ACADEMIC REGULATIONS

COURSE STRUCTURE
AND
DETAILED SYLLABUS

M.Tech (CONTROL ENGINEERING)

(ELECTRICAL & ELECTRONICS ENGINEERING)

M. Tech. Two Year Degree Course

(Applicable for the batches admitted from 2014-15)

(MR-14 Regulations)

MALLA REDDY ENGINEERING COLLEGE

(AUTONOMOUS)

(An Autonomous institution, Autonomy granted by UGC and affiliated to JNTUH, Accredited by NAAC with 'A' Grade, Accredited by NBA (2008-11) & Recipient of World Bank Assistance under TEQIP phase – II S.C.1.1for the period (2011-14))

Maisammaguda, Dhulapally (Post. Via. Kompally), Secunderabad – 500 100.

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MALLA REDDY ENGINEERING COLLEGE (AUTONOMOUS)
Maisammaguda, Dhulapally (Post via. Kompally), Secunderabad – 500100

ACADEMIC REGULATIONS MR 14 FOR M. TECH. (REGULAR) DEGREE COURSE

(Effective for the students admitted into first year from the academic year 2014-2015)

The M.Tech Degree of Malla Reddy Engineering College, Hyderabad shall be conferred on candidates by the Jawaharlal Nehru Technological University Hyderabad (JNTUH), Hyderabad who are admitted to the program and fulfill all the requirements for the award of the Degree.

1.0 ELIGIBILITY FOR ADMISSIONS

Admission to the above program shall be made subject to the eligibility, qualifications and Specialization as prescribed by the university/college from time to time.

Admissions shall be made on the basis of merit/rank obtained by the qualifying candidate at an Entrance Test conducted by the University/college or on the basis of any other order of merit approved by the University/college (say **PGECET/GATE)** subject to reservations as laid down by the Government from time to time.

2.0 AWARD OF M. TECH. DEGREE

2.1 A student shall be declared eligible for the award of the M. Tech. Degree, if he pursues a course of study in not less than two and not more than four academic years. However, he is permitted to write the examinations for two more years after four academic years of course work.

2.2 A student, who fails to fulfill all the academic requirements for the award of the degree within four Academic years from the year of his admission, shall forfeit his seat in M. Tech. course.

2.3 The student shall register for all 88 credits and secure all the 88 credits.

2.4 The minimum instruction days in each semester are 90.

3.0 COURSES OF STUDY

The following specializations are offered at present for the M. Tech. course of study.

1. Advanced Manufacturing Systems(AMS) - Shift II
2. Computer Science(CSe) - Shift I
3. Computer Science and Engineering(CSE) - Shift I & II
4. Control Systems(CS) - Shift I & II
5. Digital Systems and Computer Electronics(DSCE) - Shift I
6. Electrical Power Systems (EPS) - Shift I
7. Embedded Systems(ES) - Shift I
8. Geotechnical Engineering(GTE) - Shift I
9. Machine Designs (MD) - Shift I
10. Power Electronics and Electrical Drives(PEED) - Shift II
11. Structural Engineering(SE) - Shift I
12. Transportation Engineering(TE) - Shift II
13. Thermal Engineering(THE) - Shift I
14. VLSI System Design(VLSI SD) - Shift I

3.1 Departments offering M. Tech. Programmes with specializations are noted below:

Branch	Specialization	Specialization Code
Civil Engineering	1. Structural Engineering (SE) 2. Transportation Engineering (TE) 3. Geotechnical Engineering (GE)	11 12 13
Electrical and Electronics Engineering	1. Control Systems (CS) 2. Power Electronics and Electrical Drives (PEED) 3. Electrical Power Systems (EPS)	22 23 24
Mechanical Engineering	1. Thermal Engineering (TE) 2. Advanced Manufacturing Systems (AMS) 3. Machine Designs (MD)	31 32 33
Electronics and Communication Engineering	1.Digital Systems and Computer Electronics (DSCE) 2. VLSI System Design (VLSI SD) 3. Embedded Systems (ES)	41 42 43
Computer Science and Engineering	1. Computer Science and Engineering (CSE) 2. Computer Science (CSe)	51 52

4.0 ATTENDANCE

The programs are offered on a unit basis with each subject being considered as a unit.

4.1 A student shall be eligible to write University examinations if he acquires a minimum of 75% of attendance in aggregate of all the subjects.

4.2 Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester shall be granted by the College Academic Committee.

4.3 Shortage of Attendance below 65% in aggregate shall not be condoned.

4.4 Students whose shortage of attendance is not condoned in any semester are not eligible to write their end semester examination of that class and their registration shall stand cancelled.

4.5 A prescribed fee shall be payable towards condonation of shortage of attendance.

4.6 A student shall not be promoted to the next semester unless he satisfies the attendance requirement of the present semester, as applicable. They may seek readmission into that semester when offered next. If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.

4.7 A student shall not be promoted to the next semester unless he satisfies the attendance requirements of the previous semester including the days of attendance in sports, games, NCC and NSS activities.

5.0 EVALUATION

The performance of the candidate in each semester shall be evaluated subject-wise, with a maximum of 100 marks for theory and 100 marks for practical's, on the basis of Internal Evaluation and End Semester Examination.

5.1 For the theory subjects 60 marks shall be awarded based on the performance in the End Semester Examination and 40 marks shall be awarded based on the Internal Evaluation. The internal evaluation shall be made based on the **average** of the marks secured in the two Mid Term-Examinations conducted-one in the middle of the Semester and the other immediately after the completion of instruction. Each mid term examination shall be conducted for a total duration of 120 minutes with Part A as 2 questions to be answered out of 4 questions each question for 10 marks and Part B with 4 questions to be answered out of 6 questions each question for 5 marks. If any candidate is absent for any subject of a mid -term examination, an additional exam will be conducted in the deserving cases based on the recommendations of the College Academic Committee. End semester examination is conducted for 60 marks with 5 questions to be answered out of 8 questions, each question carries 12 marks.

5.2 For practical subjects, 60 marks shall be awarded based on the performance in the End Semester Examinations and 40 marks shall be awarded based on the day-to-day performance as Internal Marks.

5.3 There shall be two seminar presentations during I year I semester and II semester. For seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Departmental Academic Committee consisting of Head of the Department, Supervisor and two other senior faculty members of the department. For each Seminar there will be only internal evaluation of 50 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.

5.4 There shall be a Comprehensive Viva-Voce in II year I Semester. The Comprehensive Viva-Voce will be conducted by a Committee consisting of Head of the Department and two Senior Faculty members of the Department. The Comprehensive Viva-Voce is intended to assess the students' understanding of various subjects he has studied during the M. Tech. course of study. The Comprehensive Viva-Voce is evaluated for 100 marks by the Committee. There are no internal marks for the Comprehensive Viva-Voce.

5.5 A candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the End semester Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.

5.6 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 5.5) he has to reappear for the End semester Examination in that subject. A candidate shall be given one chance to re-register for each subject provided the internal marks secured by a candidate are less than 50% and so has failed in the end examination. In such a case, the candidate must re-register for the subject(s) and secure the required minimum attendance. The candidate's attendance in the re-registered subject(s) shall be calculated separately to decide upon his eligibility for writing the end examination in those subject(s). In the event of the student taking another chance, his internal marks and end examination marks obtained in the previous attempt stand cancelled.

5.7 Laboratory examination for M. Tech. courses must be conducted with two Examiners, one of them being the Laboratory Class Teacher and the second examiner shall be another Laboratory Teacher.

6.0 EVALUATION OF PROJECT/DISSERTATION WORK

Every candidate shall be required to submit a thesis or dissertation after taking up a topic approved by the Project Review Committee (PRC).

6.1 A Project Review Committee shall be constituted with Principal as chair person, Head of the Department, Coordinator, Supervisor and two other senior faculty members.

6.2 Registration of Project Work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the subjects (theory and practical subjects).

6.3 After satisfying 6.2, a candidate has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work to the Departmental Academic Committee for its approval. Only after obtaining the approval of the Departmental Academic Committee can the student initiate the Project work. Departmental Academic Committee (DAC) Consists of Head of the Department as Chairman, along with two Senior Professors and few subject experts too.

6.4 If a candidate wishes to change his supervisor or topic of the project he can do so with approval of Departmental Committee. However, the Departmental Committee shall examine whether the change of topic/supervisor leads to a major change of his initial plans of project proposal. If yes, his date of registration for the project work starts from the date of change of topic as the case may be.

6.5 Candidate shall submit status report (in a bound-form) in two stages at least with a gap of 3 months between them.

6.6 The work on the project shall be initiated in the beginning of the second year and the duration of the project is for two semesters. A candidate is permitted to submit Project Thesis only after successful completion of theory and practical course with the approval of PRC not earlier than 40 weeks from the date of registration of the project work. For the approval of PRC the candidate shall submit the draft copy of thesis to the Principal (through Head of the Department) and shall make an oral presentation/demonstration before the PRC.

6.7 Three copies of the Project Thesis certified by the supervisor shall be submitted to the College/ Institute.

6.8 The thesis shall be adjudicated by one examiner selected by the College. For this, Head of the Department shall submit a panel of 3 examiners to the Chief Controller of Examinations of the College, who are eminent in that field with the help of the concerned guide and Head of the department.

6.9 If the report of the examiner is not favorable, the candidate shall revise and resubmit the Thesis, in the time frame as described by PRC. If the report of the examiner is unfavorable again, the thesis shall be summarily rejected.

6.10 If the report of the examiner is favorable, Viva-Voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the examiner who adjudicated the Thesis. The Board shall jointly report the candidate's work as one of the following:

A. Excellent
B. Good
C. Satisfactory
D. Not Satisfactory

The Head of the Department shall coordinate and make arrangements for the conduct of Viva- Voce examination.

If the report of the viva-voce is unsatisfactory, the candidate will retake the viva-voce examination after three months. If he fails to get a satisfactory report at the second Viva-Voce examination, he will not be eligible for the award of the degree unless he is asked to revise and resubmit by the Board.

7.0 AWARD OF DEGREE AND CLASS

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M. Tech. Degree he shall be placed in one of the following four classes:

Class Awarded	% of marks to be secured
First Class with Distinction	70% and above
First Class	Below 70 but not less than 60%
Second Class	Below 60% but not less than 50%
Pass Class	Below 50% but not less than 40%

The marks in internal evaluation and end examination shall be shown separately in the memorandum of marks.

8.0 WITH-HOLDING OF RESULTS

If the candidate has not paid any dues to the university or if any case of in-discipline is pending against him, the result of the candidate will be withheld and he will not be allowed into the next higher semester. The issue of the degree is liable to be withheld in such cases.

9.0 TRANSITORY REGULATIONS

9.1 Discontinued, detained or failed candidates are eligible for admission to two earlier or equivalent subjects at a time as and when offered.

9.2 The candidate who fails in any subject will be given two chances to pass the same subject: otherwise, he has to identify an equivalent subject as per MR14 academic regulations.

10.0 GENERAL

10.1 The academic regulations should be read as a whole for purpose of any interpretation.
10.2 In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Principal is final.
10.3The College may change or amend the academic regulations and syllabus at any time and the changes and amendments made shall be applicable to all the students with effect from the date notified by the College.
10.4 Wherever the word he, him or his occur, it will also include she, her and hers.
10.5 Wherever the word 'Subject' occurs in the above regulations, it implies the 'Theory Subject' and 'Practical Subject' or 'Lab'.
10.6 Transfers not allowed among group colleges.

MALPRACTICES RULES
DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices/Improper conduct	**Punishment**
	If the candidate:	
1.(a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any mark son the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the University.
3	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shallot be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject tithe academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject

6	Refuses to obey the orders of the Chief Superintendent/Assistant –Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to the person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police cases registered against them.
7	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations.
		The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.

12	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for further action toward suitable punishment.	

Malpractices identified by squad or special invigilators

1. Punishments to the candidates as per the above guidelines.

2. Punishment for institutions: (if the squad reports that the college is also involved in encouraging malpractices)
   (i) A show cause notice shall be issued to the college.
   (ii) Impose a suitable fine on the college.
   (iii) Shifting the examination centre from the college to another college for a specific period of not less than one year.

MALLA REDDY ENGINEERING COLLEGE (Autonomous)
M.Tech (Control Engineering) MR14

Course Structure and Syllabus

I YEAR I SEMESTER

Code	Group	Subject	L	P	Credits
42101		Advanced Control Systems	3	0	3
42102		Digital Control Systems	3	0	3
42103		State and Parameter Estimation Theory	3	0	3
44113		DSP Processor Architecture and Applications	3	0	3
421A1	Elective –I	Programmable Logic Controllers and Applications	3	0	3
421A2		Transducers and Data Acquisition Systems			
421A3		Process Modeling and Simulation			
441A3	Elective -II	Embedded Systems Design	3	0	3
421B1		Robotics and Control			
44114		Microcontrollers and Applications			
42104	Lab	Control Engineering & Simulation Lab	0	3	2
42105		Seminar-1	-	-	2
Total Credits (6 Theory + 1 Lab+1seminar)			18	3	22

I YEAR II SEMESTER

Code	Group	Subject	L	P	Credits
42106		Optimal Control Theory	3	0	3
42107		Adaptive Control Theory	3	0	3
42108		Neural Networks & Fuzzy Systems	3	0	3
42109		Control System Design	3	0	3
421C1	Elective –III	Non linear Systems	3	0	3
421C2		Distributed Control Systems			
421C3		Process Dynamics and Control			
44115	Elective -IV	Advanced Digital Signal Processing	3	0	3
421D1		Real Time Systems			
421D2		Intelligent and Knowledge based systems			
42110	Lab	Signal Processing Lab	0	3	2
42111		Seminar-2	-	-	2
Total Credits (6 Theory + 1 Lab+1seminar)			18	3	22

II YEAR I & II SEMESTER

Code	Subject	L	P	Credits
42112	Comprehensive Viva	-	-	4
42113	Project Seminar	0	3	40
	Total Credits	-	-	44

L- Theory;
T-Tutorial;
P-Practical;

MALLA REDDY ENGINEERING COLLEGE
(Autonomous)

M.Tech (Control Engineering) I Semester

L	T/P	C
3	-/-	3

ADVANCED CONTROL SYSTEMS

Objective: To impart knowledge on the basic contents in state space analysis, describing function, phase plane and stability analysis including controllability and observability. It also deals with lead, lag controllers, PID controllers and optimal control.

UNIT-I LEAD, LAG AND LEAD-LAG COMPENSATORS

Control system design by root locus method-lead, lag and lead lag compensation. PI, PD and PID controllers design procedures and examples.

Control system design by frequency response approach- lead, lag and lead lag compensation. PI, PD and PID controllers design procedures and examples.

UNIT- II EIGEN VALUE AND EIGEN VECTOR SENSITIVITIES IN LINEAR SYSTEM THEORY

Continuous time systems: Introduction, first-order Eigen value sensitivities, first order eigenvector sensitivities, second-order Eigen value sensitivities, first order eigenvector sensitivities, second order Eigenvector sensitivities.

UNIT- III MODE-CONTROLLABILITY MATRIX

Distinct Eigen-values, confluent Eigen-values associated with single Jordan block, confluent Eigen-values associated with number of distinct Jordan blocks, confluent Eigen-values associated with a number of non-distinct Jordan block Mode –Controllability structure of multivariable linear systems: Introduction, Distinct Eigen-values, confluent Eigen-values associated with single Jordan block, confluent Eigen-values associated with a number of non-distinct Jordan blocks.

UNIT- IV OBSERVABILITY MATRIX AND NON-LINEAR SYSTEMS

Distinct Eigen-values, confluent Eigen-values, mode observability structure of multivariable linear systems: Introduction, Distinct Eigen-values, confluent Eigen values. Nonlinear systems: Common physical nonlinearities: the phase plane method – basic concept, singular points, construction of phase trajectories – Isocline and delta methods, Describing function – basic concept – derivation of describing functions – stability analysis by describing function method.

UNIT- V LYAPUNOV STABILITY ANALYSIS

Second method of Lyapunov, stability in the sense of Lyapunov, construction of Lyapunov functions – Krasovskii's and variable gradient methods, Lyapunov stability analysis of linear time varying systems.

TEXT BOOKS:

1. Advanced Control Systems, Sarkar, B. N. Print Edition Pages: 376 ,ISBN: 978-81-203-4710-6
2. Advanced Control Theory, Somanath Majhi, Cengage Learning, 1/e , 2009,Cengage Learning India.
3. Control System Engineering – I J Nagarath, M. Gopal – New Age International – 3rd edition, 2006.
4. Control Systems – N K Sinha – New Age International – 4th edition, 2013

REFERENCE BOOKS:

1. Automatic Control Systems – B C Kuo – PHI – 9th edition.
2. Modern Control Systems – Hsu and Meyer, McGraw-Hill, 1968.
3. Modal Control Theory and Applications – Brian Porter & Roger Corssley, 1972.
4. Modern Control Engineering - K. Ogata – PHI – 3rd edition,1998.
5. Modern Control Engineering- D. Roy Choudhury, PHI Learning Private Limited, ISBN: 978-81-203-2196-0, 2005
6. Automatic Control Systems - Kunche Sridhar, Kuo & Golnaraghi, Wiley India Pvt Ltd, 2012.
7. Modern Control Engineering,-Yaduvir Singh, S. Janardhanan, Cengage Learning, 2010.
8. Modern Control Systems an Introduction, S. M. Tirupathi, Firewal Media

MALLA REDDY ENGINEERING COLLEGE
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M.Tech (Control Engineering) I Semester

L	T/P	C
3	-/-	3

DIGITAL CONTROL SYSTEMS

Objective: To impart basic knowledge of A/D and D/A conversion, understand the basics of Z- Transform, the stability analysis of digital control system and digital process control design.

UNIT–I SAMPLE AND HOLD CIRCUIT, Z-TRANFORMS

Block Diagram of typical control system- advantages of sampling in control systems – examples of discrete data and digital systems – data conversion and quantization – sample and hold devices – D/A and A/D conversion – sampling theorem – reconstruction of sampled signals –ZOH.

Z-transform: Definition and evaluation of Z-transforms – mapping between s-plane and z-plane – inverse z-plane transform – theorems of the Z-transforms –limitations of z-transforms –pulse transfer function –pulse transfer function of ZOH –relation between G(s) and G(z) – signal flow graph method applied to digital systems.

UNIT- II STATE SPACE ANALYSIS

State space modeling of digital systems with sample and hold – state transition equation of digital time in variant systems – solution of time invariant discrete state equations by the Z-Transformation – transfer function from the state model – Eigen values – Eigen vector and diagonalisation of the A-matrix – Jordan canonical form. Computation of state transition matrix-Transformation to phase to variable canonical form-The state diagram – decomposition of digital system – Response of sample data system between sampling instants using state approach.

Stability: Definition of stability – stability tests – The second method of Lyapunov.

UNIT- III TIME DOMAIN ANALYSIS

Comparison of time response of continuous data and digital control systems-correlation between time response and root locus j the s-plane and z-plane – effect of pole-zero configuration in the z-plane upon the maximum overshoot and peak time of transient response – Root loci for digital control systems – steady state error analysis of digital control systems – Nyquist plot – Bode plot-G.M and P.M.

UNIT- IV DESIGN OF DIGITAL CONTROLLER

The digital control design with digital controller with bilinear transformation – Digital PID controller-Design with deadbeat response-Pole placement through state feedback-Design of full order state observer-Discrete Euler Lagrange Equation – Discrete maximum principle.

UNIT-V DIGITAL STATE OBSERVER

Design of - Full order and reduced order observers. Design by max.principle: Discrete Euler language equation-discrete maximum principle.

TEXT BOOKS:

1. Discrete-Time Control systems - K. Ogata, Pearson Education/PHI, 2nd Edition, 2003.
2. Digital Control Systems-V. I. George, C. P. Kurian, Cengage Learning,1/e, 2012.
3. Digital Control and State Variable Methods - M.Gopal, TMH, 3rd, 2008.
4. Digital Control Engineering - M.Gopal, John Wiley & Sons, 3rd, 1984

REFERENCE BOOKS:

1. Digital Control Systems, - Kuo, Oxford University Press, 2nd Edition, 2003.
2. Digital Control Engineering Analysis and Design - M. Sami Fadali Antonio Visioli, AP Academic Press, 2nd Edition, 2009.

2014-15 **CODE: 42103**

MALLA REDDY ENGINEERING COLLEGE
(Autonomous)

M.Tech (Control Engineering) I Semester

L	T/P	C
3	-/-	3

STATE AND PARAMETER ESTIMATION THEORY

Objective: To impart knowledge on purpose of estimator, different estimator methods, Gaussian noise, markov discrete model, error analysis, kalman filter, EKF, smoothing.

UNIT – I ESTIMATORS-I

Maximum likelihood method, Invariance of maximum likelihood estimator, Baye's cost methods: Mean square error (Minimum error variance) method.

UNIT-II ESTIMATORS-II

Uniform cost method, Absolute cost method, relationships of these estimators. Linear minimum variance method, least square method, sequential estimation.

UNIT-III NON-LINEAR ESTIMATORS AND GAUSS- MARKOV DISCRETE TIME MODEL

Non linear estimation, unbiased estimators, efficient estimators, asymptotic properties, sensitivity and error analysis. Gauss- Markov discrete time model, initial state description, propagations of means and co variances.

UNIT-IV KALMAN FILTER

Signal model, state statistics, output statistics, Estimation criteria, minimum variance estimate. Discrete time kalman filter, best linear estimator property of kalman filter, identification as a Kalman filtering problem, Kalman filter applications.

UNIT – V SMOOTHING

Fixed point smoothing, fixed log smoothing, fixed interval smoothing, extended kalman filter.

TEXT BOOK:

1. J.L.Melsa - Decision and Estimation theory, International student Edition, Mc Graw Hill- Kogakusha (Chapters 8,9,10 & 11)

REFERENCE BOOKS:

1. B.D.O.Anderson and J.B.Moore, Optimal filtering, Prentice- Hall.(Chapters 2,3& 7)
2. J.S. Meditch, Stochastic Optimal linear estimation and control, Mc Graw Hill, 1969.
3. Van Trees H.L., Detection, Estimation and Modulation Theory, Part 1&2 John Wiley sons, 1968/1971/1972.
4. Deutsch .R., Estimation Theory, Prentice Hall, 1965
5. Jazwinski.A.H. Stochastic processes& Filtering Theory, Academic press, 1970.

MALLA REDDY ENGINEERING COLLEGE
(Autonomous)

M.Tech (Control Engineering) I Semester

L	T/P	C
3	-/-	3

DSP PROCESSOR ARCHITECTURE AND APPLICATIONS

Objective: To impart knowledge on basics of DSP, architectures, Programmable DSP's and its interfacing and applications.

UNIT-I INTRODUCTION TO DIGITAL SIGNAL PROCESING

Introduction, A Digital signal-processing system, The sampling process, Discrete time sequences, Discrete Fourier Transform(DFT) and Fast Fourier Transform(FFT),Linear time-invariant systems, Digital filters, Decimation and interpolation, Analysis and Design tool for DSP Systems using MATLAB.

Computational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.

UNIT-II ARCHITECTURES FOR PROGRAMMABLE DSP DEVICES

Basic Architectural features, DSP computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed issues Features for External interfacing.

Execution Control and Pipelining: Hardware looping, Interrupts, Stacks, Relative Branch Support, Pipelining and performance, Pipeline Depth, Interlocking, Branching effects, interrupt effects, pipeline Programming models.

UNIT-III PROGRAMMABLE DIGITAL SIGNAL PROCESSORS

Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming, On-Chip peripherals, Interrupts of TMS320C54XX processors, Pipeline Operation of TMS320C54XX Processors.

UNIT-IV IMPLEMENTATION OF BASIC DSP ALGORITHMS

The Q-notation, FIR Filters, IIR Filters, interpolation Filters, Decimation filters, PID Controller, Adaptive Filters,2-D Signal Processing. Implementation of FFT Algorithms: An FFT Algorithm for DFT Computation, A Butterfly Computation, Overflow and scaling, Bit reversed index generation, An 8-point FFT implementation on the TMS320C54XX,Computation of signal spectrum.

UNIT-V INTERFACING MEMORY AND I/O PERIPHERALS TO PROGRAMMABLE DSP DEVICES

Memory space organization, External bus interfacing signals, Memory interface, parallel I/O interface, Programmed I/O, Direct Memory access(DMA).A Multichannel buffered serial port (McBSP), McBSP Programming, a CODEC interface circuit, CODEC programming, A CODEC DSP interface example.

TEXT BOOKS:

1. Digital Signal Processing-S.Salivahanan, A.Vallavaraj .C.Gnanpriya-TMH-2nd reprint 2001.
2. Theory and Applications of Digital Signal Processing – Lourens R Rebinarand Bernold,2002.
3. Digital Filter Analysis and Design -Auntoniam-TMH, 3rd ,2002.

REFERENCE BOOKS:

1. Digital Signal Processing-Sanjit K.Mitra-TMH second edition,2003.
2. Discrete Time Signal Processing – LAN V.OPPHENHEIM,RONALD W.Shafer-PHI 1996 1st edition reprint

Digital Signal Processing Principles – Algorithms and Applications-John G.Proakis-PHI-3rd edition2002

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M.Tech (Control Engineering) I Semester

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PROGRAMMABLE LOGIC CONTROLLERS AND APPLICATIONS
(Elective-I)

Objective: To impart knowledge on Mode of operation and programming of a Programmable Logic Controller (PLC), Characteristics of a PLC (synchronous, asynchronous), Analysis of the process schematic, analog PLC and PID controllers.

UNIT-I BASICS

PLC Basics PLC system, I/O modules and interfacing CPU processor programming equipment programming formats, construction of PLC ladder diagrams, devices connected to I/O modules.

UNIT-II PROGRAMMING WITH EXAMPLES

PLC programming input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill press operation. Digital logical gates programming in the Boolean algebra SYSTEM, CONVERSION EXAMPLES- Ladder diagrams for process control – Ladder diagrams for sequence listings – ladder diagram construction and flow chart for spray process system.

UNIT-III REGISTERS AND COUNTERS

PLC Registers: Characteristics of registers – module addressing – holding registers – output registers – PLC functions – Timer functions and industrial application counters – counter function industrial application – Architecture functions – number function comparison functions.- number conversion functions.

UNIT–IV DATA HANDLING FUCNTIONS AND SEQUENCE FUCNTIONS

Data handling functions: SKIP, Master control relay – Jump Move FIFO, FAL, ONS, CLR and sweep functions and their applications.

Bit pattern and changing a bit shift register, sequence functions and applications – controlling of two axes and three axis Robots with PLC, Matrix functions.

UNIT-V ANALOG PLC

Analog PLC operation: Analog modules and systems – Analog signal processing, multi-bit data processing, analog output application examples, PID principles, position indicator with PID control, PID modules, PID tuning, PID functions.

TEXT BOOKS:

1. Programmable Logic Controllers, W. Bolton, Elsevier, 5th edition, 2009.
2. Programmable Logic Controllers – Programming methods and Applications by J R Hackworth and F D Hackworth Jr - Pearson Publications , 5th edition, 2004.

REFERENCE BOOK:

1. Programmable Logic Controllers – Principles and Applications by John W Webb and Ronald A Reiss – Fifth edition – PHI, 1998.

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MALLA REDDY ENGINEERING COLLEGE
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M.Tech (Control Engineering) I Semester

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TRANSDUCERS AND DATA ACQUISTION SYSTEMS
(Elective-I)

Objective: To impart knowledge on different types of electrical transducers, feedback and data acquisition system and telemetry measuring instruments.

UNIT-I PASSIVE ELECTRICAL TRANSDUCERS

Resistive Transducers - Resistance Thermometers - Hot wire resistance Transducers - Resistive displacement Transducers - Resistive strain Transducers - Resistive magnetic flux Transducers - Resistive optical radiation Transducers - Inductive Thickness Transducers - Inductive displacement Transducers - Capacitive Thickness Transducers - Capacitive displacement Transducers**.**

UNIT-II ACTIVE ELECTRICAL TRANSDUCERS

Thermoelectric Transducers - Piezo electric phenomenon - Piezo electric materials - Piezo electric torque Transducers - Piezo electric Acceleration transducers - Magnetostrictive phenomenon - Magnetostrictive Acceleration transducers - Hall effect Transducers - Tachometers - variable reluctance tachometers - Electromagnetic Flow meter. Photoelectric phenomenon - photoconductive and photovoltaic Transducers - Photo emissive Transducers - Ionization vacuum gauges - Ionization displacement Transducers – Digital displacement Transducers - Digital Tachometers - Electromechanical Transducers.

UNIT-III FEEDBACK TRANSDUCER SYSTEMS

Feedback fundamentals - Inverse Transducers - Temperature balance system - self - balancing potentiometers - self - balancing bridges – servo - operated manometer - Feedback pneumatic load cell - servo - operated electromagnetic flow meter - feedback accelerometer system - Non - contact position measurement.

UNIT-IV DATA ACQUISITION SYSTEMS

General configurations - single and multichannel DAS - A/D converters (successive approximation and dual slope integration) - sample and hold circuits – Anti alias filters - multiplexers and de-multiplexers - Digital multiplexers.

UNIT-V DATA TRANSMISSION, TELEMETRY AND DISPLAY

Characteristics of a Telemetry system - landline telemetry - radio telemetry - frequency division multiplexing - time division multiplexing. Data Display and recording systems. Data loggers - Analog indicators - Digital Readout systems - analog recorders - magnetic tape recorders - direct recording - frequency modulation recording - digital recording technique - floppy discs.

TEXT BOOKS:

1. Transducers & Instrumentation- D.V.S.Murthy,- Prentice Hall of India Pvt. Ltd., First edition –1995.
2. Electrical and Electronic Measurements and Instrumentation,- R. K. Rajput, S. Chand & Company Ltd, 2012.

REFERENCE BOOK:

1. Instrumentation Devices &Systems - C. S. Rangan - G. R. Sarma - V. S. V. Mani, TMH - 2nd edition – 2003

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PROCESS MODELING AND SIMULATION
(Elective-I)

Objective: To impart knowledge on overview of modeling, steady state and dynamic model of process models, its control strategies and distributed parameter models.

UNIT- I INTRODUCTION TO MODELING

Introduction to modeling, a systematic approach to model building, classification of models. Conservation principles, thermodynamic principles of process systems.

UNIT-II STEADY STATE AND DYNAMIC MODELS OF PROCESS SYSTEMS-I

Development of steady state and dynamic lumped and distributed parameter models based on first principles. Analysis of ill-conditioned systems.

UNIT–III STEADY STATE AND DYNAMIC MODELS OF PROCESS SYSTEMS-II

Development of grey box models. Empirical model building. Statistical model calibration and validation. Population balance models. Examples.

UNIT-IV SOLUTION STRATEGIES FOR LUMPED PARAMETER MODELS

Solution strategies for lumped parameter models. Stiff differential equations. Solution methods for initial value and boundary value problems. Euler's method. R-K method, shooting method, finite difference methods. Solving the problems using MATLAB.

UNIT-V SOLUTION STRATEGIES FOR DISTRIBUTED PARAMETER MODELS

Solution strategies for distributed parameter models. Solving parabolic, elliptic and hyperbolic partial differential equations. Finite element and finite volume methods.

TEXT BOOK:

1. K. M. Hangos and I. T. Cameron, "Process Modeling and Model, 2001.

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EMBEDDED SYSTEMS DESIGN
(Elective-II)

Objective: To impart knowledge on software developments and its applications of embedded system, process and memory organization, device networks, programming and hardware.

UNIT –I Introduction to Embedded Systems
Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

UNIT –II Typical Embedded System
Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

UNIT –III Embedded Firmware
Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

UNIT –IV RTOS Based Embedded System Design
Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

UNIT –V Task Communication
Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.

TEXT BOOKS:

1. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.

.

REFERENCE BOOKS:

1. Embedded Systems - Raj Kamal, TMH.
2. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill
3. Embedded Systems – Lyla, Pearson, 2013
4. An Embedded Software Primer - David E. Simon, Pearson Education.

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ROBOTICS AND CONTROL
(Elective-II)

Objective: To impart knowledge on spatial transformations, kinematics, manipulators, non-linear dynamics and its force control.

UNIT-I SPATIAL DESCRIPTIONS AND TRANSFORMATIONS

Introduction - Descriptions: positions, orientations and frames -Mappings: Changing descriptions from frame to frame - Operators: translations, rotations, transformations, Transformation arithmetic - Transform equations – More on representation of orientation - Transformation of free vectors - Computational considerations.

Manipulator Kinematics Introduction - Link description - Link connection description – convention for affixing frames to links - Manipulator kinematics -Actuator space, Joint space and Cartesian space-Examples: Kinematics of two industrial robots-Computational considerations

UNIT-II INVERSE MANIPULATOR KINEMATICS

Introduction – Solvability -The notation of manipulator subspace when n<6 -Algebraic Vs. Geometric- Algebraic solution by reduction to polynomial - Pieper's solution when three axes intersect -Examples of inverse manipulator kinematics –The standard frames -solving a manipulator -Repeatability and accuracy –Computational considerations.

Jacobians: Velocities and Static Forces: Introduction- Notation for time varying position and orientation -Linear and Rotation of velocity of rigid bodies -More on angular velocity - Motion of the links of a Robot -Velocity " propagation" from link to link – Jacobians – Singularities- Static forces in Manipulators -Jacobians in the force domain - Cartesian transformation of velocities and static forces.

UNIT-III MANIPULATOR DYNAMICS

Introduction, Acceleration of a rigid body, Mass distribution, Newton's Equation, Euler's equation, Iterative Newton – Euler dynamic formulation, Iterative Vs. Closed form, An example of closed form dynamic equations, The structure of the Manipulator dynamic equations, Lagrangian Formulation of manipulator Dynamics, Formulating manipulator dynamics in Cartesian space, Computational considerations. **:** Linear Control of Manipulators: Introduction, Feedback and closed loop control, Second order linear systems, Control of second order systems, Control law partitioning – Trajectory, Following control, Disturbance rejection, Continuous Vs. Discrete time control, Modeling and control of a single joint, Architecture of industrial robot controller.

UNIT-IV NON - LINEAR CONTROL OF MANIPULATORS

Introduction, Nonlinear and time, varying systems, multi - input, Multi-output control systems, the control problem for manipulators, Practical considerations, Present industrial robot control systems, Lyapunov stability analysis, Cartesian based control systems - adaptive control.

UNIT-V FORCE CONTROL OF MANIPULATOR

Introduction - Application of Industrial robots to assembly tasks - A frame work for control in partially constrained tasks - The hybrid position/force control problem - Force control of a mass - spring - The hybrid position / force control scheme - Present industrial robot control scheme.

TEXT BOOKS:

1. Introduction to Robotics -J. J. Craig, Addison Wesley, 1986.
2. Robot modeling and Control -Mark W. Sponge, Sethhutchinson and M. Vidyasagar, Wiley student Edition, 2006.

REFERENCE BOOKS:

1. Foundations of Robotics –Analysis and Control, Tsuneo Yoshikawa, Eatern economy Edition, 1990
2. Robust Tracking Control of Robot Manipulators, Znihua Qu and Drasen M Dawson, IEEE Press, 1996.
3. Adaptive Control of Mechanical Manipulators -J. J. Craig, Addison Wesley, Reading MA, 1988.

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MICROCONTROLLERS AND APPLICATIONS
(Elective-II)

Objective: To develop an in-depth understanding of the operation of microprocessors and microcontrollers, machine language programming & interfacing techniques.

UNIT-I OVERVIEW OF ARCHITECTURE & MICROCONTROLLER RESOURCES
Architecture of a microcontroller – Microcontroller resources – Resources in advanced and next generation microcontrollers – 8051 microcontroller – Internal and External memories – Counters and Timers – Synchronous serial-cum asynchronous serial communication - Interrupts.

UNIT-II 8051- MICROCONTROLLERS INSTRUCTION SET
Basic assembly language programming – Data transfer instructions – Data and Bit-manipulation instructions – Arithmetic instructions – Instructions for Logical operations on the test among the Registers, Internal RAM, and SFRs – Program flow control instructions – Interrupt control flow.

UNIT-III REAL TIME CONTROL
Interrupts: Interrupt handling structure of an MCU – Interrupt Latency and Interrupt deadline – Multiple sources of the interrupts – Non-maskable interrupt sources – Enabling or disabling of the sources – Polling to determine the interrupt source and assignment of the priorities among them – Interrupt structure in Intel 8051.
Timers: Programmable Timers in the MCU's – Free running counter and real time control – Interrupt interval and density constraints.

UNIT-IV SYSTEMS DESIGN
Digital and Analog Interfacing Methods: Switch, Keypad and Keyboard interfacings – LED and Array of LEDs – Keyboard-cum-Display controller (8279) – Alphanumeric Devices – Display Systems and its interfaces – Printer interfaces – Programmable instruments interface using IEEE 488 Bus – Interfacing with the Flash Memory – Interfaces – Interfacing to High Power Devices – Analog input interfacing – Analog output interfacing – Optical motor shaft encoders – Industrial control – Industrial process control system – Prototype MCU based Measuring instruments – Robotics and Embedded control – Digital Signal Processing and digital filters.

UNIT-V REAL TIME OPERATING SYSTEM FOR MICROCONTROLLERS
Real Time operating system – RTOS of Keil (RTX51) – Use of RTOS in Design – Software development tools for Microcontrollers.
16-Bit Microcontrollers: Hardware – Memory map in Intel 80196 family MCU system – IO ports – Programmable Timers and High-speed outputs and input captures – Interrupts – instructions.
ARM 32 Bit MCUs: Introduction to 16/32 Bit processors – ARM architecture and organization – ARM / Thumb programming model – ARM / Thumb instruction set –Development-tools.

TEXT BOOKS:
1. Raj Kamal," Microcontrollers Architecture, Programming, Interfacing and System Design"–Pearson Education, 2005.
2. Mazidi and Mazidi, "The 8051 Microcontroller and Embedded Systems" – PHI, 2000.

REFERENCE BOOKS:
1. "Microcontrollers (Theory & Applications)" -A.V. Deshmuk,– WTMH, 2005.
2. "Design with PIC Microcontrollers"-John B. Peatman, – Pearson Education, 2005.

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CONTROL ENGINEERING AND SIMULATION LAB

Any ten experiments from the following can be conducted:

PART-1(any 5 experiments)

1. Determinations of Transfer function of DC motor.
2. Time Response Characteristics of a Second order System (Typical RLC network).
3. Characteristics of Synchros:
   (a) Synchro transmitter characteristics.
   (b) Implementation of error detector using synchro pair.
4. Determination of Magnetic Amplifier Characteristics with different possible connections.
5. Process Control Simulator:
   a) Determination of the time constant and transfer function of first order process.
   b) Determination of the time response of closed loop second order process with Proportional Control.
   c) Determination of the time response of closed loop second order process with Proportional-Integral Control.
   d) Determination of the time response of closed loop second order process with Proportional-Integral-Derivative Control.
   (e) Determination of the effect of disturbances on a process.
6. To study the compensation of the second order process by using:
   a) Lead Compensator.
   b) Lag Compensator.
   c) Lead- Lag Compensator
7. Realization of AND, OR, NOT gates, other derived gates and ladder logic on Programmable Logic Controller with computer interfacing.

PART-2(any 5 experiments)

1. Determination of AC servomotor Characteristics.
2. Study the position control of DC servomotor with P, PI control actions.
3. Study of Temperature controller using PID
4. Linear System Analysis (Time domain analysis, error analysis) using MATLAB
5. Stability analysis (Bode, Root Locus, Nyquist) of Linear Time Invariant system using MATLAB.
6. State space model for classical transfer function using MATLAB-Verification.
7. Microprocessor based stepper motor control.
8. Transfer function of DC generator.

TEXT BOOK:

1. MATLAB basics and its tool books user's manual and –Mathworks, USA, 2005.

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OPTIMAL CONTROL THEORY

Objective: To impart knowledge on basics of optimal control, discrete linear regulator problems, pontrygin's minimum principle, noise statistics and estimations.

UNIT-I BASICS

Optimal control law, the principal of optimality, application of their optimality principle to decision making, an optimal control system. Recurrence relation of dynamic programming, computational procedure for solving control problem, characteristics of dynamic programming solution.

UNIT-II DISCRETER LINEAR REGULATOR PROBLEM

Discrete linear regulator problem. Hamilton –Jacobi-bellman equation. Continuous linear regulator problems, necessary and sufficient conditions examples. The calculus of variations & Pontrygin's minimum principle**:** Fundamental concepts, functional of a single function, functional involving several independent functions, necessary conditions for optimal control, linear regulator problem.

UNIT-III PONTRYGIN'S MINIMUM PRINCIPLE

Pontrygin's minimum principle and state inequality constrains, minimum time problems, minimum control effort problems. Iterative numerical techniques for finding optimal controls and trajectories**, t**wo point boundary value problems, method of steepest descent algorithm, variation of extremalas, variation of extremal algorithm, gradient projection algorithm

UNT-IV DESIGN OF ESTIMATOR

The nature of the state estimation problem, non-statistical estimation design with full estimator dimension, non-statistical estimation with reduced estimator design.

UNIT-V NOISE STATISTICS

Description of plants noise statistics, statement of optimal estimation problem, information of the optimal estimation problem as an optimal regulator problem, solution to the regulator problem in feedback form, explicit solution of the optimal estimation problem.

TEXT BOOKS:

1. Introduction to Optimum Design, Jasbir S. Arora, Elesevier, 2005.
2. Engineering Optimization Methods and Applications, A Ravindran, K.M. Ragsdell, and G.V. Reklaitis, Wiley India Edition, 2002.
3. Optimal Control Theory an Introduction, Donald E.Kirk, Prentice - Hall Network series - First edition, 1970.

REFERENCE BOOKS:

1. D.S. Naidu, Optimal Control Systems, CRC Press, First edition, 2002.
2. Arturo Locatelli, Optimal Control: An Introduction, Birkhauser Verlag, 2001.
3. Systems and Controll, S.H.Zak, Indian Edition , Oxford University, 2003.
4. An introduction to continuous optimization, Niclas Anreasson, Anton Evgrafov and Michael Patriksson, , Overseas Press (India) Pvt. Ltd 2nd ,2000.
5. Optimal Control Systems-A.P. Sage, 2001
6. Optimal Theory and Application, .S.S.Rao-eastern Willy- First edition, 1998.

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ADAPTIVE CONTROL THEORY

Objective: To impart knowledge on basics of adaptive control, different types of adaptive control, mathematical expressions, self-tuning regulators, case studies and non-linear systems.

UNIT-I BASICS

Introduction - use of Adaptive control - definitions - essential aspects – classification – Model Reference Adaptive Systems - different configurations - classification - mathematical description - Equivalent representation as a nonlinear time varying system - direct and indirect MRAC.

UNIT-II CONTINUOUS TIME MRAC SYSTEMS

Continuous time MRAC systems - Model Reference Adaptive System Design based on Gradient method, Design of stable adaptive controllers based on Kalman - Meyer - Yakubovich Lemma, Lyapunov theory, Hyper stability theory - Narendra's error model approach. Discrete time MRAC systems - Hyper stability approach - Narendra's error model approach - Introduction - stability theorem - Relation to other algorithms - hybrid adaptive control.

UNIT-III SELF TUNING REGULATORS

Self Tuning Regulators (STR) - different approaches to self tuning - Recursive parameter estimation - implicit STR - Explicit STR. hybrid STR, hybrid predictor design and algorithms. STR design based on pole - placement technique and LQG theory - Gain scheduling. - Stability of adaptive control algorithms.

UNIT-IV ADAPTIVE CONTROL OF NONLINEAR SYSTEMS

Adaptive control of nonlinear systems - Adaptive predictive control - Robustness of adaptive control systems - Instability phenomena in adaptive systems. Concept of learning control systems. Different types of learning control schemes. LTI, learning control via parameter estimation schemes. Convergence of learning control. Fuzzy logic adaptive control stochastic adaptive control –multi decision problems-dual control.

UNIT-V CASE STUDY

Case Studies: Robotic manipulators, Aerodynamic curve identification, Electric drives, Satellite altitude control, regulators, power system, electrical generator.

TEXT BOOKS:

1. Adaptive control,-K.J.Astrom and Bjorn Witten mark, Pearson Edu., 2nd Edition,1989.
2. Adaptive Control, Sankar Sastry, 2011.

REFERENCE BOOKS:

1. Adaptive Control System - Techniques & Applications, V.V.Chalam, Marcel Dekker Inc,1987.
2. Adaptive Control Systems- Miskhin and Braun, MC Graw Hill
3. Adaptive Control, Filtering and Signal Processing,-Karl Johan Åström, Graham Clifford Goodwin, P. R. Kumar, 1961.
4. Control- G.C. Goodwin, Adaptive
5. Stable Adaptive Systems - Narendra and Anna Swamy,1980.

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NEURAL NETWORKS AND FUZZY SYSTEMS

Objective: To impart knowledge on basics of neural networks and essentials of artificial neural networks with single layer and multi-layer feed forward networks. Also deals with associate memories and introduces fuzzy sets and fuzzy logic system components.

UNIT-I OVERVIEW

Biological neuron Vs artificial neuron, structure and activation functions – Neural network architectures –learning methods, stability and convergence. Single layer networks –Mcculloh–pitts neuron model, Perceptron training and algorithm, delta learning, widrow-Hoff learning rules, limitations, adaline and modification.

UNIT-II MULTILAYER NETWORKS -I

Multilayer networks, architectures and modeling, BP algorithm, radial basis functions. Unsupervised learning-Winner all learning, out star learning, Counter propagation networks, self organizing networks-Kohonen.

UNIT-III MULTILAYER NETWORKS –II AND BASICS OF FUZZY LOGIC SYSTEMS

Grossberg, Hamming NET, MAXNET, Hopfield networks, recurrent and associative memory, BAM and ART architectures Fuzzy sets and systems – geometry of fuzzy sets – theorems – fuzzy and neural function estimators – FAM system architectures – Uncertainty and estimation – Types of uncertainty.

UNIT-IV MEASURES OF FUZZINESS

Measures of Fuzziness – Classical measures of uncertainty – measures of Dissonance – confession specificity – knowledge base defuzzification.

UNIT-V AI APPLICATIONS

Application to load forecasting, load flow, fault detection-unit commitments, LF control – economic dispatch, Neuro-Fuzzy controllers.

TEXTBOOKS:

1. Artificial neural networks – B.Yegna Narayana –PHI -1st edition 1999.
2. Neural networks – Simon Haykin – Prentice Hall International inc.1999.

REFERENCE BOOKS:

1. Neural networks and fuzzy system – Bart Kosko – 2nd edition, 2001.
2. Neural Network Fundamentals with Graphs, Algorithms & Applications – N.K.Bose and Liang –McGraw hill, 1996.
3. Fuzzy Logic with Fuzzy Applications – T.J.Rosee-Mcgraw Hill Inc .1997.
4. Fuzzy Logic and Neural Networks- M. Amirthavalli, Scitech Publications India Pvt. Ltd.

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CONTROL SYSTEM DESIGN

Objective: To impart knowledge on basics of synthesis and SISO, MIMO controllers with design and its analysis with disturbances, affine parameterization and model predictive controllers with examples.

UNIT-I SYNTHESIS OF SISO CONTROLLERS AND ARCHITECTURAL ISSUES IN SISO CONTROL
Polynomial approach, PI and PID synthesis revisited by using pole assignment, Smith predictor

UNIT- II MODELS FOR DETERMINISTIC DISTURBANCES AND REFERENCES
Internal Model principle for disturbance and for reference tracking, feed forward control-cascade control, dealing with Constraints and SISO Controllers Parameterizations: windup, anti windup scheme, state saturation, introduction to model predictive control, preview-open loop inversion revisited.

UNIT-III AFFINE PARAMETERIZATION
The stable case PID synthesis by using the affine paramertization, affine parametization for systems having time delays, undesirable closed loop poles, affine parameterization: the unstable open loop case. Analysis of MIMO control loops: Preview –motivational examples, models for multi variable systems, the basic MIMO control loop.

UNIT-IV CLOSED LOOP STABILITY
Steady state response for steps inputs, frequency domain analysis, Robustness issues-problems, Exploring SISO Techniques in MOMO control: preview-completely decentralized control, pairing of inputs and outputs, robustness issues in decentralized control, feed forward action in decentralized control, converting MIMO problems to SISO problems, Industrial case study (Strip flatness control).

UNIT-V MODEL PREDICTIVE CONTROL
Preview-anti windup-revisited-what is model predictive control –stability-linear models with quadratic cost function-state estimation and disturbance prediction.

TEXT BOOKS:

1. MATLAB Control System toolbox manual, 2000.
2. Control System Design – Graham C Good win-Stefan F.Graebe Mario E.Salgado-Pearson Publications-3rd edition ,2003.

REFERENCE BOOK:

1. Computer Aided Design of Control Systems - Resenbrock (Academic press),2002.

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NON LINEAR SYSTEMS
(Elective-III)

Objective: To impart knowledge on stability analysis for non-linear systems which includes describing function, phae-plane and etc, different special controllers.

UNIT-I PHASE PLANE ANALYSIS

Phase portraits, Singular points characterization. Analysis of non – linear systems using phase plane technique. Existence of limit cycles. Linearization: Exact linearization, input - state linearization, input - output linearization.

UNIT-II LINEAR VERSUS NONLINEAR SYSTEMS

Linear versus nonlinear systems - Describing function analysis: Fundamentals, common nonlinearities (saturation, dead - zone, on - off non - linearity, backlash, hysteresis) and their describing functions. Describing function analysis of nonlinear systems. Reliability of describing method analysis. Compensation and design of nonlinear system using describing function method.

UNIT-III LYAPUNOV STABILITY THEORY

Concept of stability, stability in the sense of Lyapunov and absolute stability. Zero - input and BIBO stability. Second (or direct) method of Lyapunov stability theory for continuous and discrete time systems.Aizerman's and Kalman's conjecture. Construction of Lyapunov function – Methods of Aizerman, Zubov, Variable gradient method. Lure problem.

UNIT-IV POPOV'S STABILITY CRITERION

Popov's stability criterion, generalized circle criterion, Kalman - Yakubovich - Popov Lemma. Popov's hyperstability theorem.

UNIT-V CONCEPT OF VARIABLE AND NON-LINEAR SYSTEM EXAMPLES

Concept of variable - structure controller and sliding control, reaching condition and reaching mode, implementation of switching control laws. Reduction of chattering in sliding and steady state mode. Some design examples of nonlinear systems such as the ball and beam, flight control, magnetic levitation and robotic manipulator etc.

TEXT BOOKS:

1. Applied Nonlinear Control, J. E. Slotine and Weiping LI, Prentice Hall, 1991
2. Nonlinear Systems, Hassan K. Khalil, Prentice Hall, 1996

REFERENCE BOOKS:

1. Nonlinear Systems Analysis, Stability and Control - Sankar Sastry,1999.
2. Nonlinear Systems Analysis, Prentice -, M. Vidyasagar, Hall International editions 1993.

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DISTRIBUTED CONTROL SYSTEMS
(Elective-III)

Objective: To impart knowledge on basics of distributed control systems, examples and open loop and closed loop systems, fault tolerance and risk management systems.

UNIT-I ARCHITECTURE

Architecture of computer control systems- controlled architecture-Distributed control architecture Data Highway system.

UNIT-II DISTRIBUTED COMPUTING SYSTEM

Distributed Computing System: Distributed processing, Digital control system- computer control, self tuning and adaptive algorithms Supervising Control systems, multi layer hierarchical structure, system decomposition, open loop co-ordination strategies, model reality differences.

UNIT-III CLOSED LOOP CO-ORDINATE STRATEGIES

Closed loop co-ordinate strategies, integrated system, Optimization of parameter (ISOPE), double interactive systems.
Real time control systems: Design techniques and tools-MASCOT, Structured development of real time system.

UNIT-IV FAULT TOLERANCE AND EXPERT SYSTEM

Fault tolerance in mixed hardware-software systems- fault detection, measures-fault detection mechanism-Damage confident and assessment.
Expert system in real time control-Knowledge based process management, Representation of knowledge, reasoning in real time, application of knowledge based systems for process management.

UNIT-V REAL TIME TASK MANAGEMENT

Real time task management, Task scheduling, dispatch, task co-operations and communications, distributed data, distributed control.

TEXT BOOK:

1. Distributed Computer control systems - SS Lamba, Y D Singh, TMH publications, New Delhi,2008.

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PROCESS DYNAMICS AND CONTROL
(Elective-III)

Objective: To impart knowledge on introduction to process control. Development of transfer function, closed loop systems, feedback systems etc.

UNIT-I BASICS OF PROCESS CONTROL

Introduction to Process Control, Illustrative Example, Classification of Control Strategies, Process Control and Block Diagrams, Control and Modeling Philosophies, Dynamic versus Steady – state Models, General Modeling Principles, Models of Several Representative Processes, Solution of Dynamic Models and the Use of Digital Simulators.

UNIT-II DEVELOPMENT OF A TRANSFER FUNCTION

Development of a Transfer Function, Linearization of Nonlinear Models, Response of Integrating Process Units, Poles and Zeros and their Effect on System response, Time Delays, Approximation of Higher - Order Systems, Interacting and Non interacting Processes, Transfer function Models for Distributed Systems, Multiple - Input, Multiple - Output (MIMO) Processes.

UNIT-III FEEDBACK CONTROLLERS

Feedback Controllers Stirred - Tank Heater Example, Controllers, and Digital Versions of PID Controllers, Transducers and Transmitters, Final Control Elements, Accuracy in Instrumentation.

Block Diagram Representation, Closed - Loop Transfer functions, Closed - Loop Responses of Simple Control Systems, General Stability Criterion, Routh-Stability Criterion for time delay systems, Direct Substitution method, Root Locus Diagrams.

UNIT-IV CLOSED LOOP SYSTEMS SYNTHESIS

Performance Criteria for Closed - Loop Systems, Direct Synthesis Method, Internal Model Control, Design Relations for PID Controllers, Comparison of Controller Design Relations. Guidelines for Common Control Loops, Trial and Error Tuning, Continuous Cycling Method, Process Reaction Curve Method, troubleshooting Control Loops.

UNIT-V FEED FORWARD AND MULTIVARIABLE CONTROL TECHNIQUES

Introduction to feed forward Control, Ratio Control, and Feed forward Controller Design based on Steady - State Models, Controller Design based on Dynamic Models, Tuning Feed forward Controllers, Configurations for Feed forward - Feedback Control. Process Interactions and Control Loop Interactions, Pairing of Controlled and Manipulated Variables, Strategies for Reducing Control Loop Interactions, Decoupling Control Systems, Multivariable Control Techniques.

TEXT BOOKS:

1. Process Dynamics and Control - Dale E. Seborg, University of California, Santa Barbara, Thomas F. Edgar, University of Texas at Austin, Duncan A. Mellichamp, University of California, Santa Barbara, , John Wiley & Sons, 1989.
2. Process Dynamics and Control - Dale E. Seborg, University of California, Santa Barbara, Thomas F. Edgar, University of Texas at Austin, Duncan A. Mellichamp, University of California, Santa Barbara, John Wiley & Sons, 2nd Edition, 2004.

REFERENCE BOOKS:

1. Process Dynamics and Control Modeling for Control and Prediction - Brian Roffel, Ben Betlem, , John Wiley & Sons Ltd., 2007.

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ADVANCED DIGITAL SIGNAL PROCESSING
(Elective-IV)

Objective: To impart knowledge on digital filter structures, filter design and DSP algorithm and finite word length effects and power spectrum applications.

UNIT–I DIGITAL FILTER STRUCTURES

Block diagram representation – Equivalent Structures – FIR and IIR digital filter Structures AII pass Filters-tunable IIR Digital Sine-cosine generator- Computational complexity of digital filter structures.

UNIT-II DIGITAL FILTER DESIGN

Preliminary considerations- Bilinear transformation method of IIR filter design –design of Low pass high pass – Band pass, and Band stop- IIR digital filters – Spectral transformations of IIR filters – FIR filter design –based on Windowed Fourier series – design of FIR digital filters with least – mean square-error – constrained Least –square design of FIR digital filters.

UNIT-III DSP ALGORITHM IMPLEMENTATION

Computation of the discrete Fourier transform- Number representation – Arithmetic operations – handling of overflow – Tunable digital filters – function approximation.

UNIT-IV ANALYSIS OF FINITE WORD LENGTH EFFECTS

The Quantization process and errors- Quantization of fixed –point and floating –point Numbers – Analysis of coefficient Quantization effects – Analysis of Arithmetic Round-off errors- Dynamic range scaling – signal –to- noise in Low –order IIR filters- Low –Sensitivity Digital filter – Reduction of Product round-off errors feedback – Limit cycles in IIR digital filter – Round – off errors in FFT Algorithms.

UNIT-V POWER SPECTRUM ESTIMATION

Estimation of spectra from Finite Duration Observations signals- Non-parametric methods for power spectrum Estimation- parametric method for power spectrum Estimation- Estimation of spectral form-Finite duration observation of signals- Nonparametric methods for power spectrum estimation – Walsh methods – Blackman and torchy method.

TEXT BOOKS:

1. Digital Signal Processing –sanjit K. Mitra – TMH second edition
2. Discrete Time Signal Processing – Alan V. Oppenheim, Ronald W, Shafer – PHI 1996 1ST Edition reprint

REFERENCE BOOKS:

1. Digital Signal Processing principles – algorithms and Applications- john G. Proakis – PHI – 3RD edition 2002.
2. Digital Signal Processing – S Salivahanan. A. Vallavaraj C. Gnanapriya – TMH – 2nd reprint 2001.
3. Theory and Applications of Digital Signal Processing –Lourens R Rebinarand Bernold,1999.
4. Digital Filter Analysis and Design - Auntoniam – TMH,2002.

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REAL TIME SYSTEMS
(Elective-IV)

Objective: To impart knowledge on real-time system basics, complex DES representations, temporal logic, multi-tasking and its examples.

UNIT-I INTRODUCTION TO REAL - TIME SYSTEMS

Introduction to Real - time systems: Typical examples of RTS, Characteristic features of RT applications. Structural, Functional and Performance requirement of Reactive RTS. Distinctive features from Non - RT and Off - line system. Modeling RTS: Representation of time, Concurrency and Distributedness in discrete event systems.

UNIT-II HIERARCHICAL REPRESENTATION OF COMPLEX DES

Hierarchical representation of complex DES. Input, Output and Communication. Examples of modeling practical systems as RT DES. Modeling programs as RTS. Analyzing RTS: Analyzing logical properties of DES such as Reach ability, Deadlock etc. Analyzing timing related properties, Specification and Verification of RT DES properties.

UNIT-III REAL – TIME OPERATING SYSTEMS EXAMPLES

Temporal logic, Model checking. Example of checking safety and timing properties of industrial systems. Requirements and features of real - time Computing Environments: Real – time Operating Systems, Interrupts, clock, Device support.

UNIT-IV RTO PROGRAMMING

Real time System, Multi tasking, Static and Dynamical Scheduling of resource Allocation, Real - time Programming.

UNIT-V APPLICATIONS

Real - time process and applications, Distributed Real - time systems.

TEXTBOOK:

1. Real- Time Systems- Jane W S Liu -Pearson publisher, 1st edition, 1997.

REFERENCE BOOK:

1. Real-Time Systems-Theory and Practice, Computer Science,Engineering and Computer Science, Higher Education,Rajib Mall, Pearson Education, India, 2002.

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INTELLIGENT AND KNOWLEDGE BASED SYSTEMS
(Elective - IV)

Objective: To impart knowledge on problem solving, expert systems and knowledge base systems and its case studies**.**

UNIT-I PROBLEM SOLVING

Problem solving: State space representation, problem reduction, constraint satisfaction networks. Heuristics. Knowledge Representation, Predicate calculus, resolution-refutation, Prolog.

UNIT-II RULE BASED SYSTEMS

Rule based systems: forward and backward chaining. Handling of uncertainty: probabilistic techniques, fuzzy logic. Reasoning with incomplete information: non monotonic reasoning. Elements of temporal logic.

UNIT-III STRUCTURED KNOWLEDGE REPRESENTATION SCHEMES

Structured Knowledge Representation schemes: Semantic Networks, Frames, Inheritance and default reasoning. Description Logic.

UNIT-IV EXPERT SYSTEMS

Expert Systems: Architecture of the expert systems. Expert system shells. Knowledge acquisition. Consistency of the knowledge base, Planning.

UNIT-V CASE STUDIES

Case studies, Distributed AI and agent based systems

NATIONAL/INTERNATIONAL JOURNALS:

1. Pratihar D.K., Jain L.C., An introduction to intelligent autonomous systems, Intelligent Autonomous Systems: Foundation and Applications, edited by D.K. Pratihar, L.C. Jain,Springer-Verlag, Germany, pp. 1-4, 2010.

2. Hui N.B., Pratihar D.K., Design and development of intelligent autonomous robots, Intelligent Autonomous Systems: Foundation and Applications, edited by D.K. Pratihar, L.C. Jain, Springer-Verlag, Germany, pp. 29-56, 2010.

3. Vundavilli P.R., Pratihar D.K., Gait planning of biped robots using soft computing: an attempt to incorporate intelligence, Intelligent Autonomous Systems: Foundation and Applications, edited by D.K. Pratihar, L.C. Jain, Springer-Verlag, Germany, pp. 57-85, 2010.

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SIGNAL PROCESSING LAB

1. Study of the architecture of DSP chips – TMS 320C 5X/6X Instructions.
2. Verification of verify linear convolution.
3. Verification the circular convolution.
4. Design FIR filter (LP/HP) using windowing technique
   a) rectangular window
   b) triangular window
   c) Kaiser window
5. Implement IIR filter (LP/HP) on DSP Processors
6. Implement N-point FFT algorithm.
7. MATLAB program to generate sum of sinusoidal signals.
8. MATLAB program to find frequency response of analog LP/HP filters.
9. Compute power density spectrum of a sequence.
10. Find the FFT of given 1-D signal and plot.

TEXT BOOKS:

1. Digital signal processing-Sanjit K.Mitra-TMH second edition
2. Discrete time signal processing – LA N V.OPPHENHEIM, RONALD W.Shafer-PHI 1996 1st edition reprint

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1. Digital signal processing principles – algorithms and applications-John G.Proakis-PHI-3rd edition, 2002.