ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS

M.TECH
CONTROL ENGINEERING / CONTROL SYSTEMS

(Applicable for the batches admitted from 2013-14)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
KUKATPALLY, HYDERABAD – 500 085.

ACADEMIC REGULATIONS R13 FOR M. TECH. (REGULAR) DEGREE COURSE

Applicable for the students of M. Tech. (Regular) Course from the Academic Year 2013-14 and onwards

The M. Tech. Degree of Jawaharlal Nehru Technological University Hyderabad shall be conferred on candidates who are admitted to the program and who fulfil all the requirements for the award of the Degree.

1.0 ELIGIBILITY FOR ADMISSIONS

Admission to the above program shall be made subject to eligibility, qualification and specialization as prescribed by the University from time to time.

Admissions shall be made on the basis of merit/rank obtained by the candidates at the qualifying Entrance Test conducted by the University or on the basis of any other order of merit as approved by the University, subject to reservations as laid down by the Govt. 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 A. COURSES OF STUDY

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

1. Advanced Manufacturing Systems
2. Aerospace Engineering/ Aeronautical Engineering
3. Automation
4. Biomedical Signal Processing and Instrumentation
5. Bio-Technology
6. CAD/CAM
7. Chemical Engineering
8. Communication Systems
9. Computer Networks
10. Computer Networks and Information Security
11. Computer Science
12. Computer Science and Engineering
13. Computers and Communication Engineering.
14. Construction Management
15. Control Engineering
16. Control Systems
17. Cyber Forensic / Cyber Security & Information Technology
18. Design for Manufacturing/ Design and Manufacturing
19. Digital Electronics and Communication Engineering.
20. Digital Electronics and Communication Systems
21. Digital Systems and Computer Electronics
22. Electrical Power Engineering
23. Electrical Power Systems
24. Electronics & Instrumentation

25. Electronics and Communication Engineering
26. Embedded Systems
27. Embedded Systems and VLSI Design
28. Energy Systems
29. Engineering Design
30. Environmental Engineering
31. Geoinformatics and Surveying Technology
32. Geotechnical Engineering.
33. Heating Ventilation & Air Conditioning.
34. Highway Engineering
35. Image Processing
36. Industrial Engineering and Management
37. Information Technology
38. Infrastructure Engineering
39. Machine Design
40. Mechatronics.
41. Microwave & Radar Engineering
42. Nano Technology
43. Neural Networks
44. Parallel Computing
45. Power and Industrial Drives
46. Power Electronics
47. Power Electronics and Electrical Drives
48. Power Engineering and Energy Systems
49. Power Plant Engineering & Energy Management
50. Power System Control and Automation
51. Power System with Emphasis H.V. Engineering / H.V. Engineering
52. Production Engineering.
53. Real Time Systems
54. Software Engineering
55. Structural Engineering
56. Systems & Signal Processing
57. Thermal Engineering.
58. Transportation Engineering
59. VLSI
60. VLSI and Embedded System/ Electronics Design Technology
61. VLSI Design
62. VLSI System Design
63. Web Technologies
64. Wireless and Mobile Communication

and any other course as approved by the University from time to time.

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

Civil Engg.	Construction Management Environmental Engineering Geoinformatics and Surveying Technology Geotechnical Engineering Highway Engineering Infrastructure Engineering Structural Engineering Transportation Engineering
EEE	Control Engineering Control Systems Electrical Power Engineering Electrical Power Systems Power and Industrial Drives Power Electronics Power Electronics and Electrical Drives Power Engineering and Energy Systems Power Plant Engineering & Energy Management Power System Control and Automation Power System with Emphasis H.V. Engineering / H.V. Engineering
ME	Advanced Manufacturing Systems Automation CAD/CAM Design for Manufacturing/ Design and Manufacturing Energy Systems Engineering Design Heating Ventilation & Air Conditioning Industrial Engineering and Management Machine Design Mechatronics. Power Plant Engineering & Energy Management Production Engineering Thermal Engineering.
ECE	Biomedical Signal Processing and Instrumentation Communication Systems Computers and Communication Engineering. Digital Electronics and Communication Engineering. Digital Electronics and Communication Systems Digital Systems and Computer Electronics Electronics & Instrumentation Electronics and Communication Engineering Embedded Systems Embedded Systems and VLSI Design

	Microwave & Radar Engineering Systems & Signal Processing VLSI VLSI and Embedded System/ Electronics Design Technology VLSI Design VLSI System Design Wireless and Mobile Communication
CSE	Computer Networks Computer Networks and Information Security Computer Science Computer Science and Engineering Cyber Forensic / Cyber Security & Information Technology Image Processing Information Technology Neural Networks Parallel Computing Real Time Systems Software Engineering Web Technologies
Aeronautical Engg.	Aerospace Engineering / Aeronautical Engineering
Bio-technology	Bio-Technology
Chemical Engg.	Chemical Engineering
Nano Technology	Nano Technology

4.0 ATTENDANCE

The programs are offered on a unit basis with each subject being considered 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 candidate shall put in a minimum required attendance at least in three (3) theory subjects in the present semester to get promoted to the next semester. In order to qualify for the award of the M. Tech. Degree, the candidate shall complete all the academic requirements of the subjects, as per the course structure.

4.8 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 practicals, 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 compulsory question (16 marks) which consists of four sub-questions and carries 4 marks each and Part B with 3 questions to be answered out of 5 questions each question for 8 marks. If any candidate is absent from any subject of a mid-term examination, an on-line test will be conducted for him by the University. The details of the Question Paper pattern for End Examination (Theory) is given below:

- The End semesters Examination will be conducted for 60 marks which consists of two parts viz. i).Part-A for 20 marks, ii). Part –B for 40 marks.
- Part-A is compulsory question where it consists of five questions one from each unit and carries four marks each. This will be treated as Question 1.
- Part-B consists of five Questions (numbered from 2 to 6) carries 8 marks each. Each of these questions is from one unit and may contain sub-questions. For each question there will be an "either" "or" choice (that means there will be two questions from each unit and the student should answer only one question)

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 In case the candidate secures less than the required attendance in any subject, he shall not be permitted to write the End Examination in that subject. He shall re-register the subject when next

offered.

5.8 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 on a topic approved by the Project Review Committee.

6.1 A Project Review Committee (PRC) shall be constituted with Principal as Chairperson, Heads of all the Departments offering the M. Tech. programs 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, both theory and practical.

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 approval. Only after obtaining the approval of the Departmental Academic Committee can the student initiate the Project work.

6.4 If a candidate wishes to change his supervisor or topic of the project, he can do so with the approval of the Departmental Academic Committee. However, the Departmental Academic Committee shall examine whether or not 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 Supervisor or topic as the case may be.

6.5 A candidate shall submit his 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 at the beginning of the II year and the duration of the project is 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 make an oral presentation before the PRC.

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

6.8 The thesis shall be adjudicated by one examiner selected by the University. For this, the Principal of the College shall submit a panel of 5 examiners, eminent in that field, with the help of the guide concerned and head of the department.

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

6.10 If the report of the examiner is favourable, 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. Unsatisfactory

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 shall retake the Viva-Voce examination only 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.

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 WITHHOLDING OF RESULTS

If the student has not paid the dues, if any, to the university or if any case of indiscipline is pending against him, the result of the student will be withheld and he will not be allowed into the next semester. His degree will 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 R13 academic regulations.

10. GENERAL

10.1 Wherever the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.

10.2 The academic regulation should be read as a whole for the purpose of any interpretation.

10.3 In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.

10.4 The University may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the University.

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 marks on 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 shall not 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 to the 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 his 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 case is 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 to award 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.

***

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.TECH - CONTROL ENGINEERING / CONTROL SYSTEMS

COURSE STRUCTURE AND SYLLABUS

I Year I Semester

Code	Group	Subject	L	P	Credits
		Advanced Control Systems	3	-	3
		Digital Control Systems	3	-	3
		State and Parameter Estimation Theory	3	-	3
		DSP Processor Architecture and Applications	3	-	3
	Elective-I	Programmable Logic Controllers and their Applications Advanced Instrumentation Systems Process Modeling and Simulation	3	-	3
	Elective-II	Embedded Systems Robotics and Control Advanced Microprocessors	3	-	3
	Lab	Control Engineering and Simulation lab	-	3	2
		Seminar	-	-	2
		Total Credits	18	3	22

I Year II Semester

Code	Group	Subject	L	P	Credits
		Optimal Control Theory	3	-	3
		Adaptive Control Theory	3	-	3
		Neural Networks & Fuzzy Systems	3	-	3
		Control System Design	3	-	3
	Elective-III	Non-linear Systems Distributed Control Systems Process Dynamics and Control	3	-	3
	Elective-IV	Advanced Digital Signal Processing Real Time Systems Intelligent and Knowledge Based Systems	3	-	3
	Lab	Signal Processing Lab	-	3	2
		Seminar	-	-	2
		Total Credits	18	3	22

II Year - I Semester

Code	Group	Subject	L	P	Credits
		Comprehensive Viva	-	-	2
		Project Seminar	-	3	2
		Project work	-	-	18
		Total Credits	-	3	22

II Year - II Semester

Code	Group	Subject	L	P	Credits
		Project work and Seminar	-	-	22
		Total Credits	-	-	22

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Control Sys. / Control Engg.)

ADVANCED CONTROL SYSTEMS

UNIT-I:

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 Eigenvector 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 blocs.

UNIT- IV:

Observability Matrices: 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 B. N. Sarkar, PHI Learning Private Limited.
2. Advanced Control Theory, Somanath Majhi, Cengage Learning.
3. Control System Engineering – I J Nagarath, M. Gopal – New Age International – 3rd edition.
4. Control Systems – N K Sinha – New Age International – 3rd edition.

REFERENCE BOOKS:

1. Automatic Control Systems – B C Kuo – PHI – 7th edition.
2. Modern Control Systems – Hsu and Meyer.
3. Modal Control theory and applications – Brian Porter & Roger Corssley.
4. Modern Control Engineering - K. Ogata – PHI – 3rd edition.
5. Modern Control Engineering, D. Roy Choudhury, PHI Learning Private Limited.
6. Automatic Control Systems, Kunche Sridhar, Kuo & Golnaraghi, Wiley India.
7. Modern Control Engineering, Yaduvir Singh, S. Janardhanan, Cengage Learning.
8. Modern Control Systems an Introduction, S. M. Tirupathi, Firewal Media.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Control Sys. / Control Engg.)

DIGITAL CONTROL SYSTEMS

UNIT – I:

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 in variant 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 Liapunov.

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 – Nyquits plot – Bode plot-G.M and P.M.

UNIT- IV:

Design: 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 Lagrance 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.
2. Digital Control Systems, V. I. George, C. P. Kurian, Cengage Learning.
3. Digital Control and State Variable Methods by M.Gopal, TMH.
4. Digital Control Engineering, M.Gopal

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.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Control Sys. / Control Engg.)

STATE AND PARAMETER ESTIMATION THEORY

UNIT – I:

Maximum likelihood method, Invariance of maximum likelihood estimator, Bayes cost methods:

Mean square error (Minimum error variance) method.

UNIT-II:

Uniform cost method, Absolute cost method, relationships of these estimators.

Linear minimum variance method, least square method, sequential estimation,

UNIT-III:

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:

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:

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

REFERENCE BOOKS:

1. J.L.Melsa, Decision and Estimation theory, International student Edition, Mc Graw Hill-Kogakusha(Chapters 8,9,10 & 11)
2. B.D.O.Anderson and J.B.Moore, Optimal filtering, Prentice- Hall.(Chapters 2,3& 7)
3. J.S. Meditch, Stochastic Optimal linear estimation and control, Mc Graw Hill, 1969.
4. Van Trees H.L., Detection, Estimation and Modulation Theory, Part 1&2 John Wiley sons, 1968/ 1971/1972.
5. Deutsch .R., Estimation Theory, Prentice Hall, 1965
6. Jazwinski.A.H. Stochastic processes& Filtering Theory, Academic press, 1970.
7. S.M.Bozic, Digital & Kalman Filtering, Edward Arnold Publishers Ltd., London.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Control Sys. / Control Engg.)

DSP PROCESSOR ARCHITECTURE 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 MATLAB,DSP using ATLAB.

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.
3. Digital filter analysis and design auntoniam-TMH.

REFERENCE BOOKS:

1. Digital signal processing-Sanjit K.Mitra-TMH second edition.
2. Discrete time signal processing – LAN V.OPPHENHEIM,RONALD W.Shafer-PHI 1996 1st edition reprint.
3. Digital signal processing principles – algorithms and applications-John G.Proakis-PHI-3rd edition2002.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Control Sys. / Control Engg.)

PROGRAMMABLE LOGIC CONTROLLERS AND THEIR APPLICATIONS

(Elective-I)

UNIT-I:

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:

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:

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 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 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.
2. Programmable Logic Controllers – Programming methods and Applications by J R Hackworth and F D Hackworth Jr - Pearson Publications – 200.

REFERENCE BOOK:

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Control Sys. / Control Engg.)

ADVANCED INSTRUMENTATION SYSTEMS

(Elective-I)

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

REFERENCE BOOK:

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Control Sys. / Control Engg.)

PROCESS MODELING AND SIMULATION

(Elective-I)

UNIT- I:

Introduction to Modelling: 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 Lumed 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/SCILAB.

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 Analysis", Academic Press, 2001.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Control Sys. / Control Engg.)

EMBEDDED SYSTEMS

(Elective-II)

UNIT-I:

Overview of Embedded System: Embedded system, types of embedded systems, requirements of embedded system, issues in embedded software development, applications.

UNIT-II:

Processor & Memory Organization: Structural units in a processor, processor selection, memory devices, memory selection, memory allocation & map, interfacing.

UNIT-III:

Devices, Device Drivers & Buses for Device Networks: I/O devices, timer & counter devices, serial communication, communication between devices using different buses. Device drivers parallel and serial port device drives in a system, interrupt servicing mechanism and context & periods for context switching, deadline and interrupt latency.

UNIT-IV:

Programming & Program Modeling Concepts: Program elements , modeling processes for software analysis, programming models, modeling of multiprocessors systems, software algorithm concepts, design, implementation, testing ,validating, debugging, management and maintenance , necessicity of RTOS.

UNIT-V:

Hardware and Software Co-design: Embedded system design and code sign issues in software development, design cycle in development phase for embedded systems, use of ICE & software tools for development of ES, Issues in embedded system design.

TEXT BOOK:

1. Embedded systems: Architectures, programming and Design – Rajkamal, TMH 200.

REFERENCE BOOK:

1. Programming for Embedded systems: Dream-Tech software Team-John Wiley-2002.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Control Sys. / Control Engg.)

ROBOTICS AND CONTROL

(Elective-II)

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

REFERENCES:

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Control Sys. / Control Engg.)

ADVANCED MICROPROCESSORS

(Elective-II)

UNIT-I:

INTEL 8086/8088: Architecture, its register organization, pin diagram, minimum and maximum mode system and timings, machine language instruction formats, addressing modes, instruction set, assembler directives and operators.

UNIT-II:

ALP and Special Architecture Features: ALP, Programming with an assembler, stack structure, interrupts, and service subroutines and interrupt programming and Macros.

UNIT-III:

Multiprocessor Systems: Inter connection topologies, numeric processor 8087, I/O processor 8089.Bus arbitration and control design of PC based multiprocessor systems, virtual memory, paging, segmentation.

UNIT-IV:

Advanced Processors: Architectural features of 80836,486 and Pentium processors their memory management, introduction to Pentium pro processors their features, RISC Vs CISC processors, RISC properties, evaluation, architectural features of DEC alpha AXP, power PC family and sun SPARC family systems.

UNIT-V:

Microcontroller: Microcontrollers – 8051 architectures, hardware, interrupts, addressing modes, instruction set –programming-applications.

TEXT BOOKS:

1. Intel microprocessors, architecture, programming and interfacing 8086/8088, 80186,80836 and 80846-BARRY b.Brey.PHI-5th edition-2001.
2. Advanced microprocessors-TABAK-McGraw-Hill Inc 2ns edition.
3. Advanced microprocessors and peripherals A.K. Ray and K M Bhurchandani TMH.
4. Microprocessors, Nilesh B. Bahadure, PHI Learning PVT. Ltd.

REFERENCE BOOKS:

1. 8051 microcontroller – architecture programming & applications-K.J.Ayala-penram Intl.
2. Programming & customizing the 8051 microcontroller – Myke Pretko – TMH,1st edition ,1999.
3. The 8088 and 8086 microprocessor-W.A.Triebel &Avtar singh-PHI,4th edition 2002.
4. Microprocessors and Interfacing N. Senthil, Kumar, M. Saravanan, S. Jeevanathan, S. K. Shah Oxford University press.
5. Microprocessors, Pc Hardware and Interfacing, n. Mathivanan, PHI Learning PVT. Ltd.
6. Microprocessors and Microcontrollers, Aechitecture, Programming and System Design, Krishna Kant, PHI Learning PVT. Ltd.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Control Sys. / Control Engg.)

CONTROL ENGINEERING AND SIMULATION LAB

Any ten experiments form the following can be conducted:

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) To determine the time constant and transfer function of first order process.

(b) To determine the time response of closed loop second order process with Proportional Control.

(c) To determine the time response of closed loop second order process with Proportional-Integral Control.

(d) To determine the time response of closed loop second order process with Proportional-Integral-Derivative Control.

(e) To determine 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.
8. To determination of AC servomotor Characteristics.
9. To study the position control of DC servomotor with P, PI control actions.
10. Temperature controller using PID.
11. Linear System Analysis(Time domain analysis, error analysis) using MATLAB.
12. Stability analysis (Bode, Root Locus, Nyquist) of Linear Time Invariant system using MATLAB.
13. State space model for classical transfer function using MATLAB-Verification.
14. Microprocessor based stepper motor control.
15. Transfer function of DC generator.

TEXT BOOKS:

1. PSPICE reference guide – Microsim, USA.
2. MATLAB and its tool books user's manual and –Mathworks, USA.

REFERENCE BOOKS:

1. Simulation of electrical and electronics circuits using PSPICE-By M.H.Rashid.M/s PHI publications.
2. PSPICE A/D user's manual – Microsim USA.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (Control Sys. / Control Engg.)

OPTIMAL CONTROL THEORY

UNIT-I:

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:

Discrete linear regulator problem. Hamilton –jocobi-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 and state inequality constrains, minimum time problems, minimum control effort problems. Iterative numerical techniques for finding optimal controls and trajectories**:** Two point boundary value problems, method of steepest descent algorithm, variation of extremalas, variation of extremal algorithm, gradient projection algorithm.

UNT-IV:

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

UNIT-V:

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. Jasbir S. Arora, Introduction to optimum design, Elesevier, 2005.
2. A Ravindran, K.M. Ragsdell, and G.V. Reklaitis, Engineering optimization : Methods and applications, Wiley India Edition.
3. Donald E.Kirk, Optimal Control Theory an Introduction, 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. S.H.Zak, Systems and Controll, Indian Edition , Oxford University, 2003.
4. Niclas Anreasson, Anton Evgrafov and Michael Patriksson, An introduction to continuous optimization, Overseas Press (India) Pvt. Ltd.
5. Optimal control systems-A.P. Sage.
6. Optimal Theory and application –Dr.S.S.Rao-eastern Willy- First edition.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (Control Sys. / Control Engg.)

ADAPTIVE CONTROL THOERY

UNIT-I:

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

TEXT BOOKS:

1. K.J.Astrom and Bjorn Witten mark, Adaptive control, Pearson Edu., 2nd Edn.
2. Sankar Sastry, Adaptive control.

REFERENCE BOOKS:

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (Control Sys. / Control Engg.)

NEURAL NETWORK AND FUZZY SYSTEMS

UNIT-I:

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, 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:

Grossberg, Hamming NET, MAXNET, Hopfiled 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 – Classical measures of uncertainty – measures of Dissonance – confession specificity – knowledge base defuzzifiction.

UNIT-V:

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

TEXT BOOKS:

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.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (Control Sys. / Control Engg.)

CONTROL SYSTEM DESIGN

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 Stabilty : 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.
2. Control system design – Graham C Good win-Stefan F.Graebe Mario E.Salgado-Pearson Publications-2003.

REFERENCE BOOK:

1. Computer aided design of control systems-by Resenbrock (Academic press).

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (Control Sys. / Control Engg.)

NONLINEAR SYSTEMS

(Elective-III)

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 - 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:

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

UNIT-V:

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

REFERENCE BOOKS:

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (Control Sys. / Control Engg.)

DISTRIBUTED CONTROL SYSTEMS

(Elective-III)

UNIT-I:

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

UNIT-II:

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

REFERENCE BOOK:

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (Control Sys. / Control Engg.)

PROCESS DYNAMICS AND CONTROL

(Elective-III)

UNIT-I:

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, 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 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:

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, Trail and Error Tuning, Continuous Cycling Method, Process Reaction Curve Method, troubleshooting Control Loops.

UNIT-V:

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

REFERENCE BOOK:

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (Control Sys. / Control Engg.)

ADVANCED DIGITAL SIGNAL PROCESSING

(Elective-IV)

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 Implémentation : 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- Non-parametric methods for power spectrum estimation – Walsh methods – Blackman and torchy method.

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (Control Sys. / Control Engg.)

REAL TIME SYSTEMS

(Elective-IV)

UNIT-I:

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. 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 Reachability, Deadlock etc. Analyzing timing related properties, Specification and Verification of RT DES properties.

UNIT-III:

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:

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

UNIT-V:

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

TEXTBOOK:

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

REFERENCE BOOK:

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (Control Sys. / Control Engg.)

INTELLIGENT AND KNOWLEDGE BASED SYSTEMS

(Elective - IV)

UNIT-I:

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

UNIT-II:

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: Semantic Networks, Frames, Inheritance and default reasoning. Description Logic.

UNIT-IV:

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

UNIT-V:

Case studies. Distributed AI and agent based systems

TEXT BOOK:

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

REFERENCE BOOKS:

1. 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
2. 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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (Control Sys. / Control Engg.)

SIGNAL PROCESSING LAB

1. To study the architecture of DSP chips – TMS 320C 5X/6X Instructions.
2. To verify linear convolution.
3. To verify the circular convolution.
4. To design FIR filter (LP/HP) using windowing technique
   a) Using rectangular window
   b) Using triangular window
   c) Using Kaiser window
5. To Implement IIR filter (LP/HP) on DSP Processors
6. 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. To compute power density spectrum of a sequence.
10. To 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

REFERENCE BOOK:

1. Digital signal processing principles – algorithms and applications-John G.Proakis-PHI-3rd edition2002.