory subjects shall be set by the Examiners appointed for the purpose by the University on the recommendations of the Board of studies of the concerned PG Course.
	4	The assessment of the term work for any subject will be done by recognized post-graduate teacher.
	5	To pass the examination a candidate must obtain a minimum CGPA of 6.25 (CGPA to the scale of 10).
	6	Candidate who secures CGPA $\geq$ 6.25 and CGPA < 6.75 declared to have passed examination in second class.
	7	Candidate who secures CGPA $\geq$ 6.75 and CGPA < 8.25 declared to have passed examination in first class.
	8	Candidate who secures CGPA $\geq$ 8.25 declared to have passed examination in first class with distinction.

IV	**1**	In case candidate fails to get D grade in one or more heads of passing examination, he will be allowed at his option, to reappear for only those heads of passing in which he has failed or got less than D grade at subsequent examinations.
	2	The grades obtained by the candidate in any head of passing at the examination will be carried forward unless the candidates reappear for the head of passing in accordance with ref. IV (1)
	3	In case the candidate passes in all heads of passing under M.E. Semester-I, M.E. Semester-II examination and obtained a minimum CGPA of 6.25 in M.E. Semester-I, M.E. Semester-II taken together as required under ref. II(2) above, he will not be allowed to reappear for any head of passing under M.E. Semester-I, M.E. Semester-II in accordance with ref. IV(1)
	4	A candidate will not be allowed to appear for M.E. Semester-III examination unless he passes in all heads of passing under M.E. Semester-I, M.E. Semester-II examination and obtains a minimum CGPA of 6.25 in M.E. Semester-I, M.E. Semester-II taken together under reference II(2).
	5	Whenever a candidate reappears for M.E. Semester-III and M.E. Semester-IV examinations he will have to resubmit the dissertation with suitable modification and must also reappear for oral examination on it.
	6	A candidate registered for M.E. Examination must clear his examination within five years from the date of registration.
V	**Attendance Requirement**	
	1	Each semester of the course shall be treated as a separate unit for calculation of the attendance
	2	A candidate shall be considered to have satisfied the attendance requirement if he/she has attended not less 75% of the class in each subject of all the semesters (Theory, Laboratory, Semester Practical training and Dissertation work) actually conducted up to the end of the semester.
	3	A Candidate, who does not satisfy the attendance required, mentioned as above, shall not be eligible to appear for the Examination of that semester and shall be required to repeat that semester along with regular students later.
	4	The Principal of the concerned College shall display regularly, the list of such candidates who fall short of attendance, on the Notice Boards.

	5	The list of the candidates falling short of attendance shall be sent to the University at least one week prior to the commencement of theory/practical examination, whichever is earlier.
VI		The following are the syllabi in the various subjects of the examination for the Degree of Master of Engineering.

Faculty of Engineering And Technology

Tentative Structure for [ME (ECT)]

Sub code	Semester - I	Contact Hrs/Week				Examination Scheme (Marks)						
	Subject	**L**	**T**	**P**	**Total**	**CT**	**TH**	**TW**	**P**	**Total**	**Duration of TH Exam.**	**Credit**
Part- I												
ME0601	Advanced Digital Signal Processing	3	1	-	4	20	80	-	-	100	3 hrs	4
ME0602	Advanced Digital Communication System	3	1	-	4	20	80	-	-	100	3 hrs	4
MET603	Detection & Estimation Theory	3	1	-	4	20	80	-	-	100	3 hrs	4
MET604	Wireless & Mobile Communication Systems	3	1	-	4	20	80	-	-	100	3 hrs	4
MET(641-643)	Elective -I	3	1	-	4	20	80	-	-	100	3 hrs	4
MET621	Digital Signal Procesing Simulation Lab	-	-	4	4	-	-	50	-	50	-	2
MET622	System Lab-I	-	-	2	2	-	-	-	50	50	-	1
MET623	Seminar-I	-	-	2	2	-	-	-	50	50	-	1
Total of Part - I		**15**	**5**	**8**	**28**	**100**	**400**	**50**	**100**	**650**		**24**

L: Lecture hours per week T: Tutorial Hours per week
P: Practical hours per week CT: Class Test
TH: University Theory Examination TW: Term Work
P: Practical / Oral Examination

Elective I

MET641 1. Advance Digital Image Processing
MET642 2. CMOS VLSI Design
MET643 3. Digital Signal Compression

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Tentative Structure for [ME (ECT)]

Sub	Semester - II	Contact Hrs/Week				Examination Scheme (Marks)						
	Subject	**L**	**T**	**P**	**Total**	**CT**	**TH**	**TW**	**P**	**Total**	**Duration of TH Exam.**	**Credit**
Part- II												
ME0651	Advanced Optimization Techniques	3	1	-	4	20	80	-	-	100	3 hrs	4
ME0652	Audio Signal Processing & Coding	3	1	-	4	20	80	-	-	100	3 hrs	4
MET653	Advanced Satellite Communication	3	1	-	4	20	80	-	-	100	3 hrs	4
ME0654	Image & Video Processing	3	1	-	4	20	80	-	-	100	3 hrs	4
MET(691-693)	Elective-II	3	1	-	4	20	80	-	-	100	3 hrs	4
MET671	Audio Processing & Coding Lab	-	-	4	4	-	-	50	-	50	-	2
MET672	System Lab-II	-	-	2	2	-	-	-	50	50		1
MET673	Seminar-II	-	-	2	2	-	-	-	50	50	-	1
Total of Part - II		**15**	**5**	**8**	**28**	**100**	**400**	**50**	**100**	**650**		**24**

L: Lecture hours per week T: Tutorial Hours per week P: Practical hours per week
CT: Class Test
TH: University Theory Examination TW: Term Work P: Practical / Oral Examination

Elective II -

MET691 1. Embedded System Design
MET692 2. Pattern Recognition
MET693 3. Stastical Signal Processing

Faculty of Engineering And Technology

Tentative Structure for [ME (E&C)]

Sub Code	Subject	Contact Hrs/Week				Examination Scheme (Marks)						
		L	T	CH	Total	CT	TH	TW	P	Total	Duration of TH Exam.	Credit
Part- III												
MEC731	Dissertation (Part-I)	-	-	12	12	-	-	100	50	100	-	12
Total of Part - III		-	-	-	-	-	-	**100**	**50**	**100**	-	12

Faculty of Engineering And Technology

Tentative Structure for [ME (E&C)]

Sub Code	Subject	Contact Hrs/Wee		Examination Scheme (Marks)								
		L	T	CH	Total	CT	TH	TW	P	Total	Duration of TH Exam.	Credit
Part- IV												
MEC781	Dissertation (Part-II)	-	-	20	20	-	-	100	200	300	-	20
Total of Part - IV		-	-	**20**	**20**	-	-	**100**	**200**	**300**	-	**20**
Total of Part - I, II, III & IV		**30**	**10**	**48**	**88**	**200**	**800**	**250**	**400**	**1700**	-	**80**

L: Lecture hours per week T: Tutorial Hours per week P: Practical hours per wee

TH: University Theory Examination TW: Term Work P: Practical / Oral Examination CH

Total :- SEM I + SEM II + SEM III + SEM IV

= 24 + 24 + 12 + 20

= 80

Total Contact Hours

SEM I + SEM II + SEM III

28+28+12+20=88

SEMESTER-I

ME0601 - ADVANCED DIGITAL SIGNAL PROCESSING

Teaching Scheme:	Examination Scheme:
Lecture - 03 Hrs	Theory Paper - 80 Marks
Tutorial - 01 Hrs	Class Test - 20 Marks
	Credit:-04

UNIT 1 **04Hrs**

LTI DISCRETE-TIME SYSTEMS IN THE TRANSFORM DOMAIN

Types of Linear-Phase transfer functions, Simple Digital Filters, Complementary Transfer Function, Inverse Systems, System Identification, Digital Two-Pairs, Algebraic Stability Test.

UNIT 2 **08Hrs**

DIGITAL FILTER SRTUCTURE AND DESIGN

All Pass Filters, Tunable IIR Digital Filter, IIR Tapped Cascade Lattice Structures, FIR Cascaded Lattice Structures, Parallel All Pass Realization of IIR Transfer Functions, State Space Structures, Polyphase Structures, Digital Sine Cosine Generator, Computational Complexity of Digital Filter Structures, Design of IIR Filter using pade' approximation, Least Square Design Methods, Design of Computationally Efficient FIR Filters.

UNIT 3 **08Hrs**

MULTI RATE SIGNAL PROCESSING

Mathematical description of change of sampling rate Interpolation and Decimation , Decimation by an integer factor - Interpolation by an integer factor, Sampling rate conversion by a rational factor, Filter implementation for sampling rate conversion- direct form FIR structures, Polyphasefilter structures, time-variant structures. Multistage implementation of multirate system.

UNIT 4 **08Hrs**

LINEAR ESTIMATION AND PREDICTION

Linear prediction- Innovations representation of a stationary Random process, Relationship between the filter parameters and the autocorrelation sequence, Autoregressive (AR) & moving average (MA) process,Forward and backward predictions, Solutions of the Normal equations-Levinson-Durbin algorithms. Least mean squared error criterion -Wiener filter for filtering and prediction, FIR Wiener filter and Wiener IIR filters.

UNIT 5 **08Hrs**

POWER SPECTRAL ESTIMATION

Estimation of spectra from finite duration observation of signals, Non-parametric methods: Bartlett, Welch &Blackmann&Tukey methods. Parametric Methods For Power Spectrum Estimation: Relation between auto correlation & model parameters, Yule-Waker& Burg Methods, MA & ARMA models for power spectrum estimation.

UNIT 6 **06Hrs**

ADAPTIVE FILTERS

FIR adaptive filters -adaptive filter based on steepest descent method-Widrow-Hoff LMS adaptive algorithm, Normalized LMS. Adaptive channel equalization-Adaptive echo cancellation-Adaptive noise cancellation- Adaptive recursive filters (IIR).

TEXT BOOKS:

1. Digital Signal Processing by Sanjit K Mitra, Tata MCgraw Hill Publications.

2. Digital Signal Processing Principles, Algorithms, Applications by J G Proakis, D G Manolokis,

PHI.

REFERENCE BOOKS:

1. Discrete-Time Signal Processing by A V Oppenhiem, R W Schafer, Pearson Education.

2. DSP- A Practical Approach- Emmanuel C Ifeacher Barrie. W. Jervis, Pearson Education.

3. Modern spectral Estimation techniques by S. M .Kay, PHI, 1997

SEMESTER-I

ME0602 - ADVANCED DIGITALCOMMUNICATION SYSTEM

Teaching Scheme:	Examination Scheme:
Lecture - 03 Hrs	Theory Paper - 80 Marks
Tutorial - 01 Hrs	Class Test - 20 Marks
	Credit:-04

Unit 1. **(04 hours)**

Introduction: Digital communication system (description of different modules of the block diagram), Complex baseband representation of signals, Gram-Schmidtorthogonalization procedure. M-ary orthogonal signals, bi-orthogonal signals, simplex signal waveform

Unit 2. **(08 hours)**

Modulation: Pulse amplitude modulation (binary and M-ary, QAM), Pulse position modulation (binary and M-ary), Carrier modulation (M-ary ASK, PSK, FSK, DPSK), Continuous phase modulation (QPSK and variants, MSK, GMSK).

Unit 3. **(08 hours)**

Receiver in additive white Gaussian noise channels: Coherent and no coherent demodulation: Matched filter, Correlator demodulator, square-law, and envelope detection; Detector: Optimum rule for ML and MAP detection Performance: Bit-error-rate, symbol error rate for coherent and no coherent schemes.

Unit 4. **(10 hours)**

Band-limited channels: Pulse shape design for channels with ISI: Nyquist pulse, Partial response signaling (duo binary and modifiedduobinary pulses), demodulation; Channel with distortion: Design of transmitting and receiving filters for a known channel and for time varying channel (equalization); Performance: Symbol by symbol detection and BER, symbol and sequence detection, Viterbi algorithm.

Unit 5. **(04 hours)**

Synchronization: Different synchronization techniques (Early-Late Gate, MMSE, ML and spectral line methods).

Unit 6 **(06 hours)**

Communication over fading channels: Characteristics of fading channels, Rayleigh and Ricianchannels, receiver performance-average SNR, outage probability, amount of fading and average bit/symbol error rate.

References Books:

1. J. G. Proakis and M. Salehi, Fundamentals of Communication Systems,Pearson Education, 2005.

2. S. Haykins, Communication Systems, 5th ed., John wiley, 2008.

3. M. K. Simon, S. M. Hinedi and W. C. Lindsey, Digital Communication Techniques: Signaling and detection, Prentice Hall India, N. Delhi, 1995.

4. W. Tomasi, Advanced Electronic Communication Systems, 4th Ed., Pearson Education, 1998.

SEMESTER-I

MET603 – DETECTION AND ESTIMATION THEORY

Teaching Scheme:	Examination Scheme:
Lecture - 03 Hrs	Theory Paper - 80 Marks
Tutorial - 01 Hrs	Class Test - 20 Marks
	Credit:-04

Unit I **(08Hrs)**

Classical Detection & Estimation Theory

Introduction to Engineering Statistics, probability, probability density function, random and discrete variables, Joint probability etc. Introduction: Simple binary hypothesis tests, M, hyppothesis, estimation theory, Composite hypothesis, General Gaussian problem, Performance bonds and approximations.

Unit II **(08Hrs)**

Detection of Signals, Estimation of Signal Parameters

Introduction, Detection and Estimation of White Gaussian Noise, Detection and Estimation in Non, White Gaussian Noise, Signal with unwanted parameters, multiple channel and multiple parameter estimation.

Unit III **(08Hrs)**

Estimation of Continuous Waveforms

Introduction, Derivation of estimation equitation, Lower bound on the mean squire estimation error, Multidimensional waveform estimation, Non random waveform estimation.

Unit IV **(08Hrs)**

Parameter Estimation:

Estimation of a signal parameter, Estimation of a signal parameter. Estimation of time- varying signals Kalman filtering, filtering signals in noise Simple problems. Weiner filters, relation between Weiner filters and Kalman filters. Recursive least squares (RLS),Weighted LS; Full and reduced order observers, Kalman filter; Parametric models, LS estimation, bias; Generalized least squares (GLS) and instrumental variable (IV) method; Persistently exciting input signal; LikelihoodLS estimation, bias; Generalized least squares (GLS) and instrumental variable (IV) method; Persistently exciting input signal; Likelihood functions and maximum likelihood estimation (MLE); Singular value decomposition (SVD); Stochastic approximation algorithm

(STA); Order and structure determination, Yule-Walker equation; Multivariable system representation, controllability and observability indices; Feedback system identification

Unit VI

Detection and estimation in coloured noise

Elements of sequential and non-parametric detection. Applications to communication, radar and sonar systems. Application to RADAR signal processing, estimation of range Detection of object, it's size etc. Linear prediction and optimum linear filters: Forward and backward linear prediction, properties of linear prediction error filters, AR lattice and ARMA lattice ladder filters, Weiner filters for filtering and prediction.

Reference Books:

1 H.L .Van Trees. Detection, Estimation, and Modulation Theory, Vol. I, John Wiley &Sons

2. M.D. Srinath, P.K. Rajasekaran and R. Vishwanathan."Introduction to statistical signal Processing with Application," Pearson Education (Asia) Pte. Ltd/Prentice Hall

SEMESTER-I

MET604 – WIRELESS AND MOBILE COMMUNICATION SYSTEM

Teaching Scheme:	Examination Scheme:
Lecture - 03 Hrs	Theory Paper - 80 Marks
Tutorial - 01 Hrs	Class Test - 20 Marks
	Credit:-04

Unit 1 **(8 HRS)**

CELLULAR CONCEPT AND WIRELESS STANDARDS Frequency reuse, Channel Assignment Strategies, Hand off Strategies, Interference and System Capacity, Trunking and Grade of Service, Improving coverage and capacity in cellular systems, interference suppression and power control, multiple access schemes Standards - GSM, IS-95,UMTS, IMT-2000.

Unit 2 **(8 HRS)**

WIRELESS NETWORK 1G, 2G, 3G wireless networks, Fixed Network Transmission Hierarchy, Traffic Routing in Wireless Networks, Wireless Data Services, CCS, ISDN, SS7, PCS/PCNs, Protocols for network access, Network Data bases.

Unit 3 **(4 HRS)**

WIRELESS LAN Types of Networks, IEEE 802.11, System and Protocol Architecture, Physical and Medium Access Control Layers, MAC management,802.11b, 802.11a, HIPERLAN

Unit 4 **(4 HRS)**

BLUE TOOT Blue tooth Architecture, radio layer, base band layer, link manager protocol, L2CAP, Security, SDP, Profiles, 802.15.

Unit 5 **(8 HRS)**

MOBILE NETWORK AND TRANSPORT LAYERS Mobile IP, mobile adhoc network – Routing, DSDV, DSR, Traditional TCP, TCP improvements, Indirect TCP, Snooping TCP, mobile TCP, TCP over 2.5 / 3G wireless networks, MAC layer scheduling and connection admission in mobile communication.

Unit 6 **(8 HRS)**

TRAFFIC MODELIN Tele-traffic modeling and Queuing theoretic analysis of cellular mobile networks, Resource allocation and mobility management.

REFERENCES:

1. Joschen Schiller , "*Mobile Communication*", Pearson Education 2003
2. T.S.Rappaport, "*Wireless Communications: Principles and Practice*", Second Edition, Pearson Education/ Prentice Hall of India, Third Indian Reprint 2003.
3. R. Blake, "*Wireless Communication Technology*", Thomson Delmar, 2003.
4. W.C.Y Lee, "*Mobile Cellular Telecommunications Systems*", McGraw Hill, International Editions 1990.
5. David Tse and Pramod Viswanath, "*Fundamentals of wireless communication*" Cambridge University Press, 2005.

SEMESTER-I

MET641 – ADVANCED DIGITAL IMAGE PROCESSING (EL-I)

Teaching Scheme:	Examination Scheme:
Lecture - 03 Hrs	Theory Paper - 80 Marks
Tutorial - 01 Hrs	Class Test - 20 Marks
	Credit:-04

Unit,I: **08Hrs**

Introduction to Image Processing, Computer Vision. Digitized Images:
Basic concepts, image digitization, sampling, and quantization, digital image properties. Data structures for image analysis: traditional data structures and hierarchical data structures.

Unit,II: **06Hrs**

Image Pre-Processing:
Pixel brightness transformation, geometrical transformation, local pre-processing, image smoothing, edge detection, scaling, parametric edge models, multi, spectral images, adaptive neighborhood pre, processing, image restoration.

Unit,III: **08Hrs**

Image Segmentation:
Thresholding, threshold detection methods, optimal thresholding, Edge, based segmentation, edge image thresholding, edge relaxation, border tracing and detection, Hough transforms, region, based segmentation and matching. Edge and Line Detection: Edge Detection, Edge Operators, Pattern Fitting Approach, Edge Linking and Edge Following, Edge Detector Operators , Line Detection, Corner Detection.

Unit,IV: **06Hrs**

Shape:
Region identification, contour, based shape representation and description, region, based shape representation and description, shape classes. Object recognition: knowledge representation, statistical pattern recognition, syntactic pattern recognition.

UNIT-V: **06Hrs**

Morphological Image Processing
Introduction, Logic Operations involving Binary Images, Dilation and Erosion, Opening and Closing, Morphological Algorithms – Boundary Extraction, Region Filling, Extraction of Connected Components, Convex Hull, Thinning, Thickening

Unit, VI **06Hrs**

: Application of DIP

Application of Fourier, Hadamard, Discrete Cosine and Wavelets. Digital water marking, biomedical image processing ,satellite image processing . JPEG & MPEG image compression.

Text Book:

1. Sonka M, Hlavac H, Boyle R “Image Processing, Analysis, and Machine Vision”, (2/e) Brooks/Cole Thomson Learning.

Reference Books:

1. “Digital image processing” by S.Jayraman, S.Esakkirajan, T.Veerkumar
2. Gonzalez and Woods, “Digital Image Processing” (2/e) Pearson Education.
3. W.K. Pratt – Digital Image Processing- Wiley New Delhi. 1987

4. Chanda and Majumdar, “Digital Image Processing and Analysis” PHI.

5. Horn B K P, “Robot Vision” MIT Press, Cambridge, MA.

6. Forsyth, “Computer Vision” Pearson Education.

SEMESTER-I

MET642 – VLSI DESIGN (EL-I)

Teaching Scheme:	Examination Scheme:
Lecture - 03 Hrs	Theory Paper - 80 Marks
Tutorial - 01 Hrs	Class Test - 20 Marks
	Credit:-04

1.	**MOS Inverter:** Introduction, MOS Inverter and its characteristics: C-V Characteristics, Nonideal I-V Effect,Dc Transfer Characteristics, Threshold voltage equations, Body effects, MOS device Design equations, Basic DC equations, Latch-up in CMOS circuits and other second order effects.	4
2.	**Introduction to CMOS circuits:** CMOS Logic- Complementary CMOS inverter- DC Characteristics, Noise margin, Static load MOS Inverters, Differential Inverter, the transmission gate, Tristate Inverter, Bi-CMOS Inverters, SPICE Model; Combination logic- static and dynamic design strategies, The NAND and NOR Gates, Compound gates, Multiplexers.	4
3.	**Designing Combinational Logic gates in CMOS:** Static CMOS Design, Dynamic CMOS Design,More Circuit Families: Differential Circuits, Sense amplifier, BiCMOS Circuits.	8
4.	**Designing Sequential logic circuits:** Static latches and registers, Dynamic latches and registers, non bistable sequential circuits.	8
5.	**Datapath Subsystems and**: Addition, Subtraction, Parity Generator, Comparator, Counters, Shifters, Multiplication and other arithmetic operators; power and speed tradeoffs, Control FSM and Control Logic Implementation.	8
6.	**Array Subsystems:** Memory cells and Arrays, ROM, RAM- SRAM, DRAM, clocking disciplines; Design, power optimization, case studies in memory design.	8

Books:

1. N. Waste and K. Eshranghian, “Principals of CMOS VLSI Design”, Addison Wesley
2. Jan Rabaey,Anantha Chandrakasan and Borivoje Nikolic, “Digital IntegratedCircuits”
3. Jacob Backer, Harry W. Lie and Devid E. Boyce,“CMOS Circuit Design , Layout and

Simulation" Prentice Hall.
4. L.Glaser and Dobberpuhi, "The Design and Analysis of VLSI Circuits", Addison Wesley
5. Mnnn, "Introduction to VLSI System" Addison Wesley
6. Dr. K.V.K.K. Prasad, Kattula Shyamala, "VLSI Design Black Book":
7. John P. Uyemura, "Introduction To VLSI Circuits And Systems" Wiley Pub

SEMESTER-I

MET643 – DIGITAL SIGNAL COMPRESSION (EL-I)

Teaching Scheme:
Lecture - 03 Hrs
Tutorial - 01 Hrs

Examination Scheme:
Theory Paper - 80 Marks
Class Test - 20 Marks
Credit:-04

1. **INTRODUCTION (4 HRS)**

   Overview of information theory - redundancy. Need for Compression – evolution of data compression and its applications -Taxonomy of compression techniques.

2. **SOURCE CODING TECHNIQUES (4 HRS)**

   Overview of source coding, source models, scalar and vector quantization theory, rate distribution theory, vector quantisation, structure quanitizers. Evaluation techniques-error analysis and methodologies.

3. **TEXT COMPRESSION (8 HRS)**

   Compaction techniques – Huffmann coding – Adaptive Huffmann Coding – Arithmatic coding – Shannon-Fano coding – Dictionary techniques – LZW family algorithms.

4. **AUDIO COMPRESSION (8 HRS)**

   Audio signal representation, compression techniques Frequency domain and filtering – Basic subband coding – G.722– MPEG audio, progressive encoding for audio – Silence compression, speech compression techniques –Vocoders

5. **IMAGE COMPRESSION (8 HRS)**

   Predictive techniques – DM, PCM, DPCM: Optimal Predictors and Optimal Quantization – Contour based compression, Quad trees – Transform Coding – JPEG Standard – Sub-band coding algorithms: Design of Filter banks – Wavelet based compression: EPIC, SPIHT coders – JPEG 2000 standards - JBIG, JBIG2 standards.

6. **VIDEO COMPRESSION (8 HRS)**

   Video compression techniques and standards – MPEG Video Coding – Motion estimation and compensation techniques – H.261 Standard – DVI technology – PLV performance – DVI real time compression.

REFERENCES:

1. Khalid Sayood, "*Introduction to Data Compression"*, Morgan Kauffman Harcourt India, 2nd Edition, 2000.
2. David Salomon, " *Data Compression"*, the Complete Reference, Springer Verlag New York Inc., 2nd Edition, 2001.
3. Yun Q.Shi, Huifang Sun, "*Image and Video Compression for Multimedia Engineering"*.
4. "*Fundamentals, Algorithms & Standards*", CRC press, 2003.
5. Peter Symes, "*Digital Video Compression*", McGraw Hill Pub., 2004.
6. Mark Nelson, "*Data compression*", BPB Publishers, New Delhi,1998.
7. Mark S.Drew, Ze-Nian Li, " *Fundamentals of Multimedia*", PHI, 1st Edition, 2003.
8. Watkinson.J, "*Compression in Video and Audio*", Focal press, London, 1995.
9. Jan Vozer, "*Video Compression for Multimedia*", AP Profes, NewYork, 1995.

SEMESTER-I

MET621 – DIGITAL SIGNAL PROCESSING SIMULATION LAB

Teaching Scheme:	Examination Scheme:
Lecture - NA	Theory Paper - NA
Tutorial - NA	Class Test - NA
Practical Hours:-04 H/Week	Term work:-50 Marks
	Credit:-02

Students are instructed to frame and perform laboratory assignment based on ADSP of theory course. The assignment should encompass the hardware and software techniques/tools introduced in the concerned subjects and should prove to be useful for the PG program in the relevant field. Assignment should be a full-fledged system design problems with multidimensional solutions suggested.

Student shall submit a laboratory work document based on the assignment performed at the end of semester. The laboratory instructor shall guide the students in framing the assignments and defining the problems pertaining to the said subjects.

SEMESTER-I

MET622 – SYSTEM LAB-I

Teaching Scheme:	Examination Scheme:
Lecture - NA	Theory Paper - NA
Tutorial - NA	Class Test - NA
Practical Hours-02 H/Week	Practical- 50 Marks
	Credit-0

Individual student will perform the work as per the following guidelines and submit the report based on result obtained and /or study performed under the guidance of respective guide (Minimum 25 pages).

The work will be assessed by two examiners out of which one will be external examiner appointed by the University and second examiner (internal) will be guide itself.

Work to be carried out by student,

1) Student should perform experimentation in any subject of the stream as assign by the respective guide, leading towards concept understanding.
2) Literature survey about the topic, research and development or thrust area subject.
3) Student should study any one of the software from given list and develop a specific software based module using C/C++/Vb/Matlab/VHDL/Microwind/LabView/PSpice/ EDA or ECAD etc.

SEMESTER-I

MET623 – SEMINAR-I

Teaching Scheme:	Examination Scheme:
Lecture - NA	Theory Paper - NA
Tutorial - NA	Class Test - NA
Hours:-02 H/Week	Seminar:-50 Marks
	Credit:-01

Student should deliver seminar on the state of the art topic infront of the external examiners and internal examiners, staff and student colleagues. Prior to presentation student should carry the details of literature survey form standard references such as international journals and periodicals, recently published reference books etc. student should submit a report on same along with computer based presentation copy to the concerned examiner/guide at the end of seminar. The assessment shall be based on selection of topic its relevance to present context, report documentation and presentation skills.

SEMESTER-II

ME0651 – ADVANCED OPTIMISATION TECHNIQUES

Teaching Scheme:	Examination Scheme:
Lecture - 03 Hrs	Theory Paper - 80 Marks
Tutorial - 01 Hrs	Class Test - 20 Marks
	Credit:-04

Units Contents

Unit I **(2Hrs)**

Introduction: Optimal problem formulation, engineering optimization problems, optimization Algorithms.

Unit II **(6Hrs)**

Single Variable Optimization Algorithms: Optimality criteria, bracketing methods, region elimination methods, point estimation methods, gradient base, root finding using optimization Techniques.

Unit III **(8Hrs)**

Multivariable Optimization Algorithms: Optimality criteria, unidirectional search, direct Search methods, gradient based methods, computer programs on above methods.

Unit IV **(8Hrs)**

Constrained Optimization Algorithms: Kuhn-Tucker conditions, transformation methods, sensitivity analysis, direct search for constrained minimization, linearised search techniques, feasible direction method, generalized reduced gradient method, gradient projection method, computer programs on above methods.

Unit V **(8Hrs)**

Special Optimization Algorithms: Integer programming, Geometric programming, Genetic Algorithms, simulated annealing, global optimization, Computer programs on above methods.

Unit VI **(8Hrs)**

Optimization in Operations Research: Linear programming problem, simplex method, artificial variable techniques, dual phase method, sensitivity analysis

Reference Books:

1. Deb Kalyanmoy, “Optimization in Engineering Design”, PHI, New Delhi.
2. Rao S.S. “Engineering Optimization”, John Wiley, New Delhi.
3. Deb Kalyanmoy, “Multi-objective Algorithms using Evolutionary Algorithms”, John Wiley, New Delhi.

4. Paplambros P.Y. and Wilde D.J., “Principles of Optimum Design: Modeling and Computation”, Cambridge University Press, UK
5. Chandrupatla, “Optimization in Design”, PHI, New DelhiUniversity Press, UK

SEMESTER-II

ME0652 – AUDIO SIGNAL PROCESSING AND CODING

Teaching Scheme:	Examination Scheme:
Lecture - 03 Hrs	Theory Paper - 80 Marks
Tutorial - 01 Hrs	Class Test - 20 Marks
	Credit:-04

UNIT-I**:** **08 Hrs**

Fundamentals of Speech Nature of Speech ,type of speech, voiced an unvoiced decision making, audio file formats, process of speech production, acoustic theory of speech production.

UNIT-II**:**

Digital models for the Speech Signal: Lossless tube models and Digital models for speech signals, time domain model for speech processing, time dependent processing of speech, parameter of speech: pitch &formats, fundamental frequency or pitch frequency, Parallel Processing Approach for calculation of pitch frequency, pitch period measurement using spectral domain, cepstral domain, estimation of formats.

UNIT-III**:** **10 Hrs**

Spectral Parameter of Speech: Homomorphic Processing, Cepstal analysis of speech, the auditory system as a filter bank,perceptual linear prediction, log frequency power coefficients, relative spetral perceptual linear prediction,short-time spectral analysis of speech, wavelet transformation analysis of speech.

UNIT-IV**:** **10 Hrs**

Speech Quantization and Coding: Uniform and non-uniform quantization and coder, companded quantizer, waveform coding of speech, comparison of different waveform coding techniques, parameter speech coding technique, mixed excitation linear prediction coder,multi-mode speech coding, transform domain coding of speech.

UNIT-V**:** **10 Hrs**

Short time Fourier Analysis: Linear filtering interpretation, filter bank summation method, overlap addition method, design of digital filter bank, implementation using FFT, spectrographic displays, pitch detection, analysis by synthesis,analysis sysnthesis system, Homomorphic speech processing: Homomorphic system for convolution, complex spectrum, pitch detection, format estimation ,Homomorphic vocoder.

UNIT-VI**:** **12 Hrs**

Speech Synthesis and Speech Processing Application: A text to speech system, synthesizer technologies ,speech sysnthesis using other methods, speech transformations,emotion recognition from speech,speech recognition for ASR, statical sequence recognition for ASR, VQ-HMM- based speech recognition, word spotting/key-word spotting,speaker recognition,speech enhancement,adaptive echo cancellation,audio processing: auditory perception and psychoacoacoustis masking frequency and loudness perception, spatial perception, digital audio, audio coding, high quality,low bit rate,audio coding standard, MPEG,AC-3

Text Books:

1. L.R.Rabiner and R.W. Schafer, “Digital processing of speech signal” Pearson Education (Asia) Pte.Ltd, 2004

2. D.O’Shaughnessy “Speech Communication: Human and Machine”Universities Press2001

3.L.R. Rabiner and B.Juang “Fundamentals of Speech Recognition”Pearson Education Pte.Ltd, 2004

4.Z.Li and M.S. Drew “Fundamentals of Multimedia” Pearson Education Pte.Ltd, 2004

5.Shaila D Apte “Speech and Audio Processing” John Wiley & Sons

ReferenceBook:

1. C Becchetti & L P Ricotti,”Speech Recognition Theory & C++ Implementation” John Wiley & Sons
2. . B Gold & N. Morga “Speech & Audio Signal Processing”,John Wiley & Sons.

SEMESTER-II

MET653 – ADVANCED SATELLITE COMMUNICATION

Teaching Scheme:	Examination Scheme:
Lecture - 03 Hrs	Theory Paper - 80 Marks
Tutorial - 01 Hrs	Class Test - 20 Marks
	Credit:-04

Unit1

Introduction: Satellite communication, Brief History, Orbits of satellite: Low, medium and geo-synchronous main characteristics, Angle period, Returning period, Angle of Evaluation, Propagation Delay, Orbital spacing.Delay transponder, Earth Stations, Antennas and Earth Coverage, Altitude and eclipses.

Unit 2: 10 hours

Earth Space Propagation Effects: Frequency window, Free space loss, Atmospheric absorption, Rainfall Attenuation, Inospheric scintillation, Telemetry, Tracking and command of satellite.

Detection: QPSK offset QPSK and MSK, Coherent and non-coherent detection, Error rate performance.

Unit 3: 08 hours

Satellite Link Design: Basic transmission theory, system noise temperature and G/T ratio, Design of downlinks, uplink design.

Unit 4. 06 Hours

Modulation, multiplexing and multiple access for satellite links: FM, BPSK, QPSK, FDMA, TDMA, DAMA, and CDMA.

Unit 5. 05 hours

VSAT Systems: overview, network architectures, access control protocols, earth station engineering , antennas, link margins, system design procedure.

Unit 6: 045hours

Applications: GPS, direct broadcast satellite television: design and error control, satellite radio broadcasting, weather forecasting satellites.

Reference books:

1. Timothy Pratt: Satellite communications, second edition, Wiley, 2012.
2. A.K. Maini: Satellite Communications, wiley, 2012.
3. J.Martin: Communication Satellite System, PH Englewood
4. D.C Aggarwal: Satellite Communication, Khanna Pub.

SEMESTER-II

MET654 – IMAGE AND VIDEO PROCESSING

Teaching Scheme:	Examination Scheme:
Lecture - 03 Hrs	Theory Paper - 80 Marks
Tutorial - 01 Hrs	Class Test - 20 Marks
	Credit:-04

UNIT 1-

IMAGE AND VIDEO ENHANCEMENT AND RESTORATION: (08HRS)

Basic Linear Filtering with Application to Image Enhancement ,Nonlinear Filtering for Image Analysis and Enhancement ,Morphological Filtering for Image Enhancement and Detection, Basic Methods for Image Restoration and Identification, Motion Detection and Estimation, Video Enhancement and Restoration

UNIT 2-

IMAGE REPRESENTATIONS AND IMAGE MODELS: **(8 HRS)**

Computational Models of Early Human Vision , Multiscale Image Decompositions and Wavelets, Random Field Models, Statistical Methods for Image Segmentation, Video Segmentation

UNIT 3-

IMAGE COMPRESSION: **(06 HRS)**

Lossless Coding,Block Truncation Coding , The JPEG Lossy Image Compression Standard, The JPEG Lossless Image Compression Standards

UNIT 4-

VIDEO COMPRESSION: **(06 HRS)**

Basic Concepts and Techniques of Video Coding and the H.261 Standard, Object-Based Video Coding, MPEG- 1 and MPEG-2 Video Standards, Emerging MPEG Standards: MPEG-4 and MPEG-7.

UNIT 5 –

IMAGE AND VIDEO ACQUISITION: **(06 HRS)**

Image Scanning. Sampling. and Interpolation ,Video Sampling and Interpolation

UNIT 6-
IMAGE AND VIDEO RENDERING AND ASSESSMENT APPLICATIONS:
(06 HRS)

Image Quantization. Halfioning. and Printing ,Perceptual Criteria for Image Quality Evaluation, Fingerprint Classification and Matching, Human Face Recognition.

REFERENCE BOOKS:

1.Al Bovik:Handbook of Image & Video Processing Academic Press

2.J. W. Woods :Multidimensional Signal, Image and Video Processing and Coding, , Academic Press

3.A. M. Tekalp :Digital Video Processing, Prentice Hall

4.Y. Wang, J. Ostermann, and Y.-Q. Zhang : Video Processing and Communications, Prentice Hall, 2002

SEMESTER-II

MET691 – PATTERN RECOGNITION (EL-II)

Teaching Scheme:	Examination Scheme:
Lecture - 03 Hrs	Theory Paper - 80 Marks
Tutorial - 01 Hrs	Class Test - 20 Marks
	Credit:-04

Unit1 **(4Hrs)**

Introduction to pattern recognition: Machine Perception, the classification model, the Descriptive Approach.

Unit 2 **(8Hrs)**

Baye's Decision Theory: Baye's Decision Theory, minimum error rate, classification, classifiers, Discriminate Functions and Decision surfaces, Error Probabilities and Integral, The Normal Density Discriminate function for the Normal Density Bayesian Decision Theory.

Unit 3 **(8Hrs)**

Parameter Estimation and Supervised leasning the mean of a Normal Density, General Bayesian Learning, Sufficient statics and Exponential family, Problems of Dimensionality, Estimating the Error rate.

Unit 4 **(6Hrs)**

Nonparametric Technique : Density Estimation Parzen windows, KNearestneighbor Estimation,Estimation of a Posteriori Probability, the nearestNeighborRule, Approximation by seriesExpansion, Approximation for the Binary case, Fisher's linear discriminate, Multiple discriminateanalysis.

Unit 5 **(7Hrs)**

Linear Discriminant Functions : Linear Discriminant functions and decision surfaces, GeneralisedLinear Descriminant functions, the two category linearly separable case, Minimizing theperception Criterion function, Relaxation procedures, Nonseparable behavior, minimum squarederror procedures, HoKashyapprocedures, linear programming procedures, the method of potentialfunction, multicategory genelalizations.

Unit 6 **(7Hrs)**

Unsupervised learning and clustering: mixture densities and identifiability, maximum likelihood

estimates, Application to normal mixtures, Unsupervised Bayesian learning, data description and clustering, criterion functions for clustering, iterative optimization, hierarchical clustering, graph theoretic methods, clustering and dimensionality reduction.

SEMESTER-II

MET692 – STATISTICAL SIGNAL PROCESSING (EL-II)

Teaching Scheme:	Examination Scheme:
Lecture - 03 Hrs	Theory Paper - 80 Marks
Tutorial - 01 Hrs	Class Test - 20 Marks
	Credit:-04

UNIT I: **8Hour**

Review of Random Variables:

Distribution and density functions, moments, independent, uncorrelated and orthogonal random variables; Vector-space representation of Random variables, Schwarz Inequality Orthogonalit principle in estimation, Central Limit theorem, Random processes, wide-sense stationary processes, autocorrelation and auto covariance functions, Spectral representation of random signals, Wiener Khinchin theorem Properties of power spectral density, Gaussian Process and White noise process, Linear System with random input, Spectral factorization theorem and its importance, innovation process and whitening filter, .Random signal modeling: MA(q), AR(p) , ARMA(p,q)models.

UNIT II: **8Hour**

Parameter Estimation Theory:

Principle of estimation and applications, Properties of estimates, unbiased and consistent estimators, Minimum Variance Unbiased Estimates (MVUE), Cramer Rao bound, Efficient estimators; Criteria of estimation: the methods of maximum likelihood and its properties ; Baysean estimation : Mean square error and MMSE, Mean Absolute error, Hit and Miss cost function and MAP estimation.

UNIT III: **6Hour**

Estimation of Signal in Presence of White Gaussian Noise:

Linear Minimum Mean-Square Error (LMMSE) Filtering: Wiener Hoff Equation, FIR Wiener filter, Causal IIR Wiener filter, Noncausal IIR Wiener filter, Linear

UNIT IV: **6Hour**

Adaptive Filtering:

Principle and Application, Steepest Descent Algorithm Convergence characteristics; LMS algorithm, convergence, excess mean square error, Leaky LMS algorithm; Application of Adaptive filters ;RLS algorithm, derivation, Matrix inversion Lemma, Initialization, tracking of nonstationarity.

UNIT V: **4Hour**

Kalman Filtering:

State-space model and the optimal state estimation problem, discrete Kalman filter, continuous-time Kalman filter, extended Kalman filter.

UNIT IV: **8Hour**

Spectral Analysis: Estimated autocorrelation function, periodogram, Averaging the periodogram (Bartlett Method), Welch modification, Blackman and Tukey method of smoothing periodogram, Prametric method, AR(p) spectral estimation and detection of Harmonic signals, MUSIC algorithm.

References:

1. M. Hays: Statistical Digital Signal Processing and Modelling, John Willey and Sons, 1996.
2. M.D. Srinath, P.K. Rajasekaran and R. Viswanathan: Statistical Signal Processing with Applications, PHI, 1996.
3. Simon Haykin: Adaptive Filter Theory, Prentice Hall, 1996.
4. D.G. Manolakis, V.K. Ingle and S.M. Kogon: Statistical and Adaptive Signal Processing, McGraw Hill, 2000.
5. S. M. Kay: Modern Spectral Estimation, Prentice Hall, 1987.

SEMESTER-II

MET693 – EMBEDDED SYSTEM DESIGN (EL-II)

Teaching Scheme:	Examination Scheme:
Lecture - 03 Hrs	Theory Paper - 80 Marks
Tutorial - 01 Hrs	Class Test - 20 Marks
	Credit:-04

Unit 1. **(12Hrs)**

Introduction: Embedded systems overview, Design Challenges, Processor Technology, IC Technology, Design Technology, Trade-offs, Custom Single purpose processors, RT level Custom Single purpose processor design, Optimization, General Purpose processors: pipelining, superscalar and VLIW architectures, Programmers view: Instruction set, program and data memory space, I/O, interrupts, operating system.

Development environment: design flow and tools, testing and debugging, Application specific instruction set processors (ASIPs), microcontrollers, digital signal processors, less-general AIP environments, selecting microprocessors, general purpose processor design.

Unit2 **(5Hrs)**

Architecture of ARM7TDMI processor, Programming model, Registers, Operating modes, Instruction set, Addressing modes, memory interface.

Unit3 **(5Hrs)**

Peripherals: Introduction, timers, counters and watchdog timers, UART, Pulse width modulators, controlling a DC motor using PWM, LCD controllers, Keypad controllers, stepper motor controllers, ADCs, Real time clocks.

Unit4 **(6Hrs)**

Memory: Memory write ability and storage permanence, common memory types, composing memory, memory hierarchy and cache, advanced RAM.

Unit5 **(7Hrs)**

Interfacing: Introduction, Communication basics, Basic protocol concepts, ISA bus protocol: memory access, Arbitration, Priority arbiter, Daisy chain Arbitration, wireless communication, Layering, error detection and correction, wireless protocols: IrDA, Bluetooth, IEEE802.11

Unit6. **(5Hrs)**

Introduction to ARM 9, ARM926EJ-S, Features, Specifications (LPC314x /LPC315x as reference controllers)

REFERENCES:

1. Rajkamal,'Embedded System – Architecture Programming and Design',Tata-McGraw Hill Pub.
2. Dr.K.V.K.K.Prasad 'Embedded Real Time Systems' Dreamtech
3. Andrew Sloss Embedded System Developers'
4. Frank Vahid and Tony Givargis, Embedded system design: A unified hardware/software introduction, John Wiley and Sons, 2002
5. Data Sheet of ARM7TDMI
6. Data Sheet of ARM926EJ-S , (LPC314x /LPC315x)

SEMESTER-II

MET671 – AUDIO PROCESSING & CODING LAB

Teaching Scheme:	Examination Scheme:
Lecture - NA	Theory Paper - NA
Tutorial - NA	Class Test - NA
Practical Hours:-04 H/Week	Term work:-50 Marks
	Credit:-02

Students are instructed to frame and perform laboratory assignment based on AP&C of theory course. The assignment should encompass the hardware and software techniques/tools introduced in the concerned subjects and should prove to be useful for the PG program in the relevant field. Assignment should be a full-fledged system design problems with multidimensional solutions suggested.

Student shall submit a laboratory work document based on the assignment performed at the end of semester. The laboratory instructor shall guide the students in framing the assignments and defining the problems pertaining to the said subjects.

SEMESTER-II

MET672 – SYSTEM LAB-II

Teaching Scheme:	Examination Scheme:
Lecture - NA	Theory Paper - NA
Tutorial - NA	Class Test - NA
Practical Hours-02 H/Week	Practical- 50 Marks
	Credit-01

Individual student will perform the work as per the following guidelines and submit the report based on result obtained and /or study performed under the guidance of respective guide (Minimum 25 pages).

The work will be assessed by two examiners out of which one will be external examiner appointed by the University and second examiner (internal) will be guide itself.

Work to be carried out by student,

1) Student should perform experimentation in any subject of the stream as assign by the respective guide, leading towards concept understanding.
2) Literature survey about the topic, research and development or thrust area subject.
3) Student should build any one of the software/Hardware based mini project as per guidelines given by respective committee and/or guide.

SEMESTER-II

MET673 – SEMINAR-II

Teaching Scheme:	Examination Scheme:
Lecture - NA	Theory Paper - NA
Tutorial - NA	Class Test - NA
Hours:-02 H/Week	Seminar:-50 Marks
	Credit:-01

Student should deliver seminar on the state of the art topic infront of the external examiners and internal examiners, staff and student colleagues. Prior to presentation student should carry the details of literature survey form standard references such as international journals and periodicals, recently published reference books etc. student should submit a report on same along with computer based presentation copy to the concerned examiner/guide at the end of seminar. The assessment shall be based on selection of topic its relevance to present context, report documentation and presentation skills.

SEMESTER-III

MET731 – DISSERTATION-I

Teaching Scheme:	Examination Scheme:
Lecture - NA	Theory Paper - NA
Tutorial - NA	Class Test - NA
Hours:-12 H/Week	Termwork:-50 Marks
	Practical Oral-50 marks
	Credit:-12

The dissertation Seminar will consist of a type written report covering the topic selected for Final Dissertation. This should include the literature survey, technical details and related data required for the proposed dissertation work. The candidate shall deliver the dissertation seminar on the topic which will be judged by two examiners (one external and one internal guide). The assessment shall be based on selection of topic its relevance to present context, report documentation and presentation skills, utility of the dissertation work & publications based on the same.

SEMESTER-IV

MET781 – DISSERTATION-II

Teaching Scheme:	Examination Scheme:
Lecture - NA	Theory Paper - NA
Tutorial - NA	Class Test - NA
Hours:-20 H/Week	Termwork:-100 Marks
	Practical Oral-200 marks
	Credit:-20

The student shall be allowed to submit the dissertation- II report only after the completion of dissertation- I. Student should deliver Viva-Voca Presentation on topic of Desertaion-II infront of the external examiners and internal examiners, staff and student colleagues The assessment shall be based on design and implementation aspects, report documentation and presentation skills, utility of the dissertation work & publications based on the same.