HINDUSTAN UNIVERSITY

HINDUSTAN INSTITUTE OF TECHNOLOGY & SCIENCE

(Estd. u/s 3 of the UGC Act, 1956)

Padur, Kancheepuram District - 603 103.

DEPARTMENT OF
ELECTRONICS AND INSTRUMENTATION ENGINEERING

Regulations Curriculum and Syllabus 2013

M.Tech.
PROCESS CONTROL & INSTRUMENTATION ENGINEERING

ACADEMIC REGULATIONS
(M.TECH./ M.B.A. / M.C.A.) (Full - Time / Part - Time)
(Effective 2013-14)

1. Vision, Mission and Objectives

1.1 The Vision of the Institute is "To make every man a success and no man a failure".

In order to progress towards the vision, the Institute has identified itself with a mission to provide every individual with a conducive environment suitable to achieve his / her career goals, with a strong emphasis on personality development, and to offer quality education in all spheres of engineering, technology, applied sciences and management, without compromising on the quality and code of ethics.

1.2 Further, the institute always strives

- To train our students with the latest and the best in the rapidly changing fields of Engineering, Technology, Management, Science & Humanities.
- To develop the students with a global outlook possessing, state of the art skills, capable of taking up challenging responsibilities in the respective fields.
- To mould our students as citizens with moral, ethical and social values so as to fulfill their obligations to the nation and the society.
- To promote research in the field of science, Humanities, Engineering, Technology and allied branches.

1.3 Our aims and objectives are focused on

- Providing world class education in engineering, technology, applied science and management.
- Keeping pace with the ever changing technological scenario to help our students to gain proper direction to emerge as competent professionals fully aware of their commitment to the society and nation.
- To inculcate a flair for research, development and entrepreneurship.

2. Admission

2.1 The admission policy and procedure shall be decided from time to time by the Board of Management (BOM) of the Institute, following guidelines issued by Ministry of Human Resource Development (MHRD), Government of India. The number of seats in each branch of the (M.TECH / M.B.A. / M.C.A.) programme will be decided by BOM as per the directives from Ministry of Human Resource Development (MHRD), Government of India and taking into account the market demands. Some seats for Non Resident Indians and a few seats for foreign nationals shall be made available.

2.2 The selected candidates will be admitted to the (M.TECH / M.B.A. / M.C.A.) programme after he/she fulfills all the admission requirements set by the Institute and after payment of the prescribed fees.

2.3 Candidates for admission to the first semester of the Master's Degree Programme shall be required to have passed an appropriate Degree Examination recognized by Hindustan University.

2.4 In all matters relating to admission to the (M.TECH / M.B.A. / M.C.A.). Programme, the decision of the Institute and its interpretation given by the Chancellor of the Institute shall be final.

2.5 If at any time after admission, it is found that a candidate has not fulfilled any of the requirements stipulated by the Institute, the Institute may revoke the admission of the candidate with information to the Academic Council.

3. Structure of the programme

3.1 The programme of instruction will have the following structure

i) Core courses of Engineering / Technology / Management.

ii) Elective courses for specialization in areas of student's choice

3.2 The minimum durations of the programmes are as given below:

Program	No. of Semesters
M.Tech.(Full-Time)	4
M.Tech.(Part -Time)	6
M.B.A. (Full - Time)	4
M.B.A. (Part - Time)	6
M.C.A.(Full - Time)	6
M.C.A.(Part -Time)	8

Every (M.TECH / M.B.A. / M.C.A.) programme will have a curriculum and syllabi for the courses approved by the Academic Council.

3.3 Each course is normally assigned certain number of credits. The following norms will generally be followed in assigning credits for courses.

- One credit for each lecture hour per week per semester
- One credit for each tutorial hour per week per semester
- One credit for each laboratory practical of three hours per week per semester.
- One credit for 4 weeks of industrial training and
- One credit for 2 hours of project per week per semester.

3.4 For the award of degree, a student has to earn certain minimum total number of credits specified in the curriculum of the relevant branch of study. The curriculum of the different programs shall be so designed that the minimum prescribed credits required for the award of the degree shall be within the limits specified below.

Program	Minimum prescribed credit range
M.Tech. (Full time / Part time)	75 - 85
M.B.A. (Full time / Part time)	85 - 95
M.C.A (Full time / Part time)	115 - 125

3.5 The medium of instruction, examination and the language of the project reports will be English.

4. Faculty Advisor

4.1 To help the students in planning their courses of study and for getting general advice on the academic programme, the concerned Department will assign a certain number of students to a Faculty member who will be called their Faculty Advisor.

5. Class Committee

5.1 A Class Committee consisting of the following will be constituted by the Head of the Department for each class:

(i) A Chairman, who is not teaching the class.

(ii) All subject teachers of the class.

(iii) Two students nominated by the department in consultation with the class.

The Class Committee will meet as often as necessary, but not less than three times during a semester.

The functions of the Class Committee will include:

(i) Addressing problems experienced by students in the classroom and the laboratories.

(ii) Analyzing the performance of the students of the class after each test and finding ways and means of addressing problems, if any.

(iii) During the meetings, the student members shall express the opinions and suggestions of the class students to improve the teaching / learning process.

6. Grading

6.1 A grading system as below will be adhered to.

Range of Marks	Letter Grade	Grade points
95-100	S	10
85 - 94	A	09
75- 84	B	08
65-74	C	07
55-64	D	06
50-54	E	05
< 50	U	00
	I (Incomplete)	–

6.2 GPA & CGPA

GPA is the ratio of the sum of the product of the number of credits C_i of course "i " and the grade points P_i earned for that course taken over all courses "i" registered by the student to the sum of Ci for all "i ". That is,

$$GPA = \frac{\sum_i C_i P_i}{\sum_i C_i}$$

CGPA will be calculated in a similar manner, at any semester, considering all the courses enrolled from first semester onwards.

6.3 For the students with letter grade I in certain subjects, the same will not be included in the computation of GPA and CGPA until after those grades are converted to the regular grades.

6.4 Raw marks will be moderated by a moderation board appointed by the Vice-Chancellor of the University. The final marks will be graded using an absolute grading system. The Constitution and composition of the moderation board will be dealt with separately.

7. Registration and Enrollment

7.1 Except for the first semester, registration and enrollment will be done in the beginning of the semester as per the schedule announced by the University.

7.2 A student will be eligible for enrollment only if he/she satisfies regulation 10 (maximum duration of the programme) and will be permitted to enroll if (i) he/she has cleared all dues in the Institute, Hostel & Library up to the end of the previous semester and (ii) he/she is not

debarred from enrollment by a disciplinary action of the University.

7.3 Students are required to submit registration form duly filled in.

8. Registration requirement

8.1 **(i)** A Full time student shall not register for less than 16 credits or more than 26 credits in any given semester.

8.1 **(ii)** A part time student shall not register for less than 10 credits or more than 20 credits in any given semester.

8.2 If a student finds his/her load heavy in any semester, or for any other valid reason, he/she may withdraw from the courses within three weeks of the commencement of the semester with the written approval of his/her Faculty Advisor and HOD. However the student should ensure that the total number of credits registered for in any semester should enable him/her to earn the minimum number of credits per semester for the completed semesters.

9. Minimum requirement to continue the programme

9.1 For those students who have not earned the minimum required credit prescribed for that particular semester examination, a warning letter to the concerned student and also to his parents regarding the shortage of his credit will be sent by the HOD after the announcement of the results of the university examinations.

10. Maximum duration of the programme

The minimum and maximum period for the completion of various programs are given below.

Program	Min. No. of Semesters	Max. No. of Semesters
M.Tech (Full - time)	4	8
M.Tech (Part - time)	6	10
M.B.A. (Full Time)	4	8
M.B.A. (Part Time)	6	10
M.C.A. (Full - Time)	6	12
M.C.A (Part -Time)	8	14

11. Temporary discontinuation

11.1 A student may be permitted by the Director(academic) to discontinue temporarily from the programme for a semester or a longer period for reasons of ill health or other valid reasons. Normally a student will be permitted to discontinue from the programme only for a maximum duration of two semesters.

12. Discipline

12.1 Every student is required to observe discipline and decorum both inside and outside the campus and not to indulge in any activity which will tend to bring down the prestige of the University.

12.2 Any act of indiscipline of a student reported to the Director (Academic) will be referred to a Discipline Committee so constituted. The Committee will enquire into the charges and decide on suitable punishment if the charges are substantiated. The committee will also authorize the Director(Academic) to recommend to the Vice-Chancellor the implementation of the decision. The student concerned may appeal to the Vice-Chancellor whose decision will be final. The Director (Academic) will report the action taken at the next meeting of the Council.

12.3 Ragging and harassment of women are strictly prohibited in the University campus and hostels.

13. Attendance

13.1 A student whose attendance is less than 75% is not eligible to appear for the end semester examination for that semester. The details of all students who have attendance less than 75% will be announced by the teacher in the class. These details will be sent to the concerned HODs and Director (Academic).

13.2 Those who have less than 75% attendance will be considered for condonation of shortage of attendance. However a condonation of 10% in attendance will be given on medical reasons. Application for condonation recommended by the Faculty Advisor, concerned faculty member and the HOD is to be submitted to the Director (Academic) who, depending on the merits of the case, may permit the student to appear for the end semester examination. A student will be eligible for this concession at most in two semesters during the entire degree programme. Application for medical leave, supported by medical certificate with endorsement by a Registered Medical Officer, should reach the HOD within seven days after returning from leave or, on or before the last instructional day of the semester, whichever is earlier.

13.3 As an incentive to those students who are involved in extra curricular activities such as representing the University in Sports and Games, Cultural Festivals, and Technical Festivals, NCC/ NSS events, a relaxation of up to 10% attendance will be given subject to the condition that these students take prior approval from the officer-in-charge. All such applications should be recommended by the concerned HOD and forwarded to Director (Academic) within seven instructional days after the programme/activity.

14. Assessment Procedure

14.1 The Academic Council will decide from time to time the system of tests and examinations in each subject in each semester.

14.2 For each theory course, the assessment will be done on a continuous basis as follows:

Test / Exam	Weightage	Duration of Test Exam
First Periodical Test*	10%	2 Periods
Second Periodical Test*	10%	2 Periods
Model exam	20%	3 hours
Seminar/ Assignments/Quiz	20%	
End - semester examination	50%	3 Hours

*** Best out of the two tests will be considered.**

14.3 For practical courses, the assessment will be done by the subject teachers as below:

(i) Weekly assignment/Observation note book / lab records - weightage 60%.

(ii) End semester examination of 3 hours duration including viva - weightage 40%

15. Make up Examination/model examination

15.1 Students who miss the end-semester examinations / model examination for valid reasons are eligible for make-up examination /model examination. Those

who miss the end-semester examination / model examination should apply to the Head of the Department concerned within five days after he / she missed examination, giving reasons for absence.

15.2 Permission to appear for make-up examination / model exam will be given under exceptional circumstances such as admission to a hospital due to illness. Students should produce a medical certificate issued by a Registered Medical Practitioner certifying that he/she was admitted to hospital during the period of examination / model exam and the same should be duly endorsed by parent / guardian and also by a medical officer of the University within 5 days.

16. Project evaluation

16.1 For Project work, the assessment will be done on a continuous basis as follows:

Review / Examination	Weightage
First Review	10%
Second Review	20%
Third Review	20%
End semester Examination	50%

For end semester exam, the student will submit a Project Report in a format specified by the Director (Academic). The first three reviews will be conducted by a Committee constituted by the Head of the Department. The end - semester examination will be conducted by a Committee constituted by the Controller of Examinations. This will include an external expert.

17. Declaration of results

17.1 A candidate who secures not less than 50% of total marks prescribed for a course with a minimum of 50% of the marks prescribed for the end semester examination shall be declared to have passed the course and earned the specified credits for the course.

17.2 After the valuation of the answer scripts, the tabulated results are to be scrutinized by the Result Passing Boards of PG programmes constituted by the Vice-Chancellor. The recommendations of the Result Passing Boards will be placed before the Standing Sub Committee of the Academic Council constituted by the Chancellor for scrutiny. The minutes of the Standing Sub Committee along with the results are to be placed before the Vice-Chancellor for approval. After getting the approval of the Vice-Chancellor, the results will be published by the Controller of Examination/ Registrar.

17.3 If a candidate fails to secure a pass in a course due to not satisfying the minimum requirement in the end semester examination, he/she shall register and re-appear for the end semester examination during the following semester. However, the sessional marks secured by the candidate will be retained for all such attempts.

17.4 If a candidate fails to secure a pass in a course due to insufficient sessional marks though meeting the minimum requirements of the end semester examination, wishes to improve on his/ her sessional marks, he/she will have to register for the particular course and

attend the course with permission of the HOD concerned and the Registrar. The sessional and external marks obtained by the candidate in this case will replace the earlier result.

17.5 A candidate can apply for the revaluation of his/her end semester examination answer paper in a theory course within 2 weeks from the declaration of the results, on payment of a prescribed fee through proper application to the Registrar/Controller of Examinations through the Head of the Department. The Registrar/ Controller of Examination will arrange for the revaluation and the results will be intimated to the candidate concerned through the Head of the Department. Revaluation is not permitted for practical courses and for project work.

17.6 The weightage for internal marks in finalizing results and grades shall be waived off after completion of 5 semesters.

18. Grade Card

18.1 After results are declared, grade sheet will be issued to each student, which will contain the following details:

(i) Program and branch for which the student has enrolled.

(ii) Semester of registration.

(iii) List of courses registered during the semester and the grade scored.

(iv) Semester Grade Point Average (GPA)

(v) Cumulative Grade Point Average (CGPA).

19. Class / Division

19.1 Classification is based on CGPA and is as follows:

CGPA $\geq$ 8.0 : **First Class with distinction**

$6.5 \leq$ CGPA < 8.0 : **First Class**

$5.0 \leq$ CGPA < 6.5 : **Second Class.**

19.2 (i) Further, the award of 'First class with distinction' is subject to the candidate becoming eligible for the award of the degree having passed the examination in all the courses in his/her first appearance within the minimum duration of the programme.

(ii) The award of 'First Class' is further subject to the candidate becoming eligible to the award of the degree having passed the examination in all the courses within the below mentioned duration of the programme.

Program	No. of Semesters
M.Tech.(Full-Time)	5
M.Tech.(Part -Time)	7
M.B.A. (Full - Time)	5
M.B.A. (Part - Time)	7
M.C.A.(Full - Time)	7
M.C.A.(Part -Time)	9

(iii) The period of authorized discontinuation of the programme (vide clause 11.1) will not be counted for the purpose of the above classification.

20. Transfer of credits

20.1 Within the broad framework of these regulations, the Academic Council, based on the recommendation of the transfer of credits committee so constituted by the Chancellor may permit students to earn part of the credit requirement in other approved institutions of repute and status in the country or abroad.

21. Eligibility for the award of (M.TECH / M.B.A. / M.C.A.) Degree

21.1 A student will be declared to be eligible for the award of the (M.TECH / M.B.A. / M.C.A.). Degree if he/she has

i) registered and successfully credited all the core courses,

ii) successfully acquired the credits in the different categories as specified in the curriculum corresponding to the discipline (branch) of his/her study within the stipulated time,

iii) has no dues to all sections of the Institute including Hostels, and

iv) has no disciplinary action pending against him/her.

The award of the degree must be recommended by the Academic Council and approved by the Board of Management of the University.

22. Power to modify

22.1 Notwithstanding all that has been stated above, the Academic Council has the right to modify any of the above regulations from time to time subject to approval by the Board of Management.

HINDUSTAN UNIVERSITY

HINDUSTAN INSTITUTE OF TECHNOLOGY AND SCIENCE
DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING
M.TECH. PROCESS CONTROL & INSTRUMENTATION

OBJECTIVES OF THE PROGRAMME

- To impart the state of the art technology in the field of Process Control and Instrumentation Engineering.
- To enable the students to Model, Design and Solve engineering Problems related Process Industries.
- To enable the students to gain sound knowledge in diversified fields of Instrumentation, Control Engineering Design Perspectives, Process Control and Measurement Engineering concepts
- To enable the students to Model, Design and Solve engineering Problems related Process Industries.
- To impart knowledge on Applied Instrumentation Systems and their applications.

PROGRAMME OUTCOME

- The student will have sound knowledge in instrumentation fields, control engineering concepts and process measurement systems
- The students will be able to model ,design and solve engineering problems related to process industries
- The students will be able to implement instrumentation system applied to industries.
- Students will become an accomplished instrumentation engineer

HINDUSTAN UNIVERSITY

HHINDUSTAN INSTITUTE OF TECHNOLOGY AND SCIENCE

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

M.TECH. PROCESS CONTROL & INSTRUMENTATION

CURRICULUM 2013-2014

SEMESTER I

Sl. No.	Course Code	Course Title	L	T	P	C	TCH
Theory							
1.	PMA106	Advanced Applied Mathematics *	3	1	0	4	4
2.	PPC101	Analog & Digital Instrumentation	3	1	0	4	4
3.	PPC102	Transducer Design	3	1	0	4	4
4.	PES102	Embedded System Design #	3	1	0	4	4
5.	PPC103	Communication Protocols for Instrumentation	3	1	0	4	4
6.	PES104	Real Time Operating System**	3	1	0	4	4
Practical							
7.	PPC104	Embedded System Design Laboratory	0	0	3	2	3
		Total				**26**	**27**

***---Common to M.Tech (ES/PCI/CS/AE/CCE/VLSI)**

#---Common to M.Tech (CS/ES/VLSI/PCI/AE/EC)

****---Common to M.Tech (ES/PCI/EC)**

SEMESTER II

Sl. No.	Course Code	Course Title	L	T	P	C	TCH
Theory							
1.	PPD204	Linear & Non-Linear System Theory*	3	1	0	4	4
2.	PPC201	Programmable Logic Controller & Distributed Control Systems	3	1	0	4	4
3.	PPC202	Modern Control Theory	3	1	0	4	4
4.	PPC203	Digital Control Theory	3	1	0	4	4
5	P***	Elective- I	3	0	0	3	3
6.	P***	Elective- II	3	0	0	3	3

Sl. No.	Course Code	Course Title	L	T	P	C	TCH
Practical							
7.	PPC204	Process Control & Instrumentation Laboratory	0	0	3	2	3
		Total				**24**	**25**

***---Common to M.Tech (PCI/PED)**

SEMESTER III

Sl. No.	Course Code	Course Title	L	T	P	C	TCH
Theory							
1.	P***	Elective -III	3	0	0	3	3
2.	P***	Elective - IV	3	0	0	3	3
3.	P***	Elective - V	3	0	0	3	3
Practical							
4.	PPC305	Project Phase- I	0	0	12	6	12
		Total				**15**	**21**

SEMESTER IV

Sl. No.	Course Code	Course Title	L	T	P	C	TCH
Practical							
1.	PPC406	Project Phase-II	0	0	24	12	24
		Total				**12**	**24**

LIST OF ELECTIVES

Sl.No	Course Code	Course Title
1.	PAL101	Advanced Digital System Design
2.	PPD702	Intelligent Control
3.	PPC701	Advanced Topics in Process Instrumentation Systems
4.	PPC702	Instrumentation in Petrochemical Industries.
5.	PPC703	Instrumentation and Control in Automotive Industries
6.	PPC704	Advanced Process Instrumentation
7.	PPC705	Industrial Automation
8.	PPC706	Artificial Intelligences
9.	PPC707	Optimal Control Theory
10.	PPC708	Advanced Process Control
11.	PPC709	Process Dynamics
12.	PCS706	Digital Image Processing
13.	PPC710	Process Control System Components
14.	PPC711	Advanced Digital Signal Processing for Instrumentation Engineers

Total Credits: 77

***- Common Subjects**

HINDUSTAN UNIVERSITY
HINDUSTAN INSTITUTE OF TECHNOLOGY AND SCIENCE

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING
M.TECH. PROCESS CONTROL & INSTRUMENTATION

CURRICULUM 2013-2014

SEMESTER I
[Common to M.Tech (ES/PCI/CS/AE/CCE and VLSI)]

PMA106 ADVANCED APPLIED MATHEMATICS

L	T	P	C
3	1	0	4

Goal

Develop the Mathematical skills to formulate certain practical problems, solve them and physically interpret the results

Objectives

The course should enable the student to

1. Understand the techniques to solve the system of equations using direct method and indirect methods. Learns to decompose the matrix in the LU form and to find the Eigen value of a matrix using power and Jacobi methods.
2. Classify the initial and boundary value problems. Understands the D'Alemberts solution of the one dimensional wave equation. Learn significance of characteristic curves.
3. Learn series solutions of Bessel's and Legendre equations. Understand recurrence relation, generating functions and orthogonal properties.
4. Learn basics of probability, addition and multiplication, Baye's theorems. Understands the concept of random variable, moment generating function and their properties. Learn standard distributions in discrete and continuous cases
5. Learn the different Markovian models with finite and infinite capacity and understands to classify them.

Outcomes

The students should be able to:

1. Write the algorithm for solving the simultaneous equations for direct and indirect methods. Identifies the Eigen values using conventional method and compares with numerical solutions. Able to write the algorithm to find the Eigen values of a matrix.
2. Form the wave equations with initial conditions and solve them using D'Alemberts solutions. Solves the wave equations using Laplace transform for displacements in long string - long string under its weight and free and forced vibrations.

3. Solve the Bessel's equation and Legendre equations and using Bessel's function solves many practical problems that arise in electrical transmission problems and vibration of membranes as in loudspeakers.

4. Evaluate the probability using addition and multiplication theorem. Applies Baye's for practical problems to find the probability. Verifies whether a given function is a probability mass or density function. Applies the discrete and continuous distributions for solving practical problems. Evaluates the moments of the distributions using moment generating function.

5. Analyze and classify the models, M / M / 1, M / M / C, finite and infinite capacity and solves practical problems related to the queuing models.

UNIT I LINEAR ALGEBRAIC EQUATION AND EIGEN VALUE PROBLEMS 12

System of Equations - Solution by Gauss Elimination and Gauss Jordan methods - LU decomposition method - Indirect methods - Gauss Jacobi and Gauss Seidel methods - Eigen values of a matrix using Jacobi and power methods.

UNIT II WAVE EQUATION 12

Solution of initial and boundary value problems - Characteristics - D'Alembert's solution - Significance of characteristic curves - Laplace transform solutions for displacement in a long string, in a long string under its weight - a bar with prescribed force on one end - Free vibrations of a string.

UNIT III SPECIAL FUNCTIONS 12

Series solutions - Bessel's equation - Bessel functions - Legendre's equation - Legendre polynomials - Rodrigue's formula - Recurrence relations - Generating functions and orthogonal property for Bessel functions of the first kind - Legendre polynomials.

UNIT IV PROBABILITY AND RANDOM VARIABLE 12

Discrete and Continuous random variables - Moments - Moment generating functions - Standard distributions - Binomial, Poisson, Geometric, Negative Binomial, Uniform, Normal ,Exponential, Gamma and Weibull distributions - Two dimensional random variables - Joint, Marginal and Conditional distributions. Correlation and Regression.

UNIT V QUEUING THEORY 12

Markovian models - Birth and death queuing models - Steady state - Single and Multiple servers - M/M/1 - Finite and infinite capacity - M/M/C - finite and infinite capacity.

L = 45 T = 15
TOTAL: 60

REFERENCE BOOK

1) Taha, H.A., "Operations Research - An Introduction ", Prentice Hall of India Ltd., 6th Edition, New Delhi, 1997.

2) Dr.Singaravelu A., Dr.Siva Subramanian S., and Dr.Ramachandran C., "Probability and Queuing Theory", Meenakshi agency, 20th edition, January 2013.

3) Veerarajan T., "Probability, Statistics and Random Processes", Tata McGraw-Hill, second edition, 2004.

4) Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 34th edition.

5) Sankara Rao K., "Introduction to Partial Differential Equations", PHI, 1995.

6) Veerarajan T., "Mathematics IV", Tata McGraw-Hill, 2000.

PPC101 ANALOG AND DIGITAL INSTRUMENTATION

L	T	P	C
3	1	0	4

Goal

The goal of the programme is to provide a thorough knowledge about different types of Data Acquisition systems and about different communication systems used in industry.

Objectives

The course should enable the students to :

1. Study the different type of A/D converters.
2. Make them understand the building blocks of Automation systems and various Data Acquisition Systems& Data loggers.
3. Assist the learners in understanding about different types of interfacing and transmission systems.
4. Learn the different types of communication protocols such as HART, Field bus, General field bus architecture, Instrumentation buses, Mod bus, GPIB, Network buses, Ethernet, TCP/IP protocols.
5. Learn the real time Data Acquisition system applications for the case studies.

Outcome

The students should be able to:

1. Select the A/D converter for different application.
2. Know the difference between single channel and multi channel Data Acquisition Systems and can use this knowledge in sensor based acquisition systems.
3. Understand TDM, Digital Modulation, Pulse Modulation and different interfacing system standards.
4. Understand the different communication protocols that industries are following.
5. Have the basic idea of PC based industrial process measurements like flow, temperature, pressure and level systems.

UNIT I BASIC BLOCKS **9**

Overview of A/D converter, types and characteristics-Understanding Data acquisition, A/D and S/H terms-passive support and Active support components-Single and Multi-slope, Low cost A/D conversion techniques, types-Electromechanical A/D converter.

UNIT II DATA ACQUISITION SYSTEMS **9**

Objective - Building blocks of Automation systems - Multi, Single channel Data Acquisition systems, PC based DAS, Data loggers- Sensors based computer data systems.

UNIT III INTERFACING AND DATA TRANSMISSION **9**

Data transmission systems- 8086 Microprocessor based system design - Peripheral Interfaces - Time Division Multiplexing (TDM) - Digital Modulation - Pulse Modulation - Pulse Code Format - Interface systems and standards - Communications.

UNIT IV PC BASED INSTRUMENTATION **9**

Introduction - Evolution of signal Standard - HART Communication protocol -Communication modes - HART networks - control system interface - HART commands -HART field controller implementation - HART and the OSI model - Field bus -Introduction - General field bus architecture - Basic requirements of field bus standard -field bus topology - Interoperability - interchangeability - Instrumentation buses- Mod bus - GPIB - Network buses - Ethernet - TCP/IP protocols

UNIT V CASE STUDIES **9**

PC based industrial process measurements like flow, temperature, pressure and level - PC based instruments development system.

L = 45 T = 15

TOTAL: 60

REFERENCE BOOK

1. Kevin M. Daugherty, "Analog - to - Digital conversion - A Practical Approach", McGraw Hill International Editions, 1995
2. N. Mathivanan, "Microprocessors, PC Hardware and Interfacing", Prentice - Hall of India Pvt. Ltd., 2003.
3. Krishna Kant "Computer- based Industrial Control" ,Prentice- Hall of India Pvt. Ltd., 2004.
4. H S. Kalsi, "Electronic Instrumentation", Technical Education Series Tata McGraw-Hill, 2004.
5. Buchanan, "Computer busses", Arnold, London, 2000.

PPC102 TRANSDUCER DESIGN

L	T	P	C
3	1	0	4

Goal

To provide basic knowledge about various sensors, its selection criteria and their Applications

Objectives

The course will enable the students to :

1. Impart knowledge about the various sensors used for measuring physical parameters.

2. Emphasis on signal processing, converting and presenting it to monitoring /controlling instruments.

3. Acquire knowledge design of electro mechanical transducers for heavy machinery devices.

4. Acquaint them with various transducers used for measurement in various environment.

Outcome

The students should be able to:

1. Understand the basic principles of sensors used for measuring physical parameters.

2. Design signal conditioning circuits and monitor parameters.

3. Design/ select electro-mechanical transducers used in air craft and ship industries.

4. Choose and apply transducer for various environments.

UNIT I FUNDAMENTALS 12

Review of Fundamentals of Transducers for measurement of: Physical parameters like. Displacement, Pressure, Force, Flow, Stress, Strain, Velocity, Vibration, Torque, Temperature, pH, Conductivity, Proximity sensors, Chemical parameters, Bio medical parameters like. Pathological parameters, Detection of alpha, beta and gamma radiation.

UNIT II SIGNAL CONDITIONERS 12

Review of signal conditioners for: Strain Gauge Transducers, Inductive Transducers, Magnetic, Magneto-strictest, Piezo Electric Transducers, Optical Transducers, Capacitive Transducers, Vibrating wire, Review of Processors for Analog and Digital Signals, Review of Various Input and Output Display Systems

UNIT III ELECTROMECHANICAL TRANSDUCERS 12

Design of Electromechanical Transducers for: Force, Pressure, Stress, Vibration measurement using Strain-gauge, LVDT , Capacitive Elements, Optical Device, Application in design case, such as measurements for Hydraulic and Pneumatic Machinery like Turbines, Aircraft Systems and Ship Machinery

UNIT IV SELECTION CRITERIA & APPLICATION 12

Discussion of Selection Criteria for each of above cases: Design of Electromechanical Transducers for Torque, Flow and Velocity. Application in design case from Automobile for Torque, Liquid Flow for Flow and Velocity. Inclination/Tilt, Rotation and Gyration of Machinery like Winches, Earth Movers, Fork lifts, Giant Wheels, Space Craft etc. Discussion on design criteria for three component and six component dynamometers both pure mechanical and electromechanically designs. Discussion on Multi-output (including digital) Transducers for various applications.

UNIT V CASE STUDIES 12

Case Studies for: Chemical Sensors, Bio sensors, Gas Sensors. Discussions on Nano Sensors and MEMS applications. Application of LASER for various measurements like: alignment, distance, velocimetry for convection and liquid flow, angular rotation. Applications of LASER for micromachining,

printing and compact discs like CD and DVD, Weapons, welding, surface hardening, cutting, nuclear fusion.

L = 45 T = 15

Total = 60

REFERENCE BOOK

1. H K P Neubert, 'Instrument Transducers', Oxford University Press, 1999
2. Bella G Liptak, 'Instrument Engineers Handbook, Vol 1, 2 and 3', 4th edition, CRC Press, 2005.
3. C.S. Rangan, G.R. Sarma and V.S.V. Mani 'Instrumentation Devices and Systems', Tata McGraw-Hill Publishing Company Ltd. New Delhi, 2004.
4. J. Wilson, J.F.B. Hawkes, 'Laser Principles and Applications', Prentice-Hall, New York, 1987.
5. J. Wilson, 'Optoelectronics', 2nd Edition, Prentice-Hall, India. 2003.

PES102 EMBEDDED SYSTEN DESIGN

L	T	P	C
3	1	0	4

Goal

The aim of this course is to expose the concepts of Embedded system principles and software development tools and introducing PIC and Motorola microcontrollers and interfacing.

Objectives

The course should enable the students to:

1. Understand the use of review in Embedded hardware
2. Understand basic concepts of design of Embedded software system
3. Understand the Software architecture and Developments tools
4. Understand the Operation of PIC microcontroller and interfacing
5. Understand the Operation of Embedded Microcomputer systems

Outcome

The student should be able to:

1. Use of hardware fundamentals.Gates.timing diagram,DMA,interrupts,built ins on the microprocessor and microprocessor architecture.
2. Explain the concept of Tasks,States,Data,Semaphores,more operating system servicesIR in RTOS environment,Basic design using RTOS.
3. Develop through basic knowledge on the behavior and the characteristics of Round-Robin techniques, Functions, Queue, Host, Target machine and Debugging techniques.

4. Learn the usage of Architecture,instruction sets of PIC, Loop time subroutine,I/O port expansion, I2C for peripherals chip access,ADC and UART special features.

5. Acquire knowledge on the configuration of Motorolla,Registers,addressing modes,interfacing methods,ISR,Timing generations and measurements.

UNIT I INTRODUCTION : REVIEW OF EMBEDDED HARDWARE 12

Hardware Fundamentals: Terminology- Gates- Timing Diagram- Microprocessors- Buses- Direct Memory Access- Interrupts- Other Common Parts- Built-Ins on the Microprocessor-Conventions Used on Schematics. Interrupts: Microprocessor Architecture - Interrupts Basics-Shared-Data Problem- Interrupt Latency, Examples of Embedded System.

UNIT II DESIGN OF EMBEDDED SOFTWARE SYSTEM 12

Introduction: Tasks and Task States- Tasks and Data- Semaphores and Shared Data. More Operating System Services: Message Queues- Mailboxes and Pipes- Timer Functions- Events- Memory Management- Interrupt Routines in an RTOS Environment, Basic Design Using a Real-Time Operating System.

UNIT III SOFTWARE ARCHITECTURES AND DEVELOPMENT TOOLS 12

Software Architectures: Round-Robin- Round-Robin with Interrupts- Function-Queue-Scheduling Architecture- Real-Time Operating System Architecture, Development Tools: Host and Target Machines-Linker/Locators for Embedded Software, Debugging Techniques.

UNIT IV PIC MICROCONTROLLER AND INTERFACING 12

Introduction- CPU Architecture and Instruction Set- Loop Time Subroutine- Timer2 and Interrupts-Interrupts Timing- I/O Port Expansion- I2C Bus for Peripheral Chip Access- Analog-to- Digital Converter-UART- Special Features.

UNIT V EMBEDDED MICROCOMPUTER SYSTEMS 12

Introduction to ARM7 - 2148 - Instruction set - Addressing Modes. Interfacing Methods: Parallel I/O Interface- Parallel Port Interfaces- Memory Interfacing- High Speed I/O interfacing-Analog interfacing, Interrupts, Interrupts Service Routine- Features of Interrupts- Interrupt Vector and Priority, Timing Generation and Measurements: Input Capture- Output Compare- Frequency Measurement, Serial I/O Devices: RS232- RS485.

L = 45, T = 15, TOTAL= 60

REFERENCE BOOK

1. David E Simon, An Embedded Software Primer, Pearson Education Asia, 2001

2. John B. Peat man , Design with Microcontroller, Pearson Education Asia, 1998

3. Jonarthan W. Valvano Brooks/cole ,Embedded Micro Computer Systems, Real Time Interfacing, Thomson Learning 2001

4. Burns, Alan and Wellings, Andy, Real-Time Systems and Programming Languages, Second Edition, Harlow: Addison-Wesley-Longman, 1997

5. Raymond J.A. Bhur and Donald L.Bialey, An Introduction to Real Time Systems: Design to Networking with C/C++, Prentice Hall Inc, NewJersey, 1999

6. Grehan Moore, and Cyliax , Real Time Programming: A Guide to 32 Bit Embedded Development. Reading: Addison-Wesley-Longman, 1998

7. Heath, Steve, Embedded Systems Design. Newnes , 1997

PPC103 COMMUNICATION PROTOCOLS FOR INSTRUMENTATION

L	T	P	C
3	1	0	4

Prerequisite **Computer Interfacing**

Goal

The aim of this course is to give exposure to Hierarchical Structure of networks used in Automation and Control Systems and Understand the ISO OSI Seven Layer Communication Structure, Communication interfaces, Ethernet, Communication protocols.

Objectives

The course should enable the students to :

1. Understand the use of Communication Model for recent Industry Networks.
2. Widen the knowledge on Communication Protocols.
3. Learn about the Network Architectures.
4. Expand knowledge on Field Bus.
5. Enrich expertise on the commissioning of Industrial Networks systems.

Outcome

The student should be able to:

1. Explain the concept of communication model, OSI reference model, Recent Industry networks.
2. Classify the Network selection applicable for specific industrial needs.
3. Differentiate the Network Architecture and understand the concepts of Industrial protocols like Ethernet, Modbus, Modbus Plus.
4. Design and install Field Bus oriented Industrial Communication Networks.
5. Calibrate the smart devices using Profibus and Field Bus of any Industrial Application

UNIT I INTRODUCTION **12**

An Introduction to Networks in process automation: Information flow requirements, Hierarchical communication model, Data Communication basics, OSI reference model, Industry Network, Recent networks.

UNIT II COMMUNICATION PROTOCOLS **12**

Introduction to Communication Protocols: Communication basics, Network Classification, Device Networks, Control Networks, Enterprise Networking, Network selection.

UNIT III NETWORK ARCHITECTURES **12**

Proprietary and open networks: Network Architectures, Building blocks, Industry open protocols (RS-232C, RS- 422, and RS-485), Ethernet, Modbus, Modbus Plus, Data Highway Plus, Advantages and Limitations of Open networks, IEEE 1394.

UNIT IV FIELD BUS **12**

Field bus: Field bus Trends, Hardware selection, Field bus design, Installation, Documentation, Field bus advantages and limitations. HART: Introduction, Design, Installation, calibration, commissioning, Application in Hazardous and Non-Hazardous area.

UNIT V PLANNING AND COMMISSIONING **12**

Foundation Field bus & Profibus: Introduction, Design, Calibration, Commissioning, Application in Hazardous and Non-Hazardous area. Introduction to wireless Protocols: WPAN, Wi-Fi, Bluetooth, ZigBee, Z-wave.

L = 45 T = 15
Total = 60

REFERENCE BOOK

1. B.G. Liptak, 'Process Software and Digital Networks, CRC Press ISA-, 2002.
2. Romilly Bowden , 'HART Communications Protocol', Fisher-Rosemount, 2003.
3. User Manuals of Foundation Field bus, Profibus, Modbus, Ethernet, Device net, Control net.

PES104 REAL TIME OPERATING SYSTEM

L	T	P	C
3	1	0	4

Goal

To develop in-depth skills in Real Time Operating Systems.

Objectives

The course will enable the students to:

1. Review Operating Systems.
2. Understand about Distributed Operating Systems.
3. Learn Real Time Models and Languages.
4. Understand about introduction to Real Time Kernels.
5. Understand about RTOS and Application Domains.

Outcome

The students should be able to :

1. Explain various operating systems
2. Explain Basic building blocks of Real time Operating Systems.
3. Interface various peripherals to RTOS.
4. Program Real time Systems.
5. Develop Real time Systems.

UNIT I REVIEW OF OPERATING SYSTEMS 12

Basic Principles-system calls-Files-Processes-Design and implementation of processes-Communication between processes operating system structures.

UNIT II DISTRIBUTED OPERATING SYSTEMS 12

Topology-Network Types-Communication-RPC-Client server model- Distributed file systems.

UNIT III REAL TIME MODELS AND LANGUAGES 12

Event based-Process based-Graph models-Petrinet models-RTOS tasks-RT scheduling- Interrupt processing-Synchronization-Control blocks-Memory requirements.

UNIT IV REAL TIME KERNEL 12

Principles - Polled loop systems-RTOS porting to a target-Comparison and Study of RTOS- VX Works and µCoS, Introduction to POSIX and OSEK standards.

UNIT V RTOS AND APPLICATION DOMAINS 12

RTOS for Control-Embedded RTOS for Control over IP - RTOS for fault tolerant applications -RTOS for control systems.

L= 45 T=15 TOTAL=60

REFERENCE BOOK

1. Hermann K, 'Real time systems-design principles for distributed embedded Applications', Kluwer academic, 1997.
2. Charles Crowley 'operating systems-A design oriented approach' McGraw Hill,1998
3. AJBUHR, DL Beily, 'An introduction to real time systems' PHI, 1999
4. CM Krishna, Kang G. Shin, 'Real time Systems', Mc GrawHill, 1997
5. Raymond J.A., Donald L Baily, 'An introduction to real time operating systems'PHI, 1999.

PPC104 EMBEDDED SYSTEM DESIGN LABORATORY

L	T	P	C
0	0	3	2

Goal

The aim of this course is to train students with skills in Designing of Embedded based systems required for Industrial Automation and Control Systems.

Objectives

The course should enable the students to:

1. Understand the register architecture of Atmel 8051,PIC 16f877A Microcontroller.
2. Widen the knowledge on interfacing various serial Communication Protocols.
3. Learn about interfacing various parallel communication protocols.
4. Expand knowledge on Interfacing Digital Input and Output.
5. Develop expertise on Interfacing the Analog input and output.

Outcome

The student should be able to:

1. Explain the organization of Registers, Memory and Instruction set with the knowledge of Addressing modes which help the student to develop program sequence for any industrial application.
2. Communicate with any device using USART Configurable Communication Interface.
3. Interface the Parallel/Serial LCD Interface and Alphanumerical Keyboard Interface.
4. Design a complete Data acquisition system with Analog sensor interface and Digital sensors.
5. Simulate the complete embedded application using Virtual Simulation Software (Proteus)

LIST OF EXPERIMENTS	**No. of Hours**
1. System Design Study using Atmel, PIC Microcontrollers.	9
2. System Design for interfacing various parallel communication protocols.	9
3. System Design for interfacing various serial communication protocols.	9
4. System Design for Digital Input and Output (includes Virtual Simulation)	9
5. System design for Analog input and output. (includes Virtual Simulation)	9

EQUIPMENTS REQUIRED

Atmel PIC Microcontroller, serial Interface cards, prallel interface cards, DAQ cards with DI/DO and AI/AO

P=45 TOTAL=45

SEMESTER II

PPD204 LINEAR AND NONLINEAR SYSTEM THEORY
Common to MTech. (PC&IE) / MTech.(EC)/ MTech. (PSE)

L	T	P	C
3	1	0	4

Prerequisite **Control Systems**

Goal

To provide an insight theory on linear and non linear control systems.

Objectives

The course should enable the students to:

1. Study the concept of state space representation of dynamic systems.
2. Study about solution of state equations of linear, nonlinear, time invariant and time varying systems and also about systems modes.
3. Know about the concepts of controllability, observability, detectability, stabilizability and reducability of time invariant and time varying systems.
4. Have an in-depth knowledge about stability of linear and nonlinear systems using Liapunov's criterion.
5. Study the concept of observable and controllable companion forms and pole placement by feedback for SISO and MIMO systems.

Outcome

The student should be able to:

1. Derive state space equations and draw state diagrams for physical systems
2. Solve state equations of linear, nonlinear, time invariant and time varying systems,
3. Verify if a given system is controllable, observable, detectable, stabilizable and reducable.
4. Verify if a given system is stable using Liapunov's criterion.
5. Develop observable and controllable companion forms for a given system.

UNIT I STATE VARIABLE REPRESENTATION **12**

Introduction-Concept of State-State equation for Dynamic Systems-Time invariance and linearity-Nonuniqueness of state model-State Diagrams-Physical System and State Assignment.

UNIT II SOLUTION OF STATE EQUATION **12**

Existence and uniqueness of solutions to Continuous-time state equations-Solution of Nonlinear and Linear Time Varying State equations-Evaluation of matrix exponential-System modes-Role of Eigenvalues and Eigenvectors.

UNIT III CONTROLLABILITY AND OBSERVABILITY **12**

Controllability and Observability-Stabilizability and Detectability-Test for Continuous time Systems-

Time varying and Time invariant case-Output Controllability-Reducibility-System Realizations.

UNIT IV STABILITY **12**

Introduction-Equilibrium Points-Stability in the sense of Lyapunov-BIBO Stability-Stability of LTI Systems-Equilibrium Stability of Nonlinear Continuous Time Autonomous Systems-The Direct Method of Lyapunov and the Linear Continuous-Time Autonomous Systems-Finding Lyapunov Functions for Nonlinear Continuous Time Autonomous Systems-Krasovskii and Variable-Gradiant Method.

UNIT V MODAL CONTROL **12**

Introduction-Controllable and Observable Companion Forms-SISO and MIMO Systems-The Effect of State Feedback on Controllability and Observability-Pole Placement by State Feedback for both SISO and MIMO Systems-Full Order and Reduced Order Observers.

L = 45 T = 15 Total = 60

REFERENCE BOOK

1. M. Gopal, "Modern Control System Theory", New Age International, 2005.
2. K. Ogatta, "Modern Control Engineering", PHI, 2002.
3. John S. Bay, "Fundamentals of Linear State Space Systems", McGraw-Hill, 1999.
4. D. Roy Choudhury, "Modern Control Systems", New Age International, 2005.
5. John J. D'Azzo, C. H. Houpis and S. N. Sheldon, "Linear Control System Analysis and Design with MATLAB", Taylor Francis, 2003.
6. Z. Bubnicki, "Modern Control Theory", Springer, 2005.

PPC201 PROGRAMMABLE LOGIC CONTROLLER &DISTRIBUTED CONTROL SYSTEMS

L	T	P	C
3	1	0	4

Goal

The goal of the programme is to acquaint the student with basic programming skills of PLC and DCS so that they will be able get an insight of industrial Process Control scenario.

Objectives

The course should enable the students to :

1. Get a sound knowledge on digital data acquisition devices and digital controllers.
2. Learn about the basic building blocks of PLC, basic commands and functions.
3. Know the various functions for programming PLC
4. Know about the various interfacing devices Bus Standards to PLC and DCS.
5. Know the basic concepts in DCS

Outcome

The students should be able to:

1. Design digital acquisition devices and digital controllers
2. Program PLC for simple applications using Timers and Counters.
3. Program PLC using Intermediate functions
4. Design interfacing system for PLC and DCS.
5. Understand the architectures of DCS environment.

UNIT I REVIEW OF COMPUTERS IN PROCESS CONTROL 12

Data loggers, Data Acquisition Systems (DAS),Direct Digital Control (DDC). Supervisory Control and Data Acquisition Systems (SCADA), sampling considerations. Functional block diagram of computer control systems. alarms, interrupts. Characteristics of digital data, controller software,linearization. Digital controller modes: Error, proportional, derivative and composite controller modes.

UNIT II PROGRAMMABLE LOGIC CONTROLLER (PLC) BASICS 12

Definition, overview of PLC systems,input/output modules, power supplies, isolators. General PLC programming procedures,programming on-off inputs/ outputs. Auxiliary commands and functions: PLC Basic Functions: Register basics, timer functions, counter functions.

UNIT III PLC INTERMEDIATE FUNCTIONS 12

Arithmetic functions, number comparison functions, SKIP and MCR functions, data move systems. PLC Advanced intermediate functions: Utilizing digital bits, sequencer functions, matrix functions. PLC Advanced functions: Alternate programming languages, analog PLC operation, networking of PLC, PLC-PID functions, PLC installation, troubleshooting and maintenance, design of interlocks and alarms using PLC. Creating ladder diagrams from process control descriptions.

UNIT IV INTERFACE AND BACKPLANE BUS STANDARDS FOR INSTRUMENTATION SYSTEMS FIELD BUS 12

Introduction, concept. HART protocol: Method of operation, structure, operating conditions and applications. Smart transmitters, examples, smart valves and smart actuators.

UNIT V DISTRIBUTED CONTROL SYSTEMS (DCS) 12

Definition, Local Control (LCU) architecture, LCU languages, LCU - Process interfacing issues, communication facilities, configuration of DCS, displays, redundancy concept- case studies in DCS.

L = 45 T = 15 Total = 60

REFERENCE BOOK

1. John. W.Webb Ronald A Reis , Programmable Logic Controllers - Principles and Applications, Third edition, Prentice Hall Inc., New Jersey, 1995.
2. Lukcas M.P Distributed Control Systems, Van Nostrand Reinhold Co., New York, 1986.

3. Deshpande P.B and Ash R.H, Elements of Process Control Applications, ISA Press, New York, 1995.

4. Curtis D. Johnson, Process Control Instrumentation Technology, Fourth edition, Prentice Hall of India, New Delhi, 1999.

PPC 202 MODERN CONTROL THEORY

L	T	P	C
3	1	0	4

Goal

The goal of the programme is to review Process Modeling and Classical Control Theory concepts, analyze and design of control schemes in the discrete-time domain.

Objectives

The course should enable the students to :

1. Study the State Space analysis of continuous time multivariable systems.
2. Make them understand the concept of controllability and observability.
3. Assist the learners in understanding Controllability and Observability tests: Kalman's test matrix, Gilbert's test, Popov-Belevitch-Hautus test, stability
4. Learn the state space analysis of discrete time multivariable systems.
5. Learn the Smith-McMillan form of a transfer function matrix and Matrix-fraction description (MFD) of a transfer function.
6. Learn the Controller parameterization for different systems.

Outcome

The students should be able to:

1. Develop a state space model for a given transfer function and be able to convert into controllable canonical or observable canonical or diagonal canonical form.
2. Know the whether the system is controllable, observable or not.
3. Do the Controllability, Observability and stability tests.
4. Do the discretization of State equations for dynamic systems and solve the discrete state equation.
5. Understand the Smith-McMillan form of a transfer function matrix and Matrix-fraction description (MFD) of a transfer function.
6. Have an idea of affine parameterization for stable systems, PID synthesis using affine parameterization and Affine parameterization, Affine parameterization for systems with dead time and multivariable's.

UNIT I INTRODUCTION **12**

State Space analysis of continuous time multivariable systems: State equations for dynamic systems, State equations using phase, physical and canonical variables, realization of transfer matrices, Minimal realization, Solution of state equation, concepts of controllability, reachability, observability, Controllability and Observability tests: Kalman's test matrix, Gilbert's test, Popov-Belevitch-Hautus test, stability.

UNIT II DISCRETE TIME CONTROL SYSTEMS **12**

Discrete time control systems: sampling theorem, pulse transfer function, modified Z-transform, stability analysis.

UNIT III STATE SPACE ANALYSIS **12**

State space analysis of discrete time multivariable systems: Discretization of State equations for dynamic systems, State equations using phase, physical and canonical variables, realization of transfer matrices, Minimal realization, Solution of state equation, stability.

UNIT IV SYSTEM REALIZATION **12**

State Space and Matrix-Fraction Descriptions of Multivariable systems: State observability, controllability and matrix-fraction descriptions, Some properties of polynomial matrices, Some basic state space realization, The Smith-McMillan form of a transfer function matrix, Poles and Zeros of a transfer function matrix, Matrix-fraction description (MFD) of a transfer function, State space realization from a transfer function matrix, Internal stability, The generalized Nyquist and inverse Nyquist stability criterion.

UNIT V AFFINE PARAMETERIZATION **12**

Controller parameterization: Affine parameterization for stable systems, PID synthesis using Affine parameterization, Affine parameterization for systems with dead time. Affine parameterization of multivariable control systems.

L = 45 T = 15 Total = 60

REFERENCE BOOK

1. Chi-Tsong, 'Linear Systems: Theory & Design', Oxford University Press, 1999.
2. Gopal M., 'Modern Control Systems Theory', New Age International New Delhi, 2009.
3. Goodwin, Graebe S F & Salgado M E, 'Control System Design', Prentice Hall of India, 2002.
4. Ogata K., 'Modern Control Engineering', Prentice Hall of India, 2001.
5. G.F.Franklin, J.David Powell, Michael Workman, 'Digital control of Dynamic Systems', 3rd Edition, Addison Wesley, 2000.
6. M.Gopal, 'Digital Control and State Variable Method', Tata-McGraw Hill, Delhi, 2006.
7. Shinners S M, 'Modern Control System: Theory & Design', Wiley Inter-science Pubs., 1998.

PPC 203 DIGITAL CONTROL THEORY

L	T	P	C
3	1	0	4

Goal

The goal of the programme is to introduce the student to the fundamentals of control theory as applied to digital controllers or sampled data control systems in general and familiarize them with the design of digital control systems

Objectives

The course should enable the students to:

i. Get access to the basic design and analysis of practical discrete-time and sampled data control systems

ii. Get an exposure to discrete-time control systems, with equal emphasis on the basics of computer controlled systems, observer design

Outcome

The students should be able to:

i. Understand the concepts of Sampling,A/D and D/A conversion

ii. Demonstrate z transform analysis of sampled data feedback loops

iii. Understand stability analysis and root locus techniques

iv. Demonstrate a suite of techniques for digital controller design

UNIT I INTRODUCTION **12**

Sampling and holding - Sample and hold devices - D/A and A/D conversion - Reconstruction - Z transform - Inverse Z transform - Properties - Pulse transfer function and state variable approach - Review of controllability, observability.

UNIT II DESIGN USING TRANSFORM TECHNIQUES **12**

Methods of discretisation - Comparison - Direct design - Frequency response methods

UNIT III DESIGN USING STATE SPACE TECHNIQUES **12**

State space design - Pole assignment - Optimal control - State estimation in the presence of noise - Effect of delays.

UNIT IV COMPUTER BASED CONTROL **12**

Selection of processors - Mechanization of control algorithms - PID control laws predictor merits and demerits - Application to temperature control - Control of electric drives - Data communication for control.

UNIT V QUANTIZATION EFFECTS AND SAMPLE RATE SELECTION **12**

Analysis of round off error - Parameter round off - Limit cycles and dither - Sampling theorem limit -

Time response and smoothness - Sensitivity to parameter variations - Measurement noise and antialising filter - Multirate sampling.

L = 45 T = 15 Total = 60

REFERENCE BOOK

1. Gopal.M., "Digital control Systems" , McGraw Hill Education, 2003.
2. G.F.Franklin, J.David Powell, Michael Workman, "Digital control of Dynamic Systems", 3rd Edition, Ellis - Kagle Press, 2006.
3. Paul Katz, "Digital control using Microprocessors", Prentice Hall, 1981.
4. Forsytheand.W.Goodall.R.N., "Digital Control", McMillan, 1991.
5. C.J. Chesmond, P.A. Wilson, M.R.Le Pla, "Advanced Control System Technology", Viva - low price edition, 1998

	L	T	P	C
P* Elective- I (Refer Elective list)**	**3**	**0**	**0**	**3**
P* Elective- II (Refer Elective list)**	**3**	**0**	**0**	**3**

PPC 204 PROCESS CONTROL & INSTRUMENTATION LABORATORY

L	T	P	C
0	**0**	**3**	**2**

Prerequisite MODERN CONTROL THEORY

Goal

To equip students with skills in various packages like MATLAB, LABVIEW, etc. and to give exposure in PC based Digital control system techniques.

Objectives

To impart knowledge on.

1. MATLAB, LABVIEW and MATHCAD.
2. Data Loggers / Data Acquisition Systems.
3. Modeling of Transducers.
4. Simulation of Electric drives with P, PI and PID controllers.
5. Interfacing PC with Real-time systems.
6. Position control system.
7. Control of second-order plan using Micro controllers.
8. Temperature and Level control.

9. Second-order filters.

10. Programmable Logic Controllers for real-time systems.

Outcome

At the end of this course students should have knowledge in the following.

1. Usage of MATLAB, LABVIEW and MATHCAD on control applications.
2. Application of Data Loggers / Data Acquisition Systems in Control Applications.
3. Modeling of Transducers using Experimental Setups.
4. Simulation of Electric drives with P, PI and PID controllers using MATLAB / MATHCAD
5. Interfacing a PC with Real-time systems Control.
6. Digital position control system.
7. Digital control of second-order plan using Micro controllers.
8. Digital temperature and level control.
9. Design and analysis of second-order filters.
10. Design of Programmable Logic Controllers for real-time systems.

LIST OF EXPERIMENTS		**No. of Hours**
1.	Study of MATLAB, LABVIEW and MATHCAD on control applications.	5
2.	Study of Data Loggers / Data Acquisition Systems.	4
3.	Study of Interacting and Non Interacting System (Cascade and ratio controller implementation).	4
4.	Simulation of Electric drives with P, PI and PID controllers using MATLAB / MATHCAD	5
5.	Interfacing PC with Real-time systems.	5
6.	Digital position control system.	4
7.	Digital control of second-order plant using Micro controllers.	5
8.	Digital temperature and level control.	4
9.	Design and analysis of second-order systems.	4
10.	Design of Programmable Logic Controllers for real-time systems.	5
		P=45 TOTAL=45

Components Required

Mat lab / lab view software, Data Loggos, Data acquistion Cards, Interacting & Non Interacting System, Realtime PC Interface Systems, PLC, Positional control system, Temperature and level control systems.

SEMESTER III

		L	T	P	C
P***	Elective -III (Refer Elective list)	3	0	0	3
P***	Elective - IV (Refer Elective list)	3	0	0	3
P***	Elective - V (Refer Elective list)	3	0	0	3
PPC305	Project Phase- I	0	0	12	6

SEMESTER IV

		L	T	P	C
PPC406	Project Phase-II	0	0	24	12

LIST OF ELECTIVES

PAL101 ADVANCED DIGITAL SYSTEM DESIGN

L	T	P	C
3	0	0	3

Goal

To acquaint the students with the advanced topics in the digital systems analysis and design.

Objectives

The course will enable the students to:

1. Study the analysis and design of various types of CSSN, iterative networks and design using ASM charts.
2. Understand the analysis and design of various types of asynchronous circuits and how to eliminate races and hazards
3. Know various types of faults that can occur during fabrication, the methods for fault detection and faults in PLA.
4. Give an insight into programmable logic devices and FPGA.
5. Study the VHDL code and use it for the design of logic devices

Outcome

The students should be able to:

1. Gain the knowledge for designing different types of synchronous sequential circuits and use of ASM charts.
2. Design ASICs, the problems involved in the design process and how to design circuits without hazards, races.
3. Know the types of faults in digital circuits, how to detect these faults, PLA minimization and fault diagnosis.
4. Design CSSN using programmable logic devices and FPGA.
5. Design various logic devices using VHDL

UNIT I SEQUENTIAL CIRCUIT DESIGN **9**

Analysis of Clocked Synchronous Sequential Networks (CSSN) Modeling of CSSN - State table Reduction , State Assignment - Design of CSSN - Design of Iterative Circuits - ASM Chart.

UNIT II ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN **9**

Analysis of Asynchronous Sequential Circuit (ASC) - Flow Table Reduction - Races in ASC - State Assignment - Problem and the Transition Table - Design of ASC - Static and Dynamic Hazards - Essential Hazards - Data Synchronizers - Mixed Operating Mode Asynchronous Circuits.

UNIT III FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS **9**

Fault Table Method - Path Sensitization Method - Boolean Difference Method - Kohavi Algorithm -

Tolerance Techniques - The Compact Algorithm - Practical PLA's - Fault in PLA - Test Generation - Masking Cycle - DFT Schemes - Built-in Self Test.

UNIT IV DESIGN OF CSSN USING PROGRAMMABLE DEVICES 9

EPROM to Realize a Sequential circuit. Programmable Logic Devices - Designing a Synchronous Sequential Circuit using a GAL- Realization State machine using PLD ,FPGA - Xilinx FPGA - Xilinx 2000 - Xilinx 3000

UNIT V SYSTEM DESIGN USING VHDL 9

VHDL Description of Combinational Circuits - Arrays - VHDL Operators - Compilation and Simulation of VHDL Code - Modeling using VHDL - Flip Flops - Registers - Counters - Sequential Machine - Combinational Logic Circuits - VHDL Code for Serial Adder, Binary Multiplier , Binary Divider, complete Sequential Systems.

L =45 Total = 45

REFERENCE BOOK

1. Donald G. Givone "Digital principles and Design" Tata McGraw Hill 2002.
2. John M Yarbrough "Digital Logic applications and Design" Thomson Learning, 2001
3. Nripendra N Biswas "Logic Design Theory" Prentice Hall of India, 2001
4. Charles H. Roth Jr. "Digital System Design using VHDL" Thomson Learning, 1998.
5. Charles H. Roth Jr. "Fundamentals of Logic design" Thomson Learning, 2004.
6. Stephen Brown and Zvonk Vranesic "Fundamentals of Digital Logic with VHDL Design" Tata McGraw Hill, 2002.
7. Navabi.Z. "VHDL Analysis and Modeling of Digital Systems. McGraw International, 1998
8. Parag K Lala, "Digital System design using PLD" BS Publications, 2003
9. Peter J Ashendem, "The Designers Guide to VHDL" Harcourt India Pvt Ltd, 2002
10. Mark Zwolinski, "Digital System Design with VHDL" Pearson Education, 2004
11. Skahill. K, "VHDL for Programmable Logic" Pearson education, 1996

PPD702 INTELLIGENT CONTROL

L	T	P	C
3	0	0	3

Goal

Students completing this course will obtain a basic understanding of fuzzy logic systems and artificial neural networks, and will know how these techniques are applied to engineering problems, including control systems. Students will understand the advantages and disadvantages of these methods relative to other control methods. Students will be aware of current research trends and issues. Students will be able to design control systems using fuzzy logic and artificial neural networks.

Objectives

The course should enable the students to :

1. Obtain a basic understanding of fuzzy logic systems and artificial neural networks.
2. Know how Artificial Neural Network techniques are applied to engineering problems, including control systems.
3. Understand Genetic Algorithm methods for solving control system problems.
4. Able to design control systems using fuzzy logic and artificial neural networks.

Outcome

The student should be able to:

1. Explain the concept of intelligent control and Expert systems .
2. Classify the various ANN Models and train the network for control system specific application.
3. Design Fuzzy Logic Controller with Knowledge based rules and specification.
4. Develop applications using Genetic Algorithm, Fuzzy Logic, Neural Networks and able to Model Linear and Non Linear systems using Matlab.

UNIT I INTRODUCTION **9**

Approaches to intelligent control. Architecture for intelligent control. Symbolic reasoning system, rule-based systems, the AI approach. Knowledge representation. Expert systems.

UNIT II ARTIFICIAL NEURAL NETWORKS **9**

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. Data Processing: Scaling, Fourier transformation, principal-component analysis and wavelet transformations. Hopfield network, Self-organizing network and Recurrent network. Neural Network based controller.

UNIT III GENETIC ALGORITHM **9**

Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like tabu search and ant-colony search techniques for solving optimization problems.

UNIT IV FUZZY LOGIC SYSTEM **9**

Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modelling and control. Fuzzification, inferencing and defuzzification. Fuzzy knowledge and rule bases. Fuzzy modelling and control schemes for nonlinear systems. Self-organizing fuzzy logic control. Fuzzy logic control for nonlinear time-delay system.

UNIT V APPLICATIONS **9**

GA application to power system optimisation problem, Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab-Neural Network toolbox. Stability analysis of Neural-Network interconnection systems. Implementation of fuzzy logic controller using Matlab fuzzy-logic toolbox. Stability analysis of fuzzy control systems.

L =45 Total = 45

REFERENCE BOOK

1. Jacek.M.Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, 1999.
2. Kosko,B. "Neural Networks And Fuzzy Systems", Prentice-Hall of India Pvt. Ltd.,1994.
3. Klir G.J. & Folger T.A. "Fuzzy sets, uncertainty and Information", Prentice-Hall of India Pvt Ltd., 1993
4. Zimmerman H.J. "Fuzzy set theory-and its Applications"-Kluwer Academic Publishers, 1994.
5. D. Driankov, H. Hellendoorn, M. Reinfrank, "Introduction to Fuzzy Control", Narosa Publishers, 2001.

PPC701 ADVANCED TOPICS IN PROCESS INSTRUMENTATION SYSTEMS

L	T	P	C
3	0	0	3

Goal

To acquaint the students with the advanced topics in process instrumentation systems.

Objectives

The course should enable the students to :

1. Learn about the sensors, modulating techniques and measurement methods using fiber optics.
2. Understand the applications that can be carried out using Laser
3. Know about the Techniques involved in Microprocessor based Instrumentation
4. Understand about the smart Instruments used in Transmitters, Communication and Measurement Systems
5. Learn about the concepts of Virtual Instrumentation including Loops, Arrays and file I/O.

Outcome

The student should be able to:

1. Design the fiber optic system using the sensors.
2. Work with the laser based applications
3. Explain the Techniques of Microprocessor based Instrumentation
4. Classify the smart equipments and work with its applications
5. Design the projects related with virtual Instrumentation

UNIT I FIBER OPTIC INSTRUMENTATION 9

Fiber optic sensors - fiber optic instrumentation system -Different types of modulators - detectors - Interferometer method of measurement of length - Moire Fringes - measurement of pressure, temperature, current, voltage, liquid level and strain - fiber optic Gyroscope- polarization - maintaining.

UNIT II LASER INSTRUMENTATION 9

Laser for measurement of distance, length, velocity, acceleration, current, voltage, atmospheric effect - material processing - laser heating, welding, melting and trimming of materials - removal and vaporization.

UNIT III MICROPROCESSOR BASED INSTRUMENTATION 9

Hardware and firmware components of a microprocessor system - micro controllers - multiple processors - An example application of a microprocessor system -calibration and correction - human interface - computer interface - software characteristics of the computer interface - numerical issues - Embedded programming issues.

UNIT IV SMART INSTRUMENTS 9

Smart/intelligent transducer-comparison with conventional transducers-self diagnosis and remote Calibration features-Smart transmitter with HART communicator-Measurement of strain, flow, and pH with smart transmitters.

UNIT V VIRTUAL INSTRUMENTATION 9

Block diagram and architecture of the virtual instrumentation - VIs and sub VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O.

L =45 Total = 45

REFERENCE BOOK

1. Paul . W. Chapman, "Smart Sensors", ISA Publications,1996.
2. John F Ready, "Industrial Applications of Lasers", Academic press,1997.
3. Jasprit Singh, "Semiconductor Optoelectronics", McGraw Hill, 1995.
4. Clyde.F, jr.Coombs, 'Electronic instrument handbook' , McGraw Hill, 1992.
5. Jeffrey Travels, Jim Kring, ' Labview for every one", Prentice Hall, 2006.

PPC702 INSTRUMENTATION IN PETRO CHEMICAL INDUSTRIES

L	T	P	C
3	0	0	3

Goal

To expose the students to the basic processing, measurement techniques and control systems in petroleum industry and to provide adequate knowledge about the petroleum products and the chemicals obtained from them.

Objectives

The course will enable the students to:

1. Expose the students to the basic processing in petroleum industry.
2. Provide adequate knowledge about the unit operations.
3. Impart knowledge pertaining to the petroleum products and the chemicals obtained from them.
4. Provide adequate knowledge about the measurement of various parameters in petrochemical industry.
5. Expose the students to the various control loops in Petrochemical Industry.

Outcome

The students should be able to:

1. Explain about the Exploration, Recovery & Processing techniques for Hydrocarbons/ Petroleum, Processing of wet gases and Refining of Crude oil.
2. Comprehend in the unit operations of Thermal Cracking, Catalytic Cracking, Catalytic Reforming, Polymerization, Alkylation and Isomerization.
3. Determine the Chemicals from petroleum- Derivatives of Methane, Acetylene, Ethylene, Propylene & other downstream products.
4. Measure the Parameters in a Refinery & Petrochemical Industry.
5. Select, Install & Maintain the Measuring Instruments. Comprehend in the Process Control in Refinery & Petrochemical Industry.

UNIT I PETROLEUM & NATURAL GAS PROCESSING 9

Exploration, Recovery & Processing techniques for Hydrocarbons/Petroleum ON SHORT & OFF SHORT -oil-Gas separations. Processing of wet gases Refining of Crude oil.

UNIT II ENGINEERING & CHEMICAL OPERATIONS IN PETROCHEMICAL INDUSTRY 9

Thermal Cracking- Catalytic Cracking - Catalytic Reforming-Polymerization - Alkylation - Isomerization - Productions of Ethylene, Acetylene & Propylene from Petroleum as stocks.

UNIT III DOWN STREAM PRODUCTS/CHEMICALS FROM PETROLEUM 9

Chemicals from petroleum- Derivatives of Methane, Derivatives of Acetylene, Derivatives of Ethylene, Derivatives of Propylene & other downstream products.

UNIT IV MEASUREMENTS IN PETROCHEMICAL INDUSTRY 9

Parameters to be measured in a Refinery & in a Petrochemical Industry, Selection, Installation & Maintenance of Measuring Instruments, Intrinsic safety of Instruments.

UNIT V CONTROL LOOPS IN PETROCHEMICAL INDUSTRY 9

Process Control in Refinery & Petrochemical Industry, Distillation Columns & their Control, Catalytic Crackers, Pyrolysis Units & their Control, Production of Polyethylene & its Automatic Control, Vinyl Chloride- Polyvinyl (PVC) Production & Control.

L = 45 TOTAL = 45

REFERENCE BOOK

1. Chemicals from Petroleum- A.L.Waddams - Butter & Janner Ltd. 2000.
2. Process Control Structures & Applications- J.G.Balchan & K.I. Mumme- Van Nustrand Reinhold Co., 2002.
3. Petroleum Chemicals Industry - Taylor Francis.
4. Shreve's Chemical Process Industries - Georget T.Avstin - McGraw Hill International Edition, 1998.
5. Instrumentation Process Industries-B.G.Liptak- Chilton Book Co.2003.
6. Standard Hand Book, Petroleum & Natural Gas Engineering-Offshore Engineer Bookstore, Houston Texas, 2002.

PPC 703 INSTRUMENTATION & CONTROL IN AUTOMOTIVE INDUSTRIES

L	T	P	C
3	0	0	3

Goal

To provide basic knowledge in Instrumentation & control in Automotive Industries and communication protocols and Automation in Manufacturing Industries

Objectives

The course should enable the students to :

1. Obtain a basic understanding of various measurements in an Automobile.
2. Know the Measurement and analysis of Fuel and exhaust systems.
3. Understand Embedded and Real time systems used in recent motor vehicles.
4. Design control systems for automobile assembly line automation with PLC and Robotic Control.

Outcome

The student should be able to:

1. Explain the Engine Control related with various measurement techniques incorporating suitable sensors.
2. Analyze and monitor the vehicle performance with respect to Fuel injection and Exhaust systems.
3. Design Microprocessor based Engine Controller with real time application.
4. Develop Automation Techniques using Robotic control for the manufacture of Automobile.

UNIT I FUNDAMENTAL MEASUREMENTS IN AUTOMOTIVE 9

Pressure -Level -Temperature-Density - Viscosity - Torque - Vibration - Luminosity.

UNIT II INSTRUMENTATION APPLICATION IN VEHICLES 9

Analysis of Fuel and Emitted particles CO_2, No_X, Hydro carbons

UNIT III EMBEDDED APPLICATION IN MV 9

Microprocessor based front panel Indicators, Ignition Systems - Engine Controls - RTOS applications.

UNIT IV COMMUNICATION PROTOCOLS 9

Serial, CAN bus, GPS tracking Systems.

UNIT V AUTOMATION IN MANUFACTURING INDUSTRY 9

Assembly line applications, PLC and DCS implementation - Robotic Controls.

L =45 Total = 45

REFERENCE BOOK

1. B.G Liptak, 'Instrument Engineer's Handbook : Process measurement and Analysis', Chilton Book Company, 2003.
2. Roy F. Knudsen ,'ISA Automotive Road Test Instrumentation Handbook: Report: Fifth wheel systems for measurement of speed, distance & acceleration - Volume 1 of ISA Automotive Road Test Instrumentation Handbook: Report, Instrument Society of America. Transportation Industry Division. Automotive Instrumentation Committee', Instrument Society of America. Transportation Industry Division. Automotive Instrumentation Committee Instrument Society of America, 1963
3. Roy F. Knudsen,'Vehicle emissions measurement--panel discussion: transcription of the Vehicle Emissions Measurement Panel presented at the 1970 ISA annual conference, Oct. 26-29, 1970', Philadelphia, Pennsylvania, Volume 1970,Instrument Society of America, 1971
4. 'Trends in testing and instrumentation Society of Automotive Engineers - Society of Automotive Engineers', 1996.

PPC 704 ADVANCED PROCESS INSTRUMENTATION

L	T	P	C
3	0	0	3

Goal

The goal of the programme is to acquaint students with skills in Advanced Process Instrumentation and educate students with various concepts in model based Control, model predictive control techniques.

Objectives

The course should enable the students to :

1. Study the basics of Process Control and dynamic performance analysis process for different types of processes.
2. Make them understand the different Multivariable control techniques such as feed-back, feed forward and IMC etc.
3. Assist the learners in understanding model based control technique.
4. Learn the Model Predictive Control.
5. Make them understand the different control case studies such as Statistical Process Control, Fuzzy-Logic based controller and Neural Network based controller.

Outcome

The students should be able to:

1. Do Mathematical Modeling for given physical systems and be able to understand the effect of Zeros and time delay.
2. Know and design the different multi loop control techniques such as Cascade control, Ratio control, feed-back, feed-forward control, override control and selective control
3. Design different model based control techniques such as Smith Predictor and Internal Model controller (IMC) for given process.
4. Understand the basic MPC, different model forms and Dynamic Matrix Controller for single input and single output for constrained and unconstrained cases.
5. Get the idea of Statistical Process Control.The learners will be able to design Fuzzy-Logic based controller and Neural Network based controller.

UNIT I INTRODUCTION **9**

Review of basics of Process Control, Control objective and benefits, Control system elements. Mathematical Modeling and dynamic performance analysis process for control: Basic Concepts in Modeling, models from fundamental laws, empirical model identification, dynamic performance analysis of first order, second order, multi-capacity processes, Effect of Zeros and time delay.

UNIT II MULTIVARIABLE PROCESS CONTROL **9**

Multivariable Process control: Cascade control, Ratio control, feed-back, feed-forward control, override control, selective control, modeling of multivariable process, Design of Multivariable controllers.

UNIT III MODEL BASED CONTROL **9**

Model Based control: Feedback, Feed-forward, delay compensation, Internal Model controller (IMC): Concept, IMC design Procedure.

UNIT IV MODEL PREDICTIVE CONTROL **9**

MPC: General Principles, Model forms, DMC, SISO unconstrained DMC Problem, controller tuning.

UNIT V CASE STUDY **9**

Statistical Process Control (SPC): Concept, Design procedure, Case study: Design of Fuzzy-Logic based controller, Case study: Design of Neural Network based controller.

L =45 Total = 45

REFERENCE BOOK

1. Thomas E. Marlin 'Process Control', McGraw-Hill International Edition, 2000.
2. Jose A. Romagnoli, Ahmet Palazoglu, 'Introduction to process Control' CRC Press, 2005.
3. John. S. Oakland, 'Statistical Process Control', Butterworth - Heinemann, 2007.
4. B.G Liptak, 'Instrument Engineer's Handbook : Process Control and Optimization', Chilton Book Company, 2005.
5. Les A. Kane, "Advanced Process Control Systems and Information systems for Process Industries" , Gulf Professional Pub., 2000.

PPC 705 INDUSTRIAL AUTOMATION

L	T	P	C
3	0	0	3

Goal

To expose the Students with various automation methodologies used in process Industries.

Objectives

The course should enable the students to:

1. Know the tools like PLC, DCS, and SCADA.
2. Understand the design of project using DCS.
3. Know the configuration of PLC and DCS.
4. Understand the interfacing protocols for sensors, actuators and PLC systems.
5. Get an idea of advanced process control blocks and apply the design principles for different case studies.

Outcome

The students should be able to:

1. Understand the application of tools like PLC, DCS, and SCADA in automation.
2. Design the DCS for their application.
3. Configure of PLC and DCS.
4. Interface sensors, actuators and PLC systems.
5. Understand advanced design methodologies and design different controller for different types of processes.

UNIT I INTRODUCTION & PLC PROGRAMMING 9

Introduction to automation tools PLC, DCS, SCADA, Hybrid DCS/PLC.

PLC - Ladder diagram - Programming timers and counters - Design of PLC-Instructions in PLC - Program control instructions, math instructions and sequencer instructions.

UNIT II PROGRAMMABLE LOGIC CONTROLLERS 9

Introduction of Advanced PLC programming, Selection of processor, Input/output modules, Interfacing of Input/output devices, Operator Interface, OPC, study of SCADA software, Interfacing of PLC with SCADA software.

UNIT III AUTOMATION SPECIFICATIONS 9

DCS Project: Development of User Requirement Specifications, Functional Design Specifications for automation tool, GAMP, FDA.

UNIT IV DISTRIBUTED CONTROL SYSTEM 9

Introduction to architecture of different makes, DCS Specifications, configuration of DCS blocks for different applications, Interfacing of protocol based sensors, actuators and PLC systems, Plant wide database management, Security and user access management, MES, ERP Interface.

UNIT V CASE STUDY 9

Study of Advance Process control blocks: Statistical Process Control, Model Predictive Control, Fuzzy Logic Based Control, Neural-Network Based Control, Higher Level Operations: Control & Instrumentation for process optimization Applications of the above techniques to the standard units/ processes

L =45 Total = 45

REFERENCE BOOK

1. Gary Dunning, Introduction to Programmable logic Controllers, Thomson / Delmar Learning, 2005.
2. Webb, Reis, Programmable logic Controllers: principles and applications, Prentice Hall of India, 2002.
3. Jose A. Romagnoli, Ahmet Palazoglu, Introduction to process Control, CRC Tylor and Francisgroup, 2005.

4. John. S. Oakland, Statistical Process Control, Butterworth - Heinemann, 2007.

5. B.G Liptak, Instrument Engineer's Handbook : Process Control and Optimization, Chilton Book Company, 2005

6. Installation and user manuals of different DCS, PLC Vendors

PPC706 ARTIFICIAL INTELLIGENCE

L	T	P	C
3	0	0	3

Goal

The goal of the programme is expose the students to artificial Intelligence concepts

Objectives

The course should enable the students to :

1. Acquaint the students with language processing and search strategies.
2. Give basic knowledge in reasoning concepts
3. Gain knowledge of basic of planning and learning of AI
4. Know about the expert systems

Outcome

The students should be able to:

1. Understand the concepts in language processing and search techniques
2. Understand the different reasoning concepts
3. Design planning and leaning environments for AI
4. Understand the Knowledge Representation in expert systems and expert system tools

UNIT I INTRODUCTION **9**

Introduction to AI: Intelligent agents - Perception - Natural language processing - Problem - Solving agents - Searching for solutions: Uniformed search strategies - Informed search strategies.

UNIT II KNOWLEDGE AND REASONING **9**

Adversarial search - Optimal and imperfect decisions - Alpha, Beta pruning - Logical agents: Propositional logic - First order logic - Syntax and semantics - Using first order logic - Inference in first order logic.

UNIT III UNCERTAIN KNOWLEDGE AND REASONING **9**

Uncertainty - Acting under uncertainty - Basic probability notation - Axioms of probability - Baye's rule - Probabilistic reasoning - Making simple decisions.

UNIT IV PLANNING AND LEARNING **9**

Planning: Planning problem - Partial order planning - Planning and acting in non-deterministic domains - Learning: Learning decision trees - Knowledge in learning - Neural networks - Reinforcement learning - Passive and active.

UNIT V EXPERT SYSTEMS **9**

Definition - Features of an expert system - Organization - Characteristics - Prospector - Knowledge Representation in expert systems - Expert system tools - MYCIN - EMYCIN.

L =45 Total = 45

REFERENCE BOOK

1. Stuart Russel and Peter Norvig, 'Artificial Intelligence A Modern Approach', Second Edition, Pearson Education, 2003.
2. Donald A.Waterman, 'A Guide to Expert Systems', Pearson Education, 1995.
3. George F.Luger, 'Artificial Intelligence - Structures and Strategies for Complex Problem Solving', Fourth Edition, Pearson Education, 2002.
4. Elain Rich and Kevin Knight, 'Artificial Intelligence', Second Edition Tata McGraw Hill, 1995.
5. Janakiraman, K. Sarukesi, P.Gopalakrishnan, 'Foundations of Artificial Intelligence and Expert Systems', Macmillan Series in Computer Science, 2005.
6. W. Patterson, 'Introduction to Artificial Intelligence and Expert Systems', Prentice Hall of India, 2003.

PPC 707 OPTIMAL CONTROL THEORY

L	T	P	C
3	0	0	3

Prerequisite Modern control theory

Goal

To expose the Students to the Concepts of Optimal Control, to develop the skills needed to design controllers using optimal control theory and to introduce to current research in optimization methods for robust control.

Objectives

The course should enable the students to:

1. Learn formulation of Optimal Control Problem and Selection of Performance Measures.
2. Learn Linear Regulator Problems and Dynamic Programming.
3. Learn Numerical Techniques for Optimal Control.
4. Learn Filtering and Estimation of Linear Systems.
5. Learn Kalman Filter and Properties.

Outcome

The students should have knowledge in the following

1. Optimal Problem Formulation and Solution of them by Proper Selection of Performance Measure. Necessary Conditions for Optimal control, Pontryagin's Minimum Principle.
2. Solution of Linear Regulator Problems, Linear Tracking Problems and Dynamic Programming.
3. Steepest Descent and Fletcher Powell solution of Ricatti equation
4. System noise smoothing and prediction: Minimum variance estimation, Least square estimation, Recursive estimation.
5. Linear estimator property of Kalman Filter, Time invariance and asymptotic stability, SNR improvement and Extended Kalman filter.

UNIT I INTRODUCTION 8

Statement of optimal control problem - Problem formulation and forms of optimal control - Selection of performance measures.Necessary conditions for optimal control - Pontryagin's minimum principle - State inequality constraints - Minimum time problem.

UNIT II LQ CONTROL PROBLEMS AND DYNAMIC PROGRAMMING 10

Linear optimal regulator problem - Matrix Riccatti equation and solution method - Choice of weighting matrices - Steady state properties of optimal regulator - Linear tracking problem - LQG problem - Computational procedure for solving optimal control problems - Characteristics of dynamic programming solution - Dynamic programming application to discrete and continuous systems - Hamilton Jacobi Bellman equation.

UNIT III NUMERICAL TECHNIQUES FOR OPTIMAL CONTROL 9

Numerical solution of 2-point boundary value problem by steepest descent and Fletcher Powell method solution of Ricatti equation by negative exponential and interactive methods

UNIT IV FILTERING AND ESTIMATION 9

Filtering - Linear system and estimation - System noise smoothing and prediction - Gauss Markov discrete time model - Estimation criteria - Minimum variance estimation - Least square estimation - Recursive estimation.

UNIT V KALMAN FILTER AND PROPERTIES 9

Filter problem and properties - Linear estimator property of Kalman Filter - Time invariance and asymptotic stability of filters - Time filtered estimates and signal to noise ratio improvement - Extended Kalman filter.

L =45 Total = 45

REFERENCE BOOK

1. Krik D.E., "Optimal Control Theory - An introduction", Dover Publications, 2004.
2. Sage, A.P., "Optimum System Control", Prentice Hall, 1968.

3. Anderson, BD.O. And Moore J.B., "Optimal Filtering", Dover Publications, 2005.
4. S.M. Bozic, "Digital and Kalman Filtering", Edward Arnould, London, 1994.
5. Astrom, K.J., "Introduction to Stochastic Control Theory", Dover Publications, 2006.

PPC 708 ADVANCED PROCESS CONTROL

L	T	P	C
3	0	0	3

Prerequisite **Modern control theory**

Goal

The aim of this course is to expose the concepts of advanced process control principles. Analyze and design of analogue and digital controllers for complex control systems.

Objectives

The course should enable the students to:

1. Acquaint them with skills required for Advanced Process Control
2. Analyze the frequency response characteristics of a system
3. Learn about the complex control schemes
4. Know about the multivariable control systems
5. Know about the analog and digital controller design and testing parameters

Outcome

The student should be able to:

1. Acquire basic skills in advanced process control techniques
2. Perform frequency analysis then identify the process and design controllers
3. Perform theoretical analysis of complex control techniques
4. Perform analysis and tuning of multi variable control systems
5. Analyze and design analog and digital controllers.

UNIT I BLOCK DIAGRAMS **9**

Block diagrams presentation of systems, Review of first and higher order systems, closed and open loop response to step, impulse and sinusoidal inputs. Control valve types linear, equal percentage and quick opening valve. Design of valves. Transient response

UNIT II FREQUENCY RESPONSE **9**

Frequency response, design of control system, controller tuning and process identification. Ziegler-Nichols and Cohen-Coon tuning methods, Bode and Nyquist Plots - Process modeling.

UNIT III ADVANCED CONTROL TECHNIQUES **9**

Advanced control techniques, cascade, ratio, feed forward, adaptive control selective controls, computing relays, simple alarms, Smith predictor, internal model control, theoretical analysis of complex processes.

UNIT IV ANALYSIS OF MULTIVARIABLE SYSTEMS **9**

Analysis of multivariable systems Interaction, an example of storage tanks. Review of matrix algebra, Bristol arrays, Niederlinski index - Tuning of multivariable controllers.

UNIT V DISCRETE SYSTEMS **9**

Basic review of Z transforms, Response of discrete systems to typical inputs. Open and closed loop response to step , impulse and sinusoidal inputs, closed loop response of discrete systems.Design of digital controllers.

L =45 Total = 45

REFERENCE BOOK

1. S.Sundaram and T.K.Radhakrishnan , "Process Dynamics and Control",Ahuja Publishers,2003
2. D.R.Coughnowr, "Process System Analysis and Control", 2nd Edn. Mc.Graw Hill, New York, 1991
3. C.ASmith and A.B Corrupio "Principles and Practice of Automative Process Control", John Wiley, New York, 1976.

PPC 709 PROCESS DYNAMICS

L	T	P	C
3	0	0	3

Goal

The goal of the programme is expose the students to dynamic involved in process control

Objectives

The course should enable the students to :

1. Acquaint the students with basic representation of linear and non-linear systems.
2. Give basic knowledge in higher order systems and discrete systems
3. Gain knowledge of phase plane behaviour of non-linear systems
4. Know about the stirred tank and bio chemical reactors

Outcome

The students should be able to:

1. Understand the Material and Energy balances and Linearization of nonlinear systems in state space form

2. Understand the chracteristics of higher order systems

3. analyse system using phase plane method and understand the characteristics of the system

4. solve problems on stirred tank and bio chemical reactors

UNIT I BASIC **9**

Basic equation - Integral and Instantaneous balances - Material and Energy balances - General form of dynamic models - Linearization of nonlinear systems in state space form - Response of lead-lag modules - Self-regulating system - transfer function analysis of higher order systems.

UNIT II SECOND ORDER SYSTEM **9**

A second order system - Pole-Zero cancellation - System in series - Blocks in parallel -linear boundary value problems- Parameter estimation of discrete linear systems.

UNIT III PHASE PLANE ANALYSIS **9**

Phase-plane analysis - generalization of phase-plane behaviour-nonlinear systems - Introduction to nonlinear dynamics - bifurcation behaviour of systems.

UNIT IV STIRRED TANK HEATERS **9**

Stirred tank heaters - Absorption - isothermal continuous stirred tank chemical reactors

UNIT V BIOCHEMICAL REACTORS **9**

Biochemical reactors -adiabatic continuous stirred tank reactor -ideal binary distillation columns.

L =45 Total = 45

REFERENCE BOOK

1. B.W.Bequette, "Process Dynamics - Modeling, Analysis and Simulation", PHIPE,New Delhi.

2. G.Stephanapoulous, "Chemical process control: An introduction to Theory and Practice" Prentice Hall of India (P) Ltd., New Delhi, 1995.

3. F.G.Shinsky, "Process Control Systems, Application, Design and Adjustment" 3rd Edition, Mc.Graw Hill Book Co., New /York,1988.

PCS 706 DIGITAL IMAGE PROCESSING

L	T	P	C
3	0	0	3

Goal

To introduce the students to various image processing techniques.

Objectives

The course should enable the students to:

1. Study the image fundamentals.
2. Study the mathematical transforms necessary for image processing.
3. Study the image enhancement techniques and image restoration procedures.
4. Study the image segmentation and recognition techniques.
5. Study the various image compression methods.

Outcome

The student should be able to:

1. Understand the image fundamentals.
2. Understand the two dimensional image transforms.
3. Understand how to improve the image quality by using enhancement techniques and Restore the image by the use of various filtering techniques.
4. Understand the various segmentation methods and recognition techniques.
5. Understand the various image compression techniques.

UNIT I DIGITAL IMAGE FUNDAMENTALS **9**

Image acquisition - Storage - Digital image representation, quantization and sampling, Imaging geometry, discrete image transforms - Properties and applications.

UNIT II ENHANCEMENT AND RESTORATION **9**

Image enhancement techniques - Spatial domain methods histogram modification techniques, spatial filtering, enhancement in the frequency domain, image restoration - Degradation model - Inverse filter - Wiener filter constraint Least squares restoration, restoration in spatial domain.

UNIT III SEGMENTATION & REPRESENTATION **9**

Edge linking, boundary detection, threshold, region oriented, segmentation, representation schemes

UNIT- IV RECOGNITION & INTERPRETATION **9**

Decision theoretic methods, structural methods, interpretation - Knowledge based systems, logical systems, expert systems.

UNIT V IMAGE COMPRESSION **9**

Image compression models, elements of information theory, transform coding - Video coding, coding standards.

L =45 Total = 45

REFERENCE BOOK

1. R.C. Gonzalez, & R.E. Woods, 'Digital Image Processing', Prentice Hall, 2007.
2. A.K. Jain, 'Fundamentals of Digital Image Processing', Pearson Education, 1997.
3. Rosenfield & A.C. Kak, 'Digital Picture Processing', II edition, Academic Press New York 2003.
4. W.K. Pratt, 'Digital Image Processing', II Edition, John Wiley 2007.
5. K.R. Rao, J.J.Hwang, 'Techniques and Standards for Image Video and Audio Coding', Prentice Hall,N.J. 1996.

PPC 710 PROCESS CONTROL SYSTEM COMPONENTS

L	T	P	C
3	0	0	3

Goal

The goal of the programme is to design the different types of sensors, pumps, microprocessor based controllers and computer based controllers.

Objectives

The course should enable the students to:

1. Study the different type of sensors.
2. Make them understand the design of flow, temperature, level and pressure sensors.
3. Assist the learners in understanding about different types of pumps and its performance
4. Learn the control of process parameters
5. Learn the computer based control and Distributed Control System.

Outcome

The students should be able to:

1. Design the flow, temperature, pressure and level sensors for different application.
2. Know the different types of pumps, its performance, selection and characteristics.
3. Understand microprocessor based PID controller, speed control of D.C motor and temperature control.
4. Understand the computer based controllers, software design and computerized distributed control system.

UNIT I DESIGN OF FLOW AND TEMPERATURE SENSORS 9

Orifice meter - Design of Orifice for given flow conditions - Design of Rotameter - Design of RTD measuring circuit - Design of cold junction compensation circuit for thermocouple using RTD - Transmitters - Zero and span adjustment in D/P transmitters and temperature transmitters.

UNIT II DESIGN OF PRESSURE SENSORS 9

Bourdon gauges - factors affecting sensitivity - design of Bourdon tube - Design of air purge system for level measurement. Design of Electrical methods in pressure measuring - strain gauges.

UNIT III PUMPS 9

Type of pumps - Pump performance - pipe work calculation -characteristics of different pumps-- pump operation, maintenance instruments used in pumping practice - pump noise and vibration - selection of pumps.

UNIT IV MICROPROCESSOR BASED CONTROLLERS 9

Design of microprocessor based system for data acquisition - Design of microprocessor based PID controller - D.C motor speed control - Temperature control.

UNIT V COMPUTER BASED CONTROLLERS 9

Design of computer controlled system - Software design, Single program approach, Multi-Testing Approach, Structured development for real time systems, computerized distributed control system; Merits and demerits, requirements and topologies of distributed control system.

L =45 Total = 45

REFERENCE BOOK

1. N.A. Anderson - Instrumentation for process measurement and control - CRC Press, 1997.
2. D.M. Considine - Process Instruments and controls Handbook - McGraw Hill Book Co.,1993.
3. R.H. Warring 'Pumping Manual', Gulg Publishing Co., 1984.
4. J.P. Bentley, 'Principles of measurement systems', Pearson Prentice Hall, 2005.
5. C.D. Johnson, 'Process control instrumentation Technology' Prentice Hall Inc., 2007.

PPC 711 ADVANCED DIGITAL SIGNAL PROCESSING FOR INSTRUMENTATION ENGINEERS

L	T	P	C
3	0	0	3

Goal

To provide knowledge of digital signal processing methods and tools, including leading algorithms for various applications.

Objectives

The course should enable the students to :

1. Study the Time Frequency analysis, distribution and polyphase filters and its applications.

2. Impart knowledge on Stochastic Processes.
3. Design and model the Spectral estimation.
4. Learn the different types of Adaptive filtering.
5. Learn the Multiresolution Signal analysis

Outcome

The students should be able to:

1. Provide solutions for Time Frequency distribution, Short Time Fourier Transform, Wigner distribution, Multirate digital signal processing and its applications.
2. Model the stochastic processes and vector processes.
3. Understand the methods of Spectral estimation and power spectrum estimation.
4. Understand the Principles of Adaptive filtering and Develop Applications in noise and echo cancellation, homomorphic deconvolution.
5. Understand the Multiresolution Signal analysis and Design QMF filter banks, Wavelet transforms Applications

UNIT I FREQUENCY ANALYSIS 9

Time Frequency analysis: Need for Time Frequency analysis, Time Frequency distribution, Short Time Fourier Transform, Wigner distribution. Multirate digital signal processing: Basic multirate operation (up sampling, down sampling), Efficient structures for decimation and interpolation, Decimation and interpolation with polyphase filters, Noninteger sampling rate conversion , Efficient multirate filtering Applications, Over sampled A/D and D/A converter.

UNIT II STOCHASTIC PROCESSES 9

Stochastic Processes: Introduction, WSS signals and linear systems, spectral factorization, models of stochastic processes, vector processes.

UNIT III SPECTRUM ESTIMATION 9

Spectral estimation: Periodogram - based nonparametric methods: Periodogram, Bartlett's method, Welch's method, Blackman-Tukey method. Parametric methods for power spectrum estimation: ARMA modelling, Yule- Walker Equation and solution.

UNIT IV ADAPTIVE FILTERING 9

Adaptive filtering : Principles of Adaptive filtering , LMS and RMS Algorithms, Applications in noise and echo cancellation, Homomorphic Signal Processing , homomorphic system for convolution, properties of complex-spectrum, Applications of homomorphic deconvolution.

UNIT V SIGNAL ANALYSIS 9

Multiresolution Signal analysis, Decompositions, transforms , Subbands and wavelets, Orthogonal transforms : Cosine , Sine , Hermite Walsh Fourier, Theory of subband decomposition , decimation ,interpolation , Design of QMF filter banks ,Wavelet transforms Applications: International Standards

for speech, image and video compression for personnel communication, Digital broadcasting and multimedia systems.

L =45 Total = 45

REFERENCE BOOK

1. J. Proakis , Charles M. Rader, Fuyun Ling, Christopher L. Nikias, 'Advanced Digital Signal Processing', Macmillan Coll Div, 1992
2. Glenn Zelniker, Fred J. Taylor, 'Advanced Digital Signal Processing', CRC Press, 1994.
3. Leon Cohen, "Time Frequency Analysis", Prentice Hall, 1995.
4. Haykins, "Adaptive Filter theory", Prentice Hall 2001
5. J.Proakis, Charles M. Rader, Fuyun Ling, Christopher L. Nikias, 'Digital Signal Processing', Macmillan Coll Div, 1992
6. A.V.Oppenheim, R.W.Schafer, J.R. Buck "Discrete time Signal Processing", Prentice Hall, 1999.