JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR ANANTAPUR-515002 (A.P) INDIA

ACADEMIC REGULATIONS COURSE STRUCTURE AND DETAILED SYLLABI OF MASTER OF TECHNOLOGY IN CONTROL SYSTEMS

(Regular Two Year P.G. Degree Course (Applicable for the batches admitted from 2012-13)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
Academic Regulations For The Award Of Full Time M.Tech. P.G. Degree
(WITH EFFECT FROM THE ACADEMIC YEAR 2012-13)

The Jawaharlal Nehru Technological University Anantapur shall confer M.Tech. Post Graduate degree to candidates who are admitted to the Master of Technology Programs and fulfill all the requirements for the award of the degree.

1.0 ELIGIBILITY FOR ADMISSIONS:

Admission to the above programme shall be made subject to the eligibility, qualifications and specialization prescribed by the University for each programme, from time to time.

Admissions shall be made either on the basis of merit rank obtained by the qualified candidates at an Entrance Test conducted by the University or on the basis of GATE / PGECET score, subject to reservations prescribed by the University or Government policies from time to time.

2.0 **COURSE WORK:**

2.1 A Candidate after securing admission must pursue the M.Tech. course of study for Four semesters duration.

2.2 Each semester shall be of 20 weeks duration including all examinations.

2.3 A candidate admitted to a programme should complete it within a period equal to twice the prescribed duration of the programme from the date of admission.

3.0 ATTENDANCE:

3.1 A candidate shall be deemed to have eligibility to write end semester examinations if he has put in atleast 75% of attendance on cumulative basis of all subjects/courses in the semester.

3.2 Condonation of shortage of attendance up to 10% i.e., from 65% and above and less than 75% may be given by the college on the recommendation of the Principal.

3.3 Condonation of shortage of attendance shall be granted only on genuine and valid reasons on representation by the candidate with supporting evidence.

3.4 If the candidate does not satisfy the attendance requirement he is detained for want of attendance and shall reregister for that semester. He / she shall not be promoted to the next semester.

4.0. 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.

4.1 For the theory subjects 60% of the marks will be for the External End Examination. While 40% of the marks will be for Internal Evaluation, based on the better of the marks secured in the two Mid Term-Examinations held, one in the middle of the Semester (I-IV units) and another immediately after the completion of instruction (V-VIII) units with Three questions to be answered out of four in 2hours, evaluated* for 40 marks.

*****Note: All the Questions shall be of equal weightage of 10 marks and the marks obtained for 3questions shall be extrapolated to 40 marks, any fraction rounded off to the next higher mark

4.2 For practical subjects, 60 marks shall be for the End Semester Examinations and 40 marks will be for internal evaluation based on the day to day performance.

4.3 For Seminar there will be an internal evaluation of 50 marks. A candidate has to secure a minimum of 50% to be declared successful. The assessment will be made by a board consisting of HOD and two internal experts at the end of IV semester instruction.

4.4 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 Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.

4.5 In case the candidate does not secure the minimum academic requirement in any of the subjects (as specified in 4.4.) he has to reappear for the Semester Examination either supplementary or regular in that subject, or repeat the course when next offered or do any other specified subject as may be required.

5.0 RE-REGISTRATION FOR IMPROVEMENT OF INTERNAL EVALUATION MARKS:

Following are the conditions to avail the benefit of improvement of internal evaluation marks.

5.1 The candidate should have completed the course work and obtained examinations results for I & II semesters.

5.2 He should have passed all the subjects for which the Internal evaluation marks secured are more than 50%.

5.3 Out of the subjects the candidate has failed in the examination due to Internal evaluation marks secured being less than 50%, the candidate shall be given one chance for each Theory subject and for a maximum of **three** Theory subjects for Improvement of Internal evaluation marks.

5.4 The candidate has to re-register for the chosen subjects and fulfill the academic requirements.

5.5 For each subject, the candidate has to pay a fee equivalent to one third of the semester tuition fee and the amount is to be remitted in the form of D.D. in favour of the

Registrar, JNTUA payable at Anantapur along with the requisition through the Principal of the respective college.

5.6 In the event of availing the Improvement of Internal evaluation marks, the internal evaluation marks as well as the End Examinations marks secured in the previous attempt(s) for the reregistered subjects stand cancelled.

6.0 EVALUATION OF PROJECT WORK:

Every candidate shall be required to submit thesis or dissertation after taking up a topic approved by the college/ institute.

6.1 Registration of Project work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the courses (theory and practical courses of I & II Sem)

6.2 An Internal Departmental Committee (I.D.C) consisting of HOD, Supervisor and one internal senior expert shall monitor the progress of the project work.

6.3 The work on the project shall be initiated in the penultimate semester and continued in the final semester. The duration of the project is for two semesters. The candidate can submit Project thesis with the approval of I.D.C. after 36 weeks from the date of registration at the earliest and one calendar year from the date of registration for the project work. Extension of time within the total permissible limit for completing the programme is to be obtained from the Head of the Institution.

6.4 The student must submit status report at least in three different phases during the project work period. These reports must be approved by the I.D.C before submission of the Project Report.

6.5 A candidate shall be allowed to submit the thesis / dissertation only after passing in all the prescribed subjects (both theory and practical) and then take viva voce examination of the project. The viva-voce examination may be conducted once in two months for all the candidates submitted during that period.

6.6 Three copies of the Thesis / Dissertation certified in the prescribed from by the supervisor & HOD shall be presented to the HOD One copy is to be forwarded to the University and one copy to be sent to the examiner.

6.7 The college shall submit a panel of three experts for a maximum of 5 students at a time. However, the thesis / dissertation will be adjudicated by one examiner nominated by the University.

6.8 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 / dissertation. The board shall jointly report candidates work as:

1.	Very Good	Grade A
2.	Good	Grade B
3.	Satisfactory	Grade C
4.	Not satisfactory	Grade D

If the report of the viva-voce is not satisfactory (Grade D) 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 the candidate is permitted to revise and resubmit the thesis.

7.0 AWARD OF DEGREE AND CLASS:

A candidate shall be eligible for the award of respective degree if he satisfies the minimum academic requirements in every subject and secures 'satisfactory' or higher grade report on his thesis/dissertation and viva-voce. Based on overall percentage of marks obtained, the following class is awarded.

First class with Distinction:	70% or more
First class	below 70% but not less than 60%
Second class	below 60% but not less than 50%

8.0 WITH – HOLDING OF RESULTS:

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

9.0 TRANSITORY REGULATIONS:

Candidates who have discontinued or have been detained for want of attendance or who have failed after having undergone the course in earlier regulations and wish to continue the course are eligible for admission into the unfinished semester from the date of commencement of class work with the same or equivalent subjects as and when subjects are offered, subject to 4.5 and 2.3 sections. Whereas they continue to be in the academic regulations they were first admitted.

10.0 GENERAL:

i. **The academic regulations should be read as a whole for purpose of any interpretation**.
ii. **Disciplinary action for Malpractice / improper conduct in examinations is appended**.
iii. **There shall be no places transfer within the constituent colleges and affiliated colleges of Jawaharlal Nehru Technological University Anantapur.**
iv. **Where the words "he", "him", "his", occur in the regulations, they include "she", "her", "hers".**
v. **In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.**
vi. **The University may change or amend the academic regulations or syllabi at any time and the changes or amendments shall be made applicable to all the students on rolls with effect from the dates notified by the University.**

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RULES FOR DISCIPLINARY ACTION FOR MALPRACTICE / 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.	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.

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.	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.
6.	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.

7.	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 impostor is an outsider, he will be handed over to the police and a case is registered against him.
8.	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.

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.	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.
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 ANANTAPUR

Course Structure and syllabi for

M.Tech- Control Systems

Offered by Department of EEE

for affiliated Engineering Colleges 2012-13

I YEAR I Semester

S. No	Course code	Subject	Theory	Lab.	Credits
1.	12D75100	Modern Control Theory	4		4
2.	12D75101	Stochastic Processes	4		4
3.	12D75102	Digital Control Systems	4		4
4.	12D75103	Intelligent Control	4		4
5.	12D75104a 12D75104b	Elective – I 1. Robot Modeling and Control 2. Advanced Instrumentation Systems	4		4
6.	9D54103 12D75105	Elective – II 1. Principles of Machine Modeling and Analysis 2. Advanced Microprocessors and Microcontrollers	4		4
7.	12D75106	Control Systems Lab		3	2
		contact periods/week	24	3	26
			Total 27		

I YEAR II Semester

S. No	Course code	Subject	Theory	Lab.	Credits
1.	12D75201	Estimation of Signals and Systems	4		4
2.	12D75202	Non - Linear Control Theory.	4		4
3.	12D75203	Optimal Control	4		4
4.	12D75204	Advanced Digital Signal Processing	4		4
5.	12D75205 12D75206	Elective – III 1.Adaptive and Learning Control 2. Robust Control	4		4
6.	12D75207 12D75208	Elective – IV 1.Real Time Systems 2. Process Dynamics and Control	4		4
7.	12D75209	Control System Simulation Lab		3	2
		contact periods/week	24	3	26
			Total 27		

II YEAR (III & IV Semesters)

S. No	Course code	Subject		credits
1	12D75401	Seminar		2
2	12D75402	Project work		16

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M.Tech I semester (CS)

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(12D75100) MODERN CONTROL THEORY

Unit I
Introductory matrix algebra and linear vector space. State space representation of systems. Linearization of a non - linear System. Solution of state equations. Evaluation of State Transition Matrix (STM) - Simulation of state equation using MATLAB/ SIMULINK program.

Unit II
Similarity transformation and invariance of system properties due to similarity transformations. Minimal realization of SISO, SIMO, MISO transfer functions. Discretization of a continuous time state space model. Conversion of state space model to transfer function model using Fadeeva algorithm.

Unit III
Fundamental theorem of feedback control - Controllability and Controllable canonical form - Pole assignment by state feedback using Ackermann's formula – Eigen structure assignment problem.

Unit IV
Linear Quadratic Regulator (LQR) problem and solution of algebraic Riccati equation using eigenvalue and eigen vector methods, iterative method. Controller design using output feedback.

Unit V
Observability and observable canonical form - Design of full order observer using Ackermann's formula - Bass Gura algorithm.

Unit VI
Duality between controllability and observability - Full order Observer based controller design. Reduced order observer design.

Unit VII
Internal stability of a system. Stability in the sense of Lyapunov, asymptotic stability of linear time invariant continuous and discrete time systems. Solution of Lyapunov type equation.

Unit VIII
Model decomposition and decoupling by state feedback. Disturbance rejection, sensitivity and complementary sensitivity functions.

Text Books:

1. K. Ogata, Modern Control Engineering, Prentice Hall, India 1997
2. T. Kailath, T., Linear Systems, Perntice Hall, Englewood Cliffs, NJ, 1980.

3. N. K. Sinha , Control Systems, New Age International, 3rd edition, 2005.

References:

1. Panos J Antsaklis, and Anthony N. Michel, Linear Systems, New - age international (P) LTD. Publishers, 2009.

2. John J D'Azzo and C. H. Houpis , "Linear Control System Analysis and Design Conventional and Modern", McGraw - Hill Book Company, 1988.

3. B.N. Dutta, Numerical Methods for linear Control Systems - , Elsevier Publication, 2007.

4. C.T.Chen Linear System Theory and Design - PHI, India.

5. Richard C. Dorf and Robert H. Bishop, Modern Control Systems, 11th Edition, Pearson Edu, India, 2009.

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M.Tech I semester (CS)

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(12D75101) STOCHASTIC PROCESSES

UNIT-1

Stochastic dynamics – Multiple Random Variables- Random Variables, Distribution functions, Discrete Random Variables- joint probability Mass function, Continuous Random Variables- Joint Probability Density function, Conditional Distribution, Covariance and Correlation Coefficient, Conditional Means and Conditional Variances, N-variant Random variables, Special Distributions - Examples.

UNIT-2 : Functions of Random Variables, Expectation and Limit Theorems-Functions of One Random Variables - Functions of Two Random Variables - Functions of n Random Variables – Expectation - Moment Generating Functions - Characteristic Functions - The Laws of Large Number and the Central Limit Theorem - Examples.

UNIT-3

Stochastic Processes – Definitions – Expectations - Vector process - Gaussian process - Harmonic process - Stationary process - Scalar process, Vector process, Correlation length - Ergodic process - Statistical properties of time averages, Temporal density estimation - Poisson process - Compound Poisson process - Markov process - Examples.

UNIT-4

Stochastic Calculus - Modes of convergence - Stochastic differentiation - Statistical properties of derivative process, Spectral analysis of derivative processes. Stochastic integration - Statistical properties of stochastic integrals, Integration of weakly stationary processes, Riemann – Stieltjes integrals. Itô calculus - Brownian motion, Itô and Stratonovich integrals, Itô and Stratonovich differential equations, Itô's lemma, Moment equations - Examples.

UNIT-5

Fokker – Planck – Kolmogorov Equation – Chapman – Kolmogorov – Smoluchowski equation Derivation of the FPK equation - Derivation using Itô's lemma - Solutions of FPK equations for linear systems - Short-time solution - Improvement of the short-time solution. Path integral solution - Markov chain representation of path integral. Exact stationary solutions - First order systems, Second order systems, Dimentberg's system, Equivalent Itô equation, Hamiltonian systems, Detailed balance - Examples.

UNIT-6

Kolmogorov Backward Equation - Derivation of the backward equation - Reliability formulation - First-passage time probability – Pontryagin – Vitt equations - Examples.

UNIT-7

Structural Reliability - Modes of failure - Level crossing - Single level crossing, Method of counting process, Higher order statistics of level crossing, Dual level crossing, Local minima and maxima, Envelope processes - Vector process - First-passage reliability based on level crossing - First-passage time probability – general approach - Example of SDOF linear oscillators, Common safe domains, Envelope process of SDOF linear oscillators.

UNIT- 8

Structural fatigue-S-N model, Rainflow counting, Linear damage model, Time-domain analysis of fatigue damage - Dirlik's formula for fatigue prediction - Extended Dirlik's formula for non-Gaussian stress - Regression analysis of fatigue, Validation of the regression model, Case studies of fatigue prediction - Examples.

REFERENCE BOOKS:

1. Jian-Qiao Sun, Stochastic Dynamics and Control, Elsevies Publishers.
2. Papoulis, Probability, Random Variables, and Stochastic Processes, McGraw-Hill.
3. Hwei P. Hsu, Probability, Random Variables, and Random Processes, Schaum's Outline Series, McGraw-Hill.

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M.Tech I semester (CS)

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(12D75102) DIGITAL CONTROL SYSTEMS

UNIT I:
Introduction - Advantages of Digital control systems - Practical aspects of the choice of sampling rate and multirate sampling - Basic discrete time signals - Quantization – Sampling theorem - Data conversion and Quantization - Sampling process - Mathematical modeling - Data reconstruction and filtering of sampled signals – zero - order hold.

UNIT II:
z - transform and inverse z - transform, Relationship between s - plane and z - plane - Difference equation - Solution by recursion and z - transform - pulse transfer functions of the zero - order Hold and relationship between G(s) and G(z)– Bilinear transformation .

UNIT III:

Digital control systems - Pulse transfer function - z transform analysis of open loop, closed loop systems - Modified z Transform - transfer function - Stability of linear digital control systems - Stability tests.

UNIT IV:
Root loci - Frequency domain analysis - Bode plots - Gain margin and phase margin - Design of Digital Control Systems based on Root Locus Technique.

UNIT V:

Cascade and feedback compensation by continuous data controllers - Digital controllers - Design using bilinear transformation - Realization of Digital PID controllers.

UNIT VI:

State equations of discrete data systems, solution of discrete state equations, State transition Matrix: z - transform method. Relation between state equations and transfer functions.

UNIT VII
Concepts on Controllability and Observability - Digital state observer: Design of the full order and reduced order state observer - Pole placement design by state feed back.

UNIT VIII:
Design of Dead beat Controller - some case studies - Stability analysis of discrete time systems based on Lyapunov approach.

Text books:

1. K. Ogata, Discrete Time Control Systems, PHI/Addison - Wesley Longman Pte. Ltd., India, Delhi, 1995.
2. B.C Kuo, Digital Control Systems, 2nd Edition, Oxford Univ Press, Inc., 1992.

Reference Books:

1. .F. Franklin, J.D. Powell, and M.L. Workman, Digital control of Dynamic Systems, Addison - Wesley Longman, Inc., Menlo Park, CA , 1998.
2. Gopal, Digital Control and State Variable Methods, Tata McGraw Hill, India, 1997.
3. C. H. Houpis and G.B. Lamont, Digital Control Systems, McGraw Hill, 1985.
4. John S. Baey, Fundamentals of Linear State Space Systems, Mc. Graw – Hill, 1st edition
5. Bernard Fried Land, Control System Design, Mc. Graw – Hill, 1st edition
6. Dorsay, Continuous and Discrete Control Systems, McGraw - Hill.

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(12D75103) INTELLIGENT CONTROL

UNIT I: Introduction and motivation. Approaches to intelligent control. Architecture for intelligent control. Symbolic reasoning system, rule - based systems, the AI approach. Knowledge representation. Expert systems.

UNIT II

Concept of Artificial Neural Networks and its basic mathematical model, McCulloch - Pitts neuron model, simple perceptron, Adaline and Madaline, Feed - forward Multilayer Perceptron. Learning and Training the neural network.

UNIT III

Data Pre - Processing: Scaling, Fourier transformation, principal - component analysis and wavelet transformations. Networks: Hopfield network, Self - organizing network and Recurrent network. Neural Network based controller, Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab / Neural Network toolbox.

UNIT IV

Genetic Algorithm: Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm.

UNIT V

Concept on some other than GA search techniques like tabu search and ant - colony search techniques for solving optimization problems.

UNIT VI

Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to Fuzzy logic modeling and control of a system. Fuzzification, inference and defuzzification. Fuzzy knowledge and rule bases.

UNIT VII

Fuzzy modeling and control schemes for nonlinear systems. Self - organizing fuzzy logic control. Implementation of fuzzy logic controller using Matlab fuzzy - logic toolbox.

UNIT VIII

Stability analysis of fuzzy control systems. Intelligent Control for SISO/MIMO Nonlinear Systems. Model Based Multivariable Fuzzy Controller.

Text Books

1. Simon Haykins, Neural Networks: A comprehensive Foundation, Pearson Edition, 2003.
2. T.J.Ross, Fuzzy logic with Fuzzy Applications, Mc Graw Hill Inc, 1997.
3. David E Goldberg, Genetic Algorithms.

References

1. M.T.Hagan, H. B. Demuth and M. Beale, Neural Network Design, Indian reprint, 2008.
2. Fredric M.Ham and Ivica Kostanic, Principles of Neurocomputing for science and Engineering, McGraw Hill, 2001.

3. N.K. Bose and P.Liang, Neural Network Fundamentals with Graphs, Algorithms and Applications, Mc - Graw Hill, Inc. 1996.
4. Yung C. Shin and Chengying Xu, Intelligent System - Modeling, Optimization and Control, CRC Press, 2009.
5. N.K.Sinha and Madan M Gupta, Soft computing & Intelligent Systems - Theory & Applications, Indian Edition, Elsevier, 2007.
6. John Yen and Reza Langari, Fuzzy logic Intelligence, Control, and Information, Pearson Education, Indian Edition, 2003.
7. Witold Pedrycz, Fuzzy Control and Fuzzy Systms, Overseas Press, Indian Edition, 2008.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
M.Tech I semester (CS)

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Elective-I	**4**	**4**

(12D75104a) ROBOT MODELING AND 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.

UNIT II: 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 III: 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 - SOLVE - ing a manipulator - Repeatability and accuracy - Computational considerations.

UNIT IV: 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 V: 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.

UNIT VI: 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 VII: 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 VIII: 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.

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Elective-I	**4**	**4**

(12D75104b) ADVANCED INSTRUMENTATION SYSTEMS

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 - I
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.

UNIT III: Active Electrical Transducers –II
Photoelectric phenomenon - photoconductive Transducers - photovoltaic Transducers - Photo emissive Transducers - Ionization vacuum gauges - Ionization displacement Transducers - Digital displacement Transducers - Digital Tachometers - Electromechanical Transducers.

UNIT IV: 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 V: Signals and their representation
Laplace and Fourier Transforms - standard test signals - Periodic signals - aperiodic signals - bandwidth - modulated signals - sampled data pulse modulation.

UNIT VI: 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 demultiplexers - Digital multiplexers.

UNIT VII: Data Transmission and Telemetry
Characteristics of a Telemetry system - landline telemetry - radio telemetry - frequency division multiplexing - time division multiplexing.

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

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Elective-II	4	4

(9D54103) PRINCIPLES OF MACHINE MODELING AND ANALYSIS

Unit I: Basic Principles for Machine Analysis:
Magnetically coupled circuits, Machine windings and air-gap MMF, winding inductances and voltage equations.

Unit-II: Modeling and Analysis of DC Machines:

Elementary dc machine, voltage and torque equations, types of dc machines, permanent and shunt dc motors, time-domain and state-equations,

Unit-III: Reference Frame Theory:

Introduction to transformations, equations of transformations, change of variables, and transformation to an arbitrary reference frame, commonly used reference frames, transformation between reference frames, Steady-state phasor relationships and voltage equations

Unit IV: Modeling of Three Phase Induction Machines: Voltage and torque equations in machine variables, Voltage and torque equations in arbitrary reference frame, Steady-state analysis and its operation.

Unit-V: Dynamic analysis of three-phase Induction Machine:
Free acceleration characteristics viewed from various reference frames, dynamic performance during sudden changes in load torque, dynamic performance during a three-phase fault at the machine terminals

Unit VI: Modeling of Synchronous Machine:

Voltage and torque equations in machine variables, Voltage equations in arbitrary and rotor reference frame, torque equations in substitute variable, Steady-state analysis and its operation.

Unit VII: Dynamic Analysis of Synchronous Machine:

Dynamic performance of synchronous machine, three-phase fault, comparison of actual and approximate transient torque characteristics, Equal area criteria.

Unit VIII: Modeling of Single Phase Induction Machine:

Comparison between single phase and poly phase induction motor - Cross field theory of single-phase induction machine, steady state analysis – steady state torque.

Text books

1. Krause, Wasynczuk, Sudhoff, Analysis of Electric Machinery and Drive Systems**: 2nd Edition, Wiley Interscience Publications, 2002.**

2. **P. C. Krause,** Analysis of Electric Machinery**.**

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Elective-II

(12D75105) ADVANCED MICROPROCESSORS AND MICROCONTROLLERS

Unit I Intel 8086:

Architecture, its register organization, Pin diagram, Minimum and Maximum Mode

System and Timings, Machine language instruction formats, Addressing modes,

Instruction set, Assembler directives.

Unit II Hardware Description:

Pin diagram, Minimum and Maximum mode and bus timings, ready and wait states and 8086 based micro-computing system.

Unit III ALP and Special Features:

ALP, Programming with an assembler, Stack structure, Interrupts, Service subroutines and Interrupt programming and Macros.

Unit IV Advanced Processors:

Architectural features of 80386, 486 and Pentium Processors their memory management,

Introduction to Pentium Pro Processors their features, RISC Vs CISC Processors.

Unit V Basic Peripherals and their Interfacing

Memory interfacing (DRAM), PPI-Modes of operation of 8255, interfacing to ADC and DAC.

Unit VI Special Purpose of Programmable Peripheral devices and their Interfacing

Programmable timer-8253, PIC 8259A, Display controller, Programmable communication interface 8251- USART and their interfacing.

Unit VII Microcontrollers

Introduction to Intel 8-bit and 16-bit Microcontrollers, 8051 architecture, Memory organization, addressing modes.

Unit VIII Hardware Description of 8051

Instruction formats, Instruction sets, Interrupt structure and interrupt priorities, Port structures and operation Linear counter functions, Different modes of operation and programming examples.

Text books:

1. Barry B.Brey, **The Intel Microprocessors, Architecture, Programming and interfacing** Prentice Hall Higher education
2. Muhammad Ali Mazidi, Janice Gillis pie, Mazidi **the 8051 Microcontroller and Embedded systems**, PHI Publications.

References:

1. Kenrith J Ayala, 8086 **Microprocessor**, Thomson publishers, 3rd-Edition.
2. Kenrith J Ayala **Microcontrollers**, Thomson publishers, 3rd-Edition.
3. Douglas V. Hall **Microprocessor and Interfacing Programming and Hardware**, Greg Community college Division-Publisher, 1991.
4. W.A. Triebel & Avtar Singh **The 8088 and 8086 Microprocessor**- PHI, 4th Edition, 2002.

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(12D75106) CONTROL SYSTEMS LABORATORY

List of Experiments

1. Determination of Transfer functions of an Electrical System.
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. Analog Computer:
    (a) To examine the operation of potentiometer and adder.
    (b) To examine the operation of integrator.

    To solve a second order differential equation.

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(12D75201) ESTIMATION OF SIGNAL AND SYSTEMS

UNIT I

Review of Probability theory and random variable - random process - A Family of Transfer function Models. Equation Error Model Structure, Linear Regression. ARMAX Model Structure, Other Equation. Error - Type Model Structures - Output Error Model Structure - Box - Jenkins Model Structure - A General Family of Model Structures - Continuous Time Black - Box Model.

UNIT II

Recursive least squares (RLS), Consistency of estimation, Weighted LS.

UNIT III

Parametric models - LS estimation, bias - Generalized Least Squares (GLS) and Instrumental Variable (IV) method.

UNIT IV

Persistently exciting input signal - Likelihood functions and Maximum Likelihood Estimation (MLE) - Singular Value Decomposition (SVD).

UNIT V

Stochastic Approximation Algorithm (STA); Model order and structure determination.

UNIT VI

Kalman filter, State estimation using Kalman filter, Parameter estimation using Kalman filter.

UNIT VII

Extended Kalman Filters for continuous and discrete time systems, State and Parameter estimations.

UNIT VIII

Multi - variable system representation, controllability and observability indices; Feedback system identification.

Text Books:

1. Papoulis and Pillai, Probability, Random Variables and Stochastic Process, McGraw Hill, 2002.
2. Jerry M. Mendel, Lessons in Estimation Theory for Signal Processing, Communications, and Control, Prentice - Hall, 1995.

References:

1. Karl J Astrom, Introduction to Stochastic Control Theory, Mathematics in Series and Engg., Vol. 70.

2. Michel Verhaegen and Vincent Verdult, Filtering and System Identification A Least Squares Approach, Cambridge Univ. Press, 2007.
3. M.S. Grewal and A.P. Andrews, Kalman Filtering Theory and Practice Using Matlab, John Wiley, 2008.

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(12D75202) NONLINEAR CONTROL THEORY

UNIT I:

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

UNIT II:

Describing function analysis of nonlinear systems. Reliability of describing method analysis. Compensation and design of nonlinear system using describing function method.

UNIT III:

Phase plane analysis: Phase portraits, Singular points characterization. Analysis of non - linear systems using phase plane technique.

UNIT IV:

Existence of limit cycles. Linearization: Exact linearization, input - state linearization, input - output linearization.

UNIT V:

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.

UNIT VI:

Aizerman's and Kalman's conjecture. Construction of Lyapunov function - Methods of Aizerman, Zubov, Variable gradient method. Lure problem.

UNIT VII:

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

UNIT VIII:

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.

References:

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

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(12D75203) OPTIMAL CONTROL

UNIT I

An overview of optimization problem - concepts and terms related to optimization - constrained and unconstrained problems and their solutions using different techniques.

UNIT II

Convex set and convex function - convex optimization problem - quadratic optimization problem - Karush - Kuhn - Tucker (KKT) necessary and sufficient conditions for quadratic programming problem.

UNIT III

Interior point method for convex optimization - linear programming - primal and dual problems and basic concept of multi - objective optimization problem.

UNIT IV

Concept of functional, different types of performance indices, Euler - Lagrange equation.

UNIT V

Calculus of variation to optimal control problem - Fundamental concepts, functionals of a single function, functional involving

several independent functions, necessary conditions for optimal control, linear regulator problems.

UNIT VI

Linear quadractic regulator, remarks on weighting matrices, solution of Riccati equation.

UNIT VII

Frequency domain interpretation of linear quadratic regulator, robustness studies.

UNIT VIII

Dynamic programming, Pontrygin's minimum principle, time optimal control, concept of system and signal norms, statement of problem and its solution.

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.

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(12D75204) ADVANCED DIGITAL SIGNAL PROCESSING

UNIT-I:

Short introduction, Analog to digital and Digital to Analog conversion, sampled and Hold circuit, Continuous time Fourier Transforms.

UNIT-II:

Discrete-time signals and systems, Discrete-time Fourier transform- its properties and applications, Fast Fourier Transform (in time-domain and Frequency domain) , IDFT and its properties.

UNIT-III: z- Transform:

Definition and properties, Rational z-transforms, Region of convergence of a rational z-Transform, The inverse z- Transform, Z-Transform properties, Computation of the convolution sum of finite-length sequences, The transfer function

UNIT-IV Digital Filter Structures:

Block Diagram representation, Equivalent structures, Basic FIR Digital Filter structures, Basic IIR Digital Filter structures, Realization of Basic structures using MATLAB, All pass filters, Computational complexity of Digital filter structures.

UNIT V: **IIR Digital Filter Design:**

Preliminary considerations, Bilinear transformation method of IIR Filter design, Design of low pass IIR Digital filters, Design of High pass, Band pass and band stop IIR digital filters, Spectral Transformations of IIR filter, IIR digital filter design using MATLAB, Computer aided design of IIR digital filters.

UNIT VI:FIR Digital Filter Design:

Preliminary considerations, FIR filter design based on windowed Fourier series, Computer aided design of Equiripple Linear phase FIR filters, Design of Minimum phase FIR filters, FIR digital filter design using MATLAB, Design of computationally efficient FIR digital filters.

UNIT VII: Analysis of Finite word length effects:

The quantization process and errors, quantization of Fixed point numbers, Quantization of floating point numbers, Analysis of coefficient quantization effects, Analysis of arithmetic

round off errors, Low sensitivity digital filters, Reduction of product round off errors using error feedback, Round off errors in FFT algorithms.

UNIT VIII:

The basic sample rate alteration devices, Multi rate structures for sampling rate conversion, Multistage design of decimator and interpolator, The Polyphase decomposition, Arbitrary-rate sampling rate converter, Nyquist Filters and some applications of digital signal processing.

Text Books:

1. S.K. Mitra**, Digital Signal Processing**-, Tata McGraw-Hill, Third Edition, 2006.

2. B.P. Lathi, **Principle of Signal Processing and Linear Systems**-, Oxford International Student Version, 2009

3. M. Mondal and A Asif, **Continuous and Discrete Time Signals and Systems**, Cambridge, 2007

References:

1. Li Tan, **Digital Signal Processing- Fundamentals and Applications**-, Indian reprint, Elsevier, 2008.

2. Alan V. Oppenheim, Ronald W. Schafer, and John R.Buck, **Discrete- Time Signal Processing**-, Pearson Edu, 2008.

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Elective-III

(12D75205) ADAPTIVE AND LEARNING CONTROL

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.

UNIT III

Discrete time MRAC systems - Hyper stability approach - Narendra's error model approach - Introduction - stability theorem - Relation to other algorithms - hybrid adaptive control.

UNIT IV

Self Tuning Regulators (STR) - different approaches to self tuning - Recursive parameter estimation - implicit STR - Explicit STR.

UNIT V

STR design based on pole - placement technique and LQG theory - Gain scheduling. - Stability of adaptive control algorithms.

UNIT VI

Adaptive control of a nonlinear systems - Adaptive predictive control - Robustness of adaptive control systems - Instability phenomena in adaptive systems.

UNIT VII

Concept of learning control systems. Different types of learning control schemes. LTI learning control via parameter estimation schemes. Convergence of learning control.

UNIT VIII

Case Studies: Robotic manipulators, Aerodynamic curve identification, Electric drives, Satellite altitude control.

Text books

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

References

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
4. G.C. Goodwin, Adaptive control.
5. Narendra and Anna Swamy, Stable Adaptive Systems.

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Elective-III

(12D75206) ROBUST CONTROL

UNIT I: Review of classical feedback control
Review of classical feedback control: The control problem, Transfer functions, Deriving linear models, Frequency response, Feedback control, Closed loop stability, Evaluating closed - loop performance, Controller design, Loop shaping, Shaping closed loop transfer functions.

UNIT II: Introduction to Multivariable Control
Transfer functions for MIMO systems, Multivariable frequency response analysis, Control of multivariable plants, Introduction to robustness, General control problem formulation.

UNIT III: Elements of Linear System Theory
Internal stability of feedback systems, Stabilizing controllers, System norms, Input - Output Controllability, perfect control and plant inversion, Constraints on S and T.

UNIT IV: Limitations on Performance in SISO Systems
Limitations imposed by RHP - zeros, Limitations imposed by RHP - poles, Performance requirements imposed by disturbances and commands, Limitations imposed by input constraints, Limitations imposed by uncertainty.

UNIT V: Limitations on Performance in MIMO Systems
Constraints on S and T, Functional Controllability, Limitations imposed by RHP - zeros, Limitations imposed by RHP - poles, Performance requirements imposed by disturbances, Limitations imposed by input constraints, Limitations imposed by uncertainty.

UNIT VI: Uncertainty and Robustness for SISO Systems
Introduction to robustness, Representing uncertainty, parametric uncertainty, Representing uncertainty in the frequency domain, SISO robust stability, SISO robust performance, Examples of parametric uncertainty.

UNIT VII: Robust Stability and Performance Analysis

General control formulation with uncertainty, Representing uncertainty, Obtaining P, N and M, Definition of robust stability and performance, Robust stability of the MΔ - structure, RS for complex unstructured uncertainty, RS with structured uncertainty: Motivation, The structured singular value and RS, Properties and computation of μ, Robust performance, Application: RP with input uncertainty, μ - synthesis and DK - iteration, Further remarks on μ.

UNIT VIII: Control System Design

Trade - offs in MIMO feedback design, LQG control, H_2 and H_∞ control, H_∞ loop - shaping design.

Text Books:

1. Sigurd Skogestad and Ian Postlethwaite, Multivariable Feedback Control Analysis and Design - John Wiley & Sons Ltd., 2nd Edition, 2005.
2. D. W. Gu, P. Hr. Petkov and M. M. Konstantinov "Robust Control Design with MATLAB" Spring - Verlag London Ltd., 2005.

References:

1. Kennin Zhou, "Robust and Optimal Control", Prentice Hall, Engle wood Cliffs, New Jersy.

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Elective-IV
(12D75207) REAL TIME SYSTEMS

UNIT I:
Introduction to Real - time systems: Typical examples of RTS, Characteristic features of RT applications. Structural, Functional and Performance requirement of Reactive RTS.

UNIT II:
Distinctive features from Non - RT and Off - line system. Modeling RTS: Representation of time, Concurrency and Distributedness in discrete event systems.

UNIT III:
Hierarchical representation of complex DES. Input, Output and Communication. Examples of modeling practical systems as RT DES. Modeling programs as RTS.

UNIT IV:
Analyzing RTS: Analysing logical properties of DES such as Reachability, Deadlock etc. Analyzing timing related properties, Specification and Verification of RT DES properties.

UNIT V:
Temporal logic, Model checking. Example of checking safety and timing properties of industrial systems.

UNIT VI:
Requirements and features of real - time Computing Environments: Real - time Operating Systems, Interrupts, clock, Device support.

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

UNIT VIII:
Real - time process and applications, Distributed Real - time systems.

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Elective-IV
(12D75208) PROCESS DYNAMICS AND CONTROL

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, Digital Versions of PID Controllers, Transducers and Transmitters, Final Control Elements, Accuracy in Instrumentation.

UNIT IV:
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 V:
Performance Criteria for Closed - Loop Systems, Direct Synthesis Method, Internal Model Control, Design Relations for PID Controllers, Comparison of Controller Design Relations.

UNIT VI:
Guidelines for Common Control Loops, Trail and Error Tuning, Continuous Cycling Method, Process Reaction Curve Method, troubleshooting Control Loops.

UNIT VII:

Introduction to Feed forward Control, Ratio Control, 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.

UNIT VIII:

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.

References:

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

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(12D75209) CONTROL SYSTEMS SIMULATION LABORATORY

List of Experiments

The following experiments may be implemented in MATLAB/SIMULINK environment.

1. Preliminary Transformations:
   (a) Transfer function to State space models vice- versa.
   (b) Conversion of Continuous to Discrete time systems vice- versa.
   (c) Verification of controllability and observablity of a given system.
2. Design of state feedback controllers.
3. Stability analysis of a given system using:
   (a) Root Locus.
   (b) Bode plot.
   (c) Lyapunov stability.
4. Implementation of Kalman Filter.
5. Implementation of Least squares error method.
6. Implementation of PID controller and its effects on a given system.
7. Design of Lead, Lag, Lead- Lag compensators using frequency domain analysis.
8. Construction of Simulink model for an Induction motor.

Note: At least four problems may be implemented from the following

9. Solving steady state Ricatti Equation.
10. Construction of Simulink model foe single area and multi area Power system.
11. Solving an optimal control problem using Ricatti equation.
12. Implementation of Full order and minimum order Observer.

13. Implementation of Back-Propagation Algorithm.
14. Implementation of simple Fuzzy controller.
15. Implementation of storage and recall algorithm of Hopfield network model.