HINDUSTAN UNIVERSITY

HINDUSTAN INSTITUTE OF TECHNOLOGY & SCIENCE

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

Padur, Kancheepuram District - 603 103.

DEPARTMENT OF
ELECTRICAL AND ELECTRONICS ENGINEERING

Regulations Curriculum and Syllabus 2013 Semesters I- IV

M.Tech. (EMBEDDED CONTROL)

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
M.TECH. EMBEDDED CONTROL

OBJECTIVE OF THE PROGRAMME:

To provide the students with an insight into the theoretical and application aspects of various areas of Drives and Embedded Control including Real Time Operating System, Control of AC and DC drives, Design of Embedded System, Programming using Hardware Description Languages (HDL) etc. The programme caters to the needs of industry and students become industry ready. The programme also enables them to pursue further research.

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M.TECH. EMBEDDED CONTROL

SEMESTER I

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C	TCH
THEORY							
1	PMA107	Advanced Mathematics for Electrical Engineers*	4	0	0	4	4
2	PES101	Digital Signal Processing**	3	1	0	4	4
3	PES102	Embedded System Design$$	3	1	0	4	4
4	PVL102	Real Time Operating System***	3	1	0	4	4
5	PPD103	Analysis of Power Converters$	3	1	0	4	4
6	PPD105	Special Electrical Machines*	3	1	0	4	4
		TOTAL				**24**	**24**

SEMESTER II

SL NO.	COURSE CODE	COURSE TITLE	L	T	P	C	TCH
THEORY							
1	PEC201	Computer Aided Design of Power Electronic Circuits	3	1	0	4	4
2	PEC202	Control of Electric Drives	3	1	0	4	4
3	PPD202	Solid State DC Drives*	3	1	0	4	4
4	PPD203	Solid State AC Drives*	3	1	0	4	4
5	-	Elective I	3	1	0	4	4
6	-	Elective II	3	1	0	4	4
PRACTICAL							
7	PEC203	Electric Drives Laboratory	0	0	3	2	3
		TOTAL				**26**	**27**

***Common to M.TECH (PED) / M.TECH (PSE)**

SEMESTER III

SL NO.	COURSE CODE	COURSE TITLE	L	T	P	C	TCH
THEORY							
1	-	Elective III	3	1	0	4	4
2	-	Elective IV	3	1	0	4	4
3	-	Elective V	3	1	0	4	4
PRACTICAL							
4	PEC301	Project Phase I	0	0	12	6	12
		TOTAL				**18**	**24**

SEMESTER IV

SL NO.	COURSE CODE	COURSE TITLE	L	T	P	C	TCH
1	PEC401	Project Phase II	0	0	24	12	24
		TOTAL				**12**	**24**

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 80

ELECTIVES FOR EMBEDDED CONTROL

SL NO.	COURSE CODE	COURSE TITLE	L	T	P	C
1	PEC701	Design of Embedded Control System	3	1	0	4
2	PEC702	Principles of Robotics	3	1	0	4
3	PEC703	Programming with VHDL	3	1	0	4
4	PPD102	Advanced Power Semiconductor Devices $$	3	1	0	4
5	PPD702	Intelligent Control*	3	1	0	4
6	PPD703	Flexible AC Transmission Systems*	3	1	0	4
7	PPD705	High Voltage Direct Current Transmission*	3	1	0	4
8	PPS706	Power Electronics for Renewable Energy Systems**	3	1	0	4
9	PPD707	Power Quality*	3	1	0	4
10	PPD204	Linear and Non-Linear Systems Theory*	3	1	0	4
11	PAL704	Digital Signal Processors***	3	1	0	4
12	PPS705	Wind Energy Conversion Systems**	3	1	0	4
13	PCS708	Electromagnetic Interference and Electromagnetic Compatibility$	3	1	0	4

$ Common to M.TECH(CS)/M.TECH(A.E)

$$ Common to M.TECH(PED)

*** Common to M.TECH(PED)/M.TECH(PSE)**

**** Common to M.TECH(PSE)**

***** Common to M.TECH(A.E)**

HINDUSTAN UNIVERSITY

SEMESTER I

PMA107 ADVANCED MATHEMATICS FOR ELECTRICAL ENGINEERS
Common to M.Tech(PED)/M.Tech(PSE)

L	T	P	C
4	0	0	4

OBJECTIVES

1. To know about probability theory useful for power system
2. To know about dynamic programming For optimization techniques
3. To know about differential calculus

OUTCOME

1. Getting idea about basic fundamentals of probability
2. Getting idea about optimization techniques
3. Getting idea about differential calculus

UNIT I ADVANCED MATRIX THEORY **9**

Matrix norms - Jordan canonical form - Generalized eigenvectors - Singular value decomposition - Pseudo inverse - Least square approximations - QR algorithm.

UNIT II CALCULUS OF VARIATIONS **9**

Variation and its properties - Euler's equation - Functional dependent on first and higher order derivatives - Functional dependent on functions of several independent variables - Some applications - Direct methods: Ritz and Kantorovich methods.

UNIT III LINEAR PROGRAMMING **9**

Basic concepts - Graphical and Simplex methods -Transportation problem - Assignment problem.

UNIT IV DYNAMIC PROGRAMMING **9**

Elements of the dynamic programming model - optimality principle - Examples of dynamic programming models and their solutions.

UNIT V RANDOM PROCESSES **9**

Classification - Stationary random processes - Auto Correlation - Cross Correlations - Power spectral density - Linear system with random input - Gaussian Process.

TOTAL = 60

REFERENCES

1. Lewis.D.W., "Matrix Theory", Allied Publishers,Chennai 1995.
2. Bronson,R, "Matrix Operations", Schaums outline Series ,McGraw Hill, New York. 1989.

3. Elsgoltis, "Differential Equations and Calculus of Variations", MIR Publishers, Moscow (1970).

4. Gupta.A.S., "Calculus of Variations with Applications", Prentice Hall of India,New Delhi,1999.

5. Taha, H.A., "Operations research - An Introduction", Mac Millan publishing Co., (1982).

6. Gupta, P.K.and Hira, D.S., "Operations Research", S.Chand & Co., New Delhi, (1999).

7. Ochi, M.K. "Applied Probability and Stochastic Processes", John Wiley & Sons (1992).

8. Peebles Jr., P.Z., "Probability Random Variables and Random Signal Principles", McGraw Hill Inc., (1993).

PES101 DIGITAL SIGNAL PROCESSING
Common to M.Tech(ES)/M.Tech(VLSI)

L	T	P	C
3	1	0	4

GOAL

To introduce the Fundamental Concepts of different signal processing techniques using Digital Processors and various transforms and their utility in control systems.

OBJECTIVES

The course should enable the students to :

(i) Study the Concept of Signals and Systems and their processing techniques.

(ii) Study the Sampling and Quantization techniques and to change the rate of sampling.

(iii) Study the Characteristics and various transform analysis of LTI systems

(iv) Study the design techniques of IIR and FIR filters.

(v) Study the fundamental concepts of real time Digital Signal Processors.

OUTCOME

At the end of the course the student should be able to:

(i) Understand the various types of Signals and Systems along with their properties.

(ii) Understand the sampling and Reconstruction of Band limited and Band pass signals along-with sampling rate conversion procedures.

(iii) Understand the performance parameters of LTI system and various Transform techniques in Frequency domain.

(iv) Understand the structure and design techniques of IIR and FIR filters and their conversion between domains.

(v) Know the various type of processors and programming concepts.

UNIT I DISCRETE TIME SIGNALS AND SYSTEMS 9

Discrete time signal- Basic definition- Some elementary Discrete Time Signals-Representation of signals-Discrete time systems- Basic operation sequences-linear systems-Time invariant systems-

Causal systems-Stable systems- Linear time invariant systems-Properties of LTI systems- Linear Constant Coefficient Difference Equations-Fourier Transform Of Discrete Time Signals - Z-Transform-Inverse Z-Transform

UNIT II SAMPLING OF CONTINUOUS TIME SIGNALS 9

Periodic Sampling-Reconstruction of Band Limited Signal from its samples- Sampling of Band Pass signals-Sampling rate conversion-Decimation by decimation factors- Inter polarization by an integer Factor-Sampling rate conversion by rational Factor-Sampling rate conversion of Band pass signals-A/D Conversion- Quantization -Coding-D/A conversion.

UNIT III TRANSFORM ANALYSIS OF LTI SYSTEMS 9

Ideal filter characteristics-System function and frequency response of LTI systems-Stability and Causality-All pass systems-Minimum phase systems-Discrete Fourier Transform-Relationship between DFT and Fourier Transform of a Discrete Time Signal-Frequency analysis of signals using DFT-Fast Fourier Transform.

UNIT IV DESIGN OF FILTERS 9

Block Diagram and signal flow graph representation- Basic structure of IIR Systems-Basic Structure of FIR Systems-Design of FIR Filters -Design of FIR filter by windowing-Classical continuous -Time Low Pass Filter Approximations-Conversion of transfer functions from continuous to discrete Time frequency Transformations of Low Pass Filters.

UNIT V PRACTICAL DIGITAL SIGNAL PROCESSORS 9

Fundamentals of Fixed Point DSP architecture-Fixed Point representation of numbers-Arithmetic computation- Memory accessing-Pipelining of instructions-Features of example processors- Floating point DSPs-Floating point Representation of numbers- Comparison of DSPs.

L = 45, T=15,TOTAL=60

TEXT BOOKS:

1. Oppenheim and RW Scaffer- Digital Signal Processing-PHI,2000
2. Proakis And Manolakis "Digital Signal Processing: principles, Algorithms and applications "PHI,1992

REFERENCE:

1. Rabiner and Gold-Theory and Application of Digital Processing-PHI,1975.

PES102 EMBEDDED SYSTEM DESIGN
Common to M.Tech(ES)/M.Tech(AE)

L	T	P	C
3	1	0	4

PREREQUISITE Nil

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. Review basics in Embedded hardware,
2. Learn basic concepts of design of Embedded software system,
3. Learn the Software architecture and Developments tools,
4. Learn the Operation of PIC microcontroller and interfacing.
5. Learn the Operation of Embedded Microcomputer systems.

OUTCOME

At the end of the course the student should be able to:

1. Use of hardware fundamentals. Gates, timing diagram, DMA, interrupts, built -Ins on the microprocessor architecture,
2. Explain the concept of Tasks, States, Data, Semaphores, more operating system services IR in RTOS environment, Basic design using RTOS,
3. Develop thorough basic knowledge on the behavior and the characteristics of Round-Robin techniques, Functions, Queue, Host and 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 Introduction to ARM7 - 2148 - Instructions set, Registers, addressing modes, Interfacing methods, ISR, Timing generations and measurements

UNIT I INTRODUCTION : REVIEW OF EMBEDDED HARDWARE 9

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 9

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 AND TOOLS 9

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 9

Introduction- CPU Architecture and Instruction Set- Loop Time Subroutine- Timer 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 9

Introduction to ARM7 - 2148 - Instructions 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

TEXT BOOKS:

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.

REFERENCES:

1. Burns, Alan and Wellings, Andy, Real-Time Systems and Programming Languages, Second Edition, Harlow: Addison-Wesley-Longman, 1997.
2. 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.
3. Grehan Moore, and Cyliax, Real Time Programming: A Guide to 32 Bit Embedded Development. Reading: Addison-Wesley-Longman, 1998.
4. Heath, Steve, Embedded Systems Design. Newnes , 1997.

PVL102 REAL TIME OPERATING SYSTEM
Common to M.Tech(ES)/M.Tech(PC&I)

L	T	P	C
3	1	0	4

PREREQUISITE Nil

GOAL

To develop in-depth skills in real time operating systems and its application domains

OBJECTIVES

The course should enable the students to:

(i) Know the overview of operating systems.

(ii) Know the distributed operating system.

(iii) Know the Real Time Models and Languages.

(iv) Know the Real Time Kernels principles and standards.

(v) Know the RTOS Application Domains.

OUTCOME

At the end of the course the student should be able to:

(i) Understand the concepts of operating system principles, files, processes and structures.

(ii) Understand about the distributed operating system.

(iii) Understand the concepts of Real Time Models and Languages.

(iv) Understand about the Real Time Kernels principles and standards.

(v) Understand about the RTOS Application Domains.

UNIT I REVIEW OF OPERATING SYSTEMS **9**

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

UNIT II DISTRIBUTED OPERATING SYSTEMS **9**

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

UNIT III REAL TIME MODELS AND LANGUAGES **9**

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

UNIT IV REAL TIME KERNEL **9**

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

UNIT V RTOS AND APPLICATION DOMAINS **9**

RTOS for image processing - Embedded RTOS for voice over IP-RTOS for fault tolerant applications - RTOS for control systems.

L = 45, T = 15, TOTAL= 60

TEXT BOOKS:

1. Hermann K, "Real time systems-design principles for distributed embedded Applications", kluwer academic, 1995
2. Charles Crowley "operating systems - A design oriented approach" McGraw Hill

REFERENCES:

1. RAJ BUHR,DL Beily, "An introduction to real time systems" PHI,1999
2. CM Krishna,Kang G. Shin, "Real time Systems", Mc Graw Hill, 1997
3. Raymond J.A., Donald L Baily, "An introduction to real time operating systems"PHI, 1999

PPD103 ANALYSIS OF POWER CONVERTERS
Common to M.Tech(PED)

L	T	P	C
3	1	0	4

PREREQUISITE Power Electronics

GOAL

To provide knowledge about the structure and functioning of different converter circuits

OBJECTIVES

The course will enable the students :

(i) To get exposed to the construction, working and performance calculation of various types of single phase converters.

(ii) To familiarize the students with the working of three phase AC-DC converters with different types of loads.

(iii) To familiarize the students with the working of DC-DC converters

(iv) To expose the students to the types of AC voltage controllers

(v) To familiarize the students with single phase and three phase cycloconverters

OUTCOME

After completion of the course the students are expected to be able to:

(i) Explain the theory and working of different types of single phase converters.

(ii) Explain the working of three phase converters for different load conditions

(iii) Gain knowledge about DC choppers

(iv) Explain the functioning of various AC voltage controllers

(v) Explain the working of single phase and three phase cycloconverters

UNIT I SINGLE PHASE AC-DC CONVERTER 9

Uncontrolled, half controlled and fully controlled converters with R-L, R-L-E loads and free wheeling diodes - continuous and discontinuous models of operation - inverter operation - Dual converter - Sequence control of converters - performance parameters: harmonics, ripple, distortion, power factor - effect of source impedance and overlap.

UNIT II THREE PHASE AC-DC CONVERTER 9

Uncontrolled and fully controlled - converter with R, R-L, R-L-E - loads and free wheeling diodes - inverter operation and its limit - dual inverter - performance parameters - effect of source impedance and over lap

UNIT III DC-DC CONVERTERS 9

Principles of step-down and step-up converters - Analysis of buck, boost, buck-boost and Cuk converters - time ratio and current limit control - Full bridge converter - Resonant and quasi - resonant converters.

UNIT IV AC VOLTAGE CONTROLLERS 9

Principle of phase control: single phase and three phase controllers - various configurations - analysis with R and R-L loads.

UNIT V CYCLO CONVERTERS 9

Principle of operation - Single phase and three phase cycloconverters - power circuits and gating signals.

L = 45, T = 15,TOTAL = 60

TEXT BOOKS

1. Ned Mohan,Undeland and Robbin, "Power Electronics: converters, Application and design" John Wiley and sons.Inc,Newyork,1995.

2. Rashid M.H., "Power Electronics Circuits, Devices and Applications", PrenticeHall of India, New Delhi, 1995.

REFERENCES

1. P.C Sen.," Modern Power Electronics ", Wheeler publishing Co, First Edition,New Delhi-1998.

2. P.S.Bimbra, "Power Electronics", Khanna Publishers, Eleventh Edition, 2003.

PPD105 SPECIAL ELECTRICAL MACHINES
Common to M.TECH(PED)/M.TECH(PSE)

L	T	P	C
3	1	0	4

PREREQUISTIE Electrical Machines

GOAL

To provide the basic principles, control and applications of special electrical machines in industries.

OBJECTIVES

The course will enable the students to:

(i) Learn the constructional features, principle of operation ,methods of control and applications of stepper motors.

(ii) Understand the constructional features, principle of operation ,methods of control and applications of Switched reluctance motors.

(iii) Have an insight into the constructional features, principle of operation ,methods of control and applications of PMBLDC motors.

(iv) Have a clear picture of the types, the constructional features, principle of operation ,methods of control and applications of PMSM.

(v) Gain knowledge in the types, the constructional features, principle of operation ,methods of control and applications of SyRM.

OUTCOME

After completion of the course, the students are expected to:

(i) realize the need for stepper motors and the various applications in industries.

(ii) Get a clear picture of the operational characteristics and the applications of SRM.

(iii) Know the various types of PMBLDC motors, rotor position sensors ,methods of control and their applications.

(iv) Get a clear idea of the features ,control and the applications of PMSM.

(v) Get a clear picture of the operational characteristics and the applications of SyRM.

UNIT I STEPPING MOTORS **9**

Constructional features, principle of operation, modes of excitation, torque production in Variable Reluctance (VR) stepping motor, Dynamic characteristics, Drive systems and circuit for open loop control, Closed loop control of stepping motor

UNIT II SWITCHED RELUCTANCE MOTORS **9**

Constructional features, principle of operation. Torque equation, Power controllers, Characteristics and control Microprocessor based controller.

UNIT III PERMANENT MAGNET BRUSHLESS DC MOTORS **9**

Commutation in DC motors, Difference between mechanical and electronic commutators, Hall sensors, Optical sensors, Multiphase Brushless motor, Square wave permanent magnet brushless motor drives, Torque and emf equations, Torque-speed characteristics, Controllers-Microprocessor based controller.

UNIT IV PERMANENT MAGNET SYNCHRONOUS MOTORS **9**

Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power controllers, Torque speed characteristics, Self control, Vector control, Current control schemes.

UNIT V SYNCHRONOUS RELUCTANCE MOTORS **9**

Constructional features: axial and radial air gap Motors. Operating principle, reluctance torque - phasor diagram, motor characteristics, vernier motor.

L = 45 T=15 TOTAL = 60

TEXT BOOKS

1. Miller, T.J.E. " Brushless permanent magnet and reluctance motor drives ",Clarendon Press, Oxford, 1989.
2. Kenjo, T," Stepping motors and their microprocessor control ", Clarendon Press, Oxford,1989.

REFERENCES

1. Kenjo, T and Naganori, S " Permanent Magnet and brushless DC motors ", Clarendon Press, Oxford, 1989.
2. Kenjo, T. Power Electronics for the microprocessor Age, 1989.
3. B.K. Bose, "Modern Power Electronics & AC drives"
4. R.Krishnan, " Electric Motor Drives - Modeling, Analysis and Control", Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.

SEMESTER II

PEC201 COMPUTER AIDED DESIGN OF POWER ELECTRONIC CIRCUITS

L	T	P	C
3	1	0	4

PREREQUISITE : PPD103 Analysis of Power Converters

GOAL

To impart knowledge of formulation and solution of design problem of power electronic circuits using modelling and simulation.

OBJECTIVES

The course will enable the students to:

(i) learn the basics of Simulation

(ii) Acquire knowledge about advanced techniques in simulation.

(iii) Know the basics of Modeling

(iv) Know the Schematic capture and libraries

(v) Get familiarized with Simulation of different power electronic circuits

OUTCOME

At the end of the course the students should be able to

(i) Analyse different Power electronic systems using simulation

(ii) Gain adequate knowledge about computing steady state solution by various algorithms.

(iii) Understand the concept of modeling.

(iv) Understand about Time domain analysis and Fourier analysis.

(v) Simulate Converters, choppers, inverters, AC voltage Controller and Cycloconverters..

UNIT I INTRODUCTION **9**

Importance of simulation - General purpose circuit analysis - Methods of analysis of power electronic systems - Review of power electronic devices and circuits.

UNIT II ADVANCED TECHNIQUES IN SIMULATION **9**

Analysis of power electronic systems in a sequential manner - coupled and decoupled systems - Various algorithms for computing steady state solution in power electronic systems - Future trends in computer simulation.

UNIT III MODELING OF POWER ELCTRONIC DEVICES **9**

Introduction - AC sweep and DC sweep analysis - Transients and the time domain analysis - Fourier series and harmonic components - BJT, FET, MOSFET and its model- Amplifiers and Oscillator - Non-linear devices.

UNIT IV SIMULATION OF CIRCUITS **9**

Introduction - Schematic capture and libraries - Time domain analysis - System level integration and analysis - Monte Carlo analysis - Sensitivity/stress analysis - Fourier analysis.

UNIT V CASE STUDIES **9**

Simulation of Converters, Choppers, Inverters, AC voltage controllers, and Cyclo-converters feeding R, R-L, and R-L-E loads - computation of performance parameters: harmonics, power factor, angle of overlap.

L=45 T=15 TOTAL: 60

REFERENCES

1. Rashid, M., Simulation of Power Electronic Circuits using pSPICE, PHI, 2006.
2. Rajagopalan, V. "Computer Aided Analysis of Power Electronic systems"-Marcell -Dekker Inc., 1987.
3. John Keown "Microsim, Pspice and circuit analysis"-Prentice Hall Inc., 1998.

PEC202CONTROL OF ELECTRIC DRIVES

L	T	P	C
3	1	0	4

GOAL

To provide various methods of control of electric drives.

COREQUISITE

Solid State DC Drives, Solid State AC Drives

OBJECTIVES

The course should enable the student to

- Able to understand the performance characteristics of various types of dc drives.
- To study about the various modes of chopper fed DC drives and its waveforms.
- To learn about Voltage Source Inverter fed IM drive, generation of firing pulse, PWM generation and sampling techniques for PWM inverter.
- Analising the steady state and dynamic behavior of frequency controlled drive by mathematical model.
- To study the measurement of Voltage, Current, Torque and Speed for closed loop microcomputer based drives.

OUTCOME

The students should be able to:

- Analyse different dc drive characteristics of 1-phase and 3-phase converters.

- Understand about the modes of operation of chopper fed DC drives and analised its waveforms.
- Study how to generate firing pulses, firing circuits, flow charts and waveforms for 1-phase, 3-phase Non-PWM and 3-phase PWM VSI fed induction motor drives.
- Understand about the mathematical modeling of frequency controlled drive and its steady state and dynamic behavior.
- Understand how to measure Voltage, Current, Torque and Speed measurements using digital measurement techniques and closed loop control of microcomputer based drives.

UNIT I CONVERTER FED DC DRIVES 9

Microcontroller hardware circuit, flow charts waveforms, Performance characteristics of dc drives fed through single phase converters, 3-phase converters, dual converters, 1-phase fully controlled converter and 3-phase fully controlled converter fed dc drive.

UNIT II CHOPPER FED DC DRIVES 9

Microcontroller hardware circuits and waveforms of various modes of operation of chopper fed DC drives.

UNIT III INVERTER FED INDUCTION MOTOR DRIVE 9

Microcomputer controlled VSI fed induction motor drive - Detailed power circuit, generation of firing pulses and firing circuit, flow charts and waveforms for 1-phase, 3-phase Non-PWM and 3-phase PWM VSI fed induction motor drives. Sampling techniques for PWM inverter.

UNIT IV MATHEMATICAL MODELING OF FREQUENCY CONTROLLED DRIVE 9

Development of mathematical model for various components of frequency controlled induction drive, mathematical model of the system for steady state and dynamic behaviour, Study of stability based on the dynamic model of the system.

UNIT V CLOSED LOOP CONTROL OF MICROCOMPUTER BASED DRIVES 9

Voltage, Current, Torque and Speed measurements using digital measurement techniques. Types of controllers, position and velocity measurement algorithm, closed loop control of microcomputer based drives.

L = 45 T = 15 TOTAL = 60

TEXT BOOKS :

1. Bose.B.K., Power Electronics and Motor Drives - Advances and Trends, IEEE Press, 2006.
2. Buxbaum, A. Schierau, and K.Staughen, "A design of control systems for DC drives", Springer- Verlag, Berlin,1990.
3. Thyristor control of Electric drives, Vedam Subrahmanyam, Tata McGraw Hill, 1988.

REFERENCES:

1. R.Krishnan, "Electric Motor Drives, Modeling, Analysis and Control" Prentice Hall of India, 2002.

2. Bin Wu, "High Power Converters and AC Drives", IEEE Press, A John Wiley and Sons, Inc., 2006.

3. Dubey G.K., Power semiconductor controlled drives, Prentice-HALL 1989

4. Control of Electric Drives, Leonard W, Springer Verlag, NY, 1985

5. Bose B.K., Microcomputer control of power electronics and drives, IEEE Press, 1987.

6. Bose B.K., Adjustable Speed A.C. drives, IEEE Press, 1993.

PPD202 SOLID STATE DC DRIVES
Common to M.TECH(PED)/M.TECH(PSE)

L	T	P	C
3	1	0	4

PREREQUISITE PPD 103 - Analysis of Power Converter

GOAL

To provide knowledge about the fundamentals, operation and design of DC drives with power electronic converter and chopper

OBJECTIVES

The course will enable the students to:

(i) Know the basic DC motor fundamentals with their speed-torque relations, mutli-quadrant operation, selection of motor and characteristics of mechanical system

(ii) Give in-depth knowledge in analysis of single and three phase fully controlled converter fed DC motor drive

(iii) Give in-depth knowledge in analysis of chopper fed DC drive

(iv) Give adequate knowledge to model a DC drive with closed loop speed control with various controller

(v) Acquire knowledge about digital control of DC drive

OUTCOME

At the end of the course the students should be able to

(i) Select the suitable drive for the required load characteristics.

(ii) Understand the concept of Converter / Chopper control of Dc motor drive.

(iii) Gain adequate knowledge about DC motor drive and various speed control methods.

(iv) Design controllers for DC drives for open loop and closed loop speed control

(v) Gain adequate knowledge about digital control of DC drive

UNIT I DC MOTORS FUNDAMENTALS AND MECHANICAL SYSTEMS 9

DC motor- Types, induced emf, speed-torque relations; Speed control - Armature and field speed control; Ward Leonard control - Constant torque and constant horse power operations.Characteristics

of mechanical system - dynamic equations, components of torque, types of load; Requirements of drives characteristics - multi-quadrant operation; Drive elements, types of motor duty and selection of motor rating.

UNIT II CONVERTER CONTROL **9**

Principle of phase control - Fundamental relations; Analysis of series and separately excited DC motor with single-phase and three-phase converters - waveforms, performance parameters, performance characteristics. Continuous and discontinuous armature current operations; Current ripple and its effect on performance; Operation with free wheeling diode; Implementation of braking schemes; Drive employing dual converter.

UNIT III CHOPPER CONTROL **9**

Introduction to time ratio control and frequency modulation; Class A, B, C, D and E chopper controlled DC motor - performance analysis, multi-quadrant control - Chopper based implementation of braking schemes; Multi-phase chopper; Related problems.

UNIT IV CLOSED LOOP CONTROL **9**

Modeling of drive elements - Equivalent circuit, transfer function of self, separately excited DC motors; Linear Transfer function model of power converters; Sensing and feed back elements - Closed loop speed control - current and speed loops, P, PI and PID controllers - response comparison. Simulation of converter and chopper fed d.c drive.

UNIT V DIGITAL CONTROL OF D.C DRIVE **9**

Phase Locked Loop and micro-computer control of DC drives - Program flow chart for constant horse power and load disturbed operations; Speed detection and gate firing.

L = 45 T = 15 TOTAL = 60

TEXT BOOKS

1. Gopal K Dubey, "Power Semiconductor controlled Drives", Prentice Hall Inc.,New Jersy, 1989.
2. R.Krishnan, "Electric Motor Drives - Modeling, Analysis and Control", Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.

REFERENCES

1. Gobal K.Dubey, "Fundamentals of Electrical Drives", Narosal Publishing House, New Delhi, 2001.
2. Bimal K.Bose "Modern Power Electronics and AC Drives", Pearson Education, Asia 2002.

3. Vedam Subramanyam, "Electric Drives - Concepts and Applications", Tata McGraw-Hill publishing company Ltd., New Delhi, 1994.

4. P.C Sen "Thyristor DC Drives", John Wiley and sons, New York, 1981.

PPD203 SOLID STATE AC DRIVES
Common to M.TECH(PED)/M.TECH(PSE)

L	T	P	C
3	1	0	4

GOAL

To provide knowledge about the control of AC Drives

OBJECTIVES

The course will enable the students :

(i) To get exposed to the control of induction machine by various methods.

(ii) To know about voltage source and current source inverter fed induction machine and its operational characteristics.

(iii) To familiar the students with the direct and indirect field control method of induction machine.

(iv) To expose the students to the Direct torque control of induction machine.

(v) To familiarize the students with brush and brushless excitation in synchronous motor control.

OUTCOME

After completion of the course the students are expected to be able to:

(i) Calculate the performance of the induction motor by different conventional control methods.

(ii) Explain the compensation methods for CSI and VSI fed induction machine.

(iii) Gain knowledge about field oriented control of induction machine.

(iv) Explain the direct torque control of induction machine.

(v) Explain the synchronous motor control.

UNIT I CONVENTIONAL CONTROL OF INDUCTION MOTORS 9

Review of Induction Machine operation - Equivalent circuit - Performance of the machine with variable voltage, rotor resistance variation, pole changing and cascaded induction machines, slip power recovery - Static Kramer Drive.

UNIT II VSI AND CSI FED INDUCTION MOTOR CONTROL 9

AC voltage controller fed induction machine operation - Energy conservation issues - V/f operation theory - requirement for slip and stator voltage compensation. CSI fed induction machine - Operation and characteristics.

UNIT III FIELD ORIENTED CONTROL **9**

Field oriented control of induction machines - Theory - DC drive analogy - Direct and Indirect methods - Flux vector estimation.

UNIT IV DIRECT TORQUE CONTROL **9**

Direct torque control of Induction Machines - Torque expression with stator and rotor fluxes, DTC control strategy.

UNIT V SYNCHRONOUS MOTOR CONTROL **9**

Synchronous motor control - Brush and Brushless excitation - Load commutated inverter fed Drive.

L = 45 T = 15 TOTAL = 60

TEXT BOOKS

1. Bimal K Bose , "Modern Power Electronics and AC Drives" , Pearson Education Asia 2002.
2. Vedam Subramanyam, "Electric Drives - Concepts and Applications", Tata McGraw Hill, 1994.

REFERENCES

1. W.Leonhard , "Control of Electrical Drives", Narosa Publishing House, 1992.
2. Murphy J.M.D and Turnbull, "Thyristor Control of AC Motors", Pergamon Press,Oxford, 1988.

PEC203 ELECTRIC DRIVES LABORATORY

L	T	P	C
0	0	3	2

PREREQUISITE

Electrical Machines and Embedded Control Systems

GOAL

To provide a practical insight of application of AC, DC and special machine drives.

OBJECTIVES

The course should enable the students to:

(i) Understand the microcontroller based speed control of Converter/Chopper fed DC motor, VSI fed three-phase induction motor and Stepper motor.

(ii) Study the DSP based speed control of BLDC motor and SRM motor.

(iii) Know the Condition monitoring and the simulation of three-phase induction motor under different operating conditions and fault conditions.

(iv) Know the fundamentals of Self control operation and of Synchronous motors and Simulation of Automatic Voltage Regulation of three-phase Synchronous Generator.

(v) Understand the Programming of Re-programmable Logic Devices.

OUTCOME

At the end of the course the student should be able to:

(i) Design and Implement the speed control algorithm of Electrical machines

(ii) Analyze completely the DSP based speed control techniques for special machines

(iii) Get the insight knowledge about Induction motor and thereby selecting the motor for specific applications

(iv) Analyze the performance of Synchronous motors and Generator.

(v) Write the coding and analyze the program for devices like VHDL and FPGA for various applications.

LIST OF EXPERIMENTS:

1. Micro controller based speed control of Converter/Chopper fed DC motor.
2. Micro controller based speed control of VSI fed three-phase induction motor.
3. Micro controller based speed control of Stepper motor.
4. DSP based speed control of BLDC motor.
5. DSP based speed control of SRM motor.
6. Self control operation of Synchronous motors.
7. Condition monitoring of three-phase induction motor under fault conditions.
8. Re-programmable Logic Devices and Programming
   (a) VHDL programming - Examples
   (b) Verilog HDL programming - Examples
   (c) Realisation of control logic for electric motors using FPGA.
9. Simulation of Four quadrant operation of three-phase induction motor.
10. Simulation of Automatic Voltage Regulation of three-phase Synchronous Generator.

TOTAL = 45

ELECTIVE COURSES

PEC701 DESIGN OF EMBEDDED CONTROL SYSTEM

L	T	P	C
3	1	0	4

PREREQUISITE Real Time Operating System

GOAL

To provide theory behind the design, simulation and testing of embedded systems

OBJECTIVES

The course will enable the students to:

(i) Know the basic of embedded system design

(ii) Know the basic real time operating system

(iii) Know the basic of design methodologies and tools

(iv) Know the basic of interfacing, porting and debugging

(v) Give basic of programming hardware and interface

OUTCOME

At the end of the course the students should be able to

(i) understand the design of memory, I2C, CAN and various MODEM

(ii) Understand the RTOS, IPC and concept of threads

(iii) Design methodologies like design flow, data acquisition and interface

(iv) understand the concepts of interfacing, porting , debugging with VxWorks, UC/OS-II

(v) understand various embedded controller with case studies

UNIT I EMBEDDED SYSTEM ORGANIZATION **9**

Embedded computing - characteristics of embedded computing applications - embedded system design challenges; Build process of Realtime Embedded system - Selection of processor; Memory; I/O devices-RS-485, MODEM, Bus Communication system using I2C, CAN, USB buses, 8 bit - ISA, EISA bus;

UNIT II REAL-TIME OPERATING SYSTEM **9**

Introduction to RTOS; RTOS- Inter Process communication, Interrupt driven Input and Output - Nonmaskable interrupt, Software interrupt; Thread - Single, Multithread concept; Multitasking Semaphores.

UNIT III INTERFACE WITH COMMUNICATION PROTOCOL **9**

Design methodologies and tools - design flows - designing hardware and software Interface . - system integration; SPI, High speed data acquisition and interface-SPI read/write protocol, RTC interfacing and programming.

UNIT IV DESIGN OF SOFTWARE FOR EMBEDDED CONTROL **9**

Software abstraction using Mealy-Moore FSM controller, Layered software development, Basic concepts of developing device driver - SCI - Software - interfacing & porting using standard C & C++; Functional and performance Debugging with benchmarking Real-time system software - Survey on basics of contemporary RTOS - VxWorks, UC/OS-II

UNIT V CASE STUDIES WITH EMBEDDED CONTROLLER **9**

Programmable interface with A/D & D/A interface; Digital voltmeter, control- Robot system; - PWM motor speed controller, serial communication interface.

L = 45 T = 15 TOTAL = 60

REFERENCES:

1. Steven F. Barrett, Daniel J. Pack, "Embedded Systems - Design and Applications with the 68HC 12 and HCS12", Pearson Education, 2008.
2. Raj Kamal, "Embedded Systems- Architecture, Programming and Design" Tata McGraw Hill, 2006.
3. Micheal Khevi, "The M68HC11 Microcontroller application in control,Instrumentation & Communication", PH NewJersy, 1997.
4. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey, "PIC Microcontroller and Embedded Systems- Using Assembly and C for PIC18", Pearson Education,2008.
5. Steven F.Barrett,Daniel J.Pack,"Embedded Systems-Design & Application with the 68HC12 & HCS12", Pearson Education,2008.
6. Daniel W. Lewis, "Fundamentals of Embedded Software", Prentice Hall India, 2004.
7. Jack R Smith "Programming the PIC microcontroller with MBasic" Elsevier, 2007.
8. Keneth J.Ayala, "The 8086 Microprocessor: Programming & Interfacing the PC", Thomson India edition, 2007.

PEC702 PRINCIPLES OF ROBOTICS

L	T	P	C
3	1	0	4

PREREQUISITE

EC1703-Embedded control design ,EE1671 Real time operating system ,EE1643 Intelligent control

GOAL

To introduce the principle of robotics, kinematics, differential motion, image processing and vision systems

OBJECTIVES

The course will enable the students to:

(i) Give the knowledge about the basics and terminologies of robotics.

(ii) Learn the concepts of kinematics

(iii) Learn the differential motion involved in robotics.

(iv) Learn the basics of control system involved in robotics.

(v) Study the basic concepts of image processing

OUTCOME

At the end of the course the students should be able to

(i) Understand the basics of robotics and the terminologies related to it

(ii) Understand the concepts of kinematics.

(iii) Understand the Jacobian design, Legrangian mechanics and the differential equations associated with it.

(iv) Understand about the sensors, non linear control and dynamic equations involved in it .

(v) Classify and analyze various types of images and to recognize objects .

UNIT I INTRODUCTION AND TERMINOLOGIES: 9

Definition-Classification-History- Robots components-Degrees of freedom-Robot joints- coordinates-Reference frames-workspace-Robot languages-actuators-sensors- Position, velocity and acceleration sensors-Torque sensors-tactile and touch sensors-proximity and range sensors-social issues

UNIT II KINEMATICS 9

Mechanism-matrix representation-homogenous transformation-DH representation-Inverse kinematics-solution and programming-degeneracy and dexterity

UNIT III DIFFERENTIAL MOTION & VELOCITIES 9

Jacobian-differential motion of frames-Interpretation-calculation of Jacobian-Inverse Jacobian-Design-Lagrangian mechanics-dynamic equations-static force analysis

UNIT IV ROBOT CONTROL SYSTEM 9

Sensor characteristics- Hydraulic, Pneumatic and electric actuators-trajectory planning- decentralised PID control- non-linear decoupling control

UNIT V IMAGE PROCESSING & VISION SYSTEMS 9

Two and three dimensional images-spatial and frequency domain representation-noise and edges-convolution masks-Processing techniques-thersholding-noise reduction-edge detection-segmentation-Image analysis and object recognition

L=45 T=15 TOTAL=60

REFERENCES

1. Saeed B. Niku ,"Introduction to Robotics", Pearson Education, 2002

2. Fu,Gonzalez and Lee Mcgrahill ,"Robotics", international

3. R.D. Klafter, TA Chmielewski and Michael Negin, "Robotic Engineering, An Integrated approach", Prentice Hall of India, 2003.

PEC703 PROGRAMMING WITH VHDL

L	T	P	C
3	1	0	4

GOAL

To introduce the VHDL fundamentals, programming using VHDL and design with PLC.

OBJECTIVES

The course will enable the students to:

(i) learn the fundamentals of VHDL.

(ii) Learn advanced data types and modeling concepts .

(iii) Use concepts like concurrent procedures, functions and Packages in VHDL

(iv) Use signals , components and configurations in VHDL with the help of a case study.

(v) Implement the VHDL programs using PLDs.

OUTCOME

At the end of the course the students should be able to

(i) Write simple programs in VHDL

(ii) Write the VHDL programs by using advanced data types and modeling concepts through a case study

(iii) Use the concepts like functions and packages in VHDL and be in a position to extend the same for different applications.

(iv) use components and configurations in VHDL

(v) implement microcontroller CPU and memories etc in PLDs.

UNIT I VHDL FUNDAMENTALS 9

languages-VHDL modeling concepts-Scalar Data types and operations- constants and Variable-Scalar Types- Type Classification-Attributes and scalar types-expression and operators-Sequential statements.

UNIT II DATA TYPES AND BASIC MODELING CONSTRUCTS 9

Arrays- unconstrained array types-array operations and referencing- records - Access Types- Abstract Data types- -basic modeling constructs-entity declarations-Architecture bodies-behavioral description-structural descriptions- design Processing, case study: A pipelined Multiplier accumulator.

UNIT III SUBPROGRAMS , PACKAGES AND FILES 9

Procedures-Procedure parameters- Concurrent procedure call statements -Functions -Overloading -visibility of Declarations-packages and use clauses- Package declarations-package bodies-use clauses-Predefined aliases-Aliases for Data objects-Aliases for Non-Data items-Files- I/O-Files. Case study: A bit vector arithmetic Package.

UNIT IV SIGNALS, COMPONENTS, CONFIGURATIONS. 9

Basic Resolved Signals-IEEE std_Logic_1164 resolved subtypes- resolved Signal Parameters - Generic Constants- Parameterizing behavior- Parameterizing structure-components and configurations-Generate Statements-Generating Iterative structure-Conditionally generating structure-Configuration of generate statements-case study: DLX computer Systems.

UNIT V DESIGN WITH PROGRAMMABLE LOGIC DEVICES 9

Realization of -Micro controller CPU.- Memories-I/O devices-MAC-Design,synthesis,simulation and testing.

L=45 T=15 TOTAL =60

REFERENCES

1. Peter J.Ashenden, "The Designer's guide to VHDL", Morgan Kaufmann publishers,San Francisco,Second Edition, May 2001.
2. Zainalabedin navabi, "VHDL Analysis ans modeling of Digital Systems", McGraw Hill international Editions, Second Editions, 1998.
3. Charles H Roth, Jr. "Digital system Design using VHDL", Thomson ,2006.
4. Douglas Perry, "VHDL Programming by Example", Tata McGraw Hill,4th Edition 2002.
5. Navabi.Z., "VHDL Analysis and Modeling of Digital Systems", McGraw International, 1998.
6. Peter J Ashendem, "The Designers Guide to VHDL", Harcourt India Pvt Ltd, 2002
7. Skahill. K, "VHDL for Programmable Logic", Pearson education, 1996.

PPD102 ADVANCED POWER SEMICONDUCTOR DEVICES

L	T	P	C
3	1	0	4

PREREQUISITE Power Electronics

GOAL

To introduce students to new power semiconductor device technologies with a focus on fast switching devices.

OBJECTIVES

The course should enable the students to:

(i) Study the key device concepts & electrical characteristics & to study the operation & characteristics of power diode.

(ii) Know about the construction, physics of operation, safe operating areas of power BJT & SCR.

(iii) Know about the construction, physics of operation, steady state & dynamic model of Power MOSFET & IGBT.

(iv) Know about the driving & protection circuits of power semiconductor devices.

(v) Study the thermal protection of power semiconductor devices

OUTCOME

At the end of the course the student should be able to:

(i) Understand important power semiconductor devices covering various fields of applications.

(ii) Understand the operation & static & dynamic performance of power BJT & SCR.

(iii) Describe the structure & switching behavior of MOS-Controlled devices.

(iv) Understand the driving & protection circuits for various power semiconductor devices.

(v) Study the thermal protection of power semiconductor devices.

UNIT I INTRODUCTION **9**

Power switching devices overview - Attributes of an ideal switch, application requirements, circuit symbols; Power handling capability - (SOA); Device selection strategy - On-state and switching losses - EMI due to switching - Power diodes - Types, forward and reverse characteristics, switching characteristics - rating.

UNIT II CURRENT CONTROLLED DEVICES **9**

BJT's - Construction, static characteristics, switching characteristics; Negative temperature co-efficient and secondary breakdown; Power darlington - Thyristors - Physical and electrical principle underlying operating mode, Two transistor analogy - concept of latching; Gate and switching characteristics; converter grade and inverter grade and other types; series and parallel operation; comparison of BJT and Thyristor - steady state and dynamic models of BJT & Thyristor.

UNIT III VOLTAGE CONTROLLED DEVICES **9**

Power MOSFETs and IGBTs - Principle of voltage controlled devices, construction, types, static and switching characteristics, steady state and dynamic models of MOSFET and IGBTs - Basics of GTO, MCT, FCT, RCT and IGCT.

UNIT IV FIRING AND PROTECTING CIRCUITS **9**

Necessity of isolation, pulse transformer, optocopler - Gate drives circuit: SCR, MOSFET, IGBTs and base driving for power BJT. Over voltage, over current and gate protections; Design of snubbers.

UNIT V THERMAL PROTECTION **9**

Heat transfer - conduction, convection and radiation; Cooling - liquid cooling, vapour phase cooling; Guidance for hear sink selection - Thermal resistance and impedance Electrical analogy of thermal components, heat sink types and design - Mounting types.

L=45, T=15, TOTAL = 60

TEXT BOOKS

1. B.W Williams ' Power Electronics Circuit Devices and Applications'. Wiley, 1987.
2. Rashid M.H., " Power Electronics Circuits, Devices and Applications ", Prentice Hall of India, Third Edition, New Delhi, 2004.

REFERENCES

1. MD Singh and K.B Khanchandani, "Power Electronics", Tata McGraw Hill, 2001.
2. Mohan, Undcland and Robins, "Power Electronics - Concepts, applications and Design, John Wiley and Sons, Singapore, 2000.

PPD702 INTELLIGENT CONTROL

L	T	P	C
3	1	0	4

PREREQUISITE Control Systems

GOAL

To equip the students with a knowledge of modern intelligent control techniques and their applications.

OBJECTIVES

The course should enable the students to:

1. Study the concept of approaches and architecture for intelligent control, knowledge representation and expert systems.
2. Study various concepts about artificial neural networks, types of ANN and neural network based controller.
3. Study the concept of genetic algorithm and solution of typical problems using genetic algorithm.
4. Study the various concepts of fuzzy logic control and its applications.
5. Study the applications of expert systems, fuzzy logic control, ANN and genetic algorithm.

OUTCOME

At the end of the course the student should be able to:

1. Understand the concepts of intelligent control and their comparisons .
2. Understand the concepts of artificial neural network, types of ANN and to design ANN based controller.
3. Understand the concept of genetic algorithm and its applications to optimization techniques.
4. Design fuzzy logic controller.
5. Understand various intelligent control applications.

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 modeling and control. Fuzzification, inferencing and defuzzification. Fuzzy knowledge and rule bases. Fuzzy modeling 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 system

L=45 T=15 TOTAL=60

REFERENCES

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. Driankov, Hellendroon, "Introduction to Fuzzy Control", Narosa Publishers.

PPD703 FLEXIBLE AC TRANSMISSION SYSTEMS
Common to M.TECH(PED)/M.TECH(PSE)

L	T	P	C
3	1	0	4

GOAL

To provide a knowledge of application of power electronics in the efficient design and operation of power systems

OBJECTIVES

The course will enable the students :

(i) To get introduced to basic concepts of FACTS controllers.

(ii) To familiar the students with the working of series compensation .

(iii) To familiar the students with the working of Unified Power Flow Controller.

(iv) To expose the students to the designing of FACTS controllers.

(v) To familiarize the students with static VAR compensators

OUTCOME

After completion of the course the students are expected to be able to:

(i) Explain the basic compensators used in power systems.

(ii) Explain how a series compensation is done in power system

(iii) Explain the working of Unified Power Flow Controller.

(iv) Design variable structure of FACTS controllers for power system

(v) Explain the working of static VAR compensators and their applications in power system.

UNIT I INTRODUCTION **9**

FACTS-a toolkit, Basic concepts of Static VAR compensator, Resonance damper, Thyristor controlled series capacitor, Static condenser, Phase angle regulator, and other controllers.

UNIT II SERIES COMPENSATION SCHEMES **9**

Sub-Synchronous resonance, Torsional interaction, torsional torque, Compensation of conventional, ASC, NGH damping schemes, modeling and control of thyristor controlled series compensators.

UNIT III UNIFIED POWER FLOW CONTROL **9**

Introduction, Implementation of power flow control using conventional thyristors, Unified power flow concept, Implementation of unified power flow controller.

UNIT IV DESIGN OF FACTS CONTROLLERS **9**

Approximate multi-model decomposition, Variable structure FACTS controllers for Power system transient stability, Non-linear variable-structure control, variable structure series capacitor control, and variable structure resistor control.

UNIT V STATIC VAR COMPENSATION **9**

Basic concepts, Thyristor controlled reactor (TCR), Thyristor switched reactor (TSR), Thyristor switched capacitor (TSC), saturated reactor (SR), Fixed Capacitor (FC).

L = 45 T=15 TOTAL = 60

REFERENCES

1. Narin G.Hingorani, "Flexible AC Transmission ", IEEE Spectrum, April 1993,pp 40-45.
2. Narin G. Hingorani, " High Power Electronics and Flexible AC Transmission Systems IEEE High Power Engineering Review, 1998.
3. Narin G.Hingorani, "Power Electronics in Electric Utilities : Role of Power Electronics infuture power systems", Proc. of IEEE, Vol.76, No.4, April 1988.
4. Einar V.Larsen, Juan J. Sanchez-Gasca, Joe H.Chow, "Concepts for design of FACTS Controllers to damp power swings", IEEE Trans On Power Systems, Vol.10, No.2, May 1995.
5. Gyugyi L., "Unified power flow control concept for flexible AC transmission ", IEEE Proc-C Vol.139, No.4, July 1992.

PPD705 HIGH VOLTAGE DIRECT CURRENT TRANSMISSION
Common to M.TECH(PED)/M.TECH(PSE)0

L	T	P	C
3	1	0	4

PREREQUISITE Power Electronics, Transmission & Distribution

GOAL

To impart knowledge on design, simulation and analysis of HVDC converters and associated control system.

OBJECTIVES

The course should enable the students to:

1. Study the basics of dc power transmission technology and its modern trends.
2. Study the analysis of Graetz circuits for 6-pulse & 12-pulse converter characteristics.
3. Study the system control hierarchy and firing angle control.
4. Study the characteristics and non-characteristics harmonics in HVDC system and types of Filters
5. Study about the simulation of converter station using HVDC Simulator software.

OUTCOME

At the end of the course the student should be able to:

1. Know the comparison of AC and DC transmission and application of HVDC transmission systems,

2. Learn about the applications of different converter bridges,
3. Know the HVDC system control and start-stop DC link,
4. Know the different types of harmonics in HVDC system Filters to remove them,
5. Learn about the modeling and analysis of HVDC system using HVDC simulator.

UNIT I DC POWER TRANSMISSION TECHNOLOGY 9

Introduction-comparison of AC and DC transmission application of DC transmission - description of DC transmission system planning for HVDC transmission-modern trends in DC transmission.

UNIT II ANALYSIS OF HVDC CONVERTERS 9

Pulse number, choice of converter configuration-simplified analysis of Graetz circuit-converter bridge characteristics - characteristics of a twelve pulse converter-detailed analysis of converters.

UNIT III CONVERTER AND HVDC SYSTEM CONTROL 9

General principles of DC link control-converter control characteristics-system control hierarchy-firing angle control-current and extinction angle control-starting and stopping of DC link-power control-higher level controllers-telecommunication requirements.

UNIT IV HARMONICS AND FILTERS 9

Introduction-generation of harmonics-design of AC filters-DC filters-carrier frequency and RI noise.

UNIT V SIMULATION OF HVDC SYSTEMS 9

Introduction-system simulation: Philosophy and tools-HVDC system simulation-modeling of HVDC systems for digital dynamic simulation.

L = 45 T=15 TOTAL = 60

REFERENCES

1. Padiyar, K.R., "HVDC Power Transmission System", Wiley Eastern Limited, New Delhi 1990. First edition.
2. Edward Wilson Kimbark, "Direct Current Transmission", Vol. I, Wiley interscience, New York, London, Sydney, 1971.
3. Rakosh Das Begamudre, Extra high voltage AC transmission engineering New Age International (P) Ltd., New Delhi, 1990.
4. Arrillaga, J., High Voltage direct current transmission, Peter Pregrinus, London, 1983.

PPS706 POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS
Common to M.TECH(PSE)

L	T	P	C
3	1	0	4

PREREQUISITE Power Electronics

GOAL

To impart knowledge on design, simulation and analysis of HVDC converters and associated control system.

OBJECTIVES

The course should enable the students to:

1. To provide an idea about usage of power electronics for renewable energy systems.
2. To provide idea about controlling and storage of non conventional energy using power electronics.

OUTCOME

At the end of the course the student should be able to:

1. To gain the knowledge about power electronics utility in renewable energy systems
2. To gain the knowledge about controlling and storage of non conventional energy using power electronics.

UNIT I INTRODUCTION **9**

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

UNIT II ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION **9**

Review of reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.

UNIT III POWER CONVERTERS **9**

Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection Of inverter, battery sizing, array sizing Wind: three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.

UNIT IV ANALYSIS OF WIND AND PV SYSTEMS **9**

Stand alone operation of fixed and variable speed wind energy conversion systems and solar system-Grid connection Issues -Grid integrated PMSG and SCIG Based WECS-Grid Integrated solar system

UNIT V HYBRID RENEWABLE ENERGY SYSTEMS **9**

Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV-Maximum Power Point Tracking (MPPT).

L=45 T=15 TOTAL = 60

REFERENCES:

1. Rashid .M. H "power electronics Hand book", Academic press, 2001.
2. Rai. G.D, "Non conventional energy sources", Khanna publishes, 1993.
3. Rai. G.D," Solar energy utilization", Khanna publishes, 1993.
4. Gray, L. Johnson, "Wind energy system", prentice hall linc, 1995.
5. Non-conventional Energy sources B.H.Khan Tata McGraw-hill Publishing Company, New Delhi.

PPD707 POWER QUALITY
Common to M.TECH(PED)/M.TECH(PSE)

L	T	P	C
3	1	0	4

GOAL

To provide the fundamentals of power quality, voltage variations, analysis of power outages and power quality improvement.

OBJECTIVES

The course should enable the students to:

1. Study the basics of power quality , power quality problems and power quality standards,
2. Study about the characteristics of non-linear loads ,
3. Study Voltage, Current, Power and Energy measurements and analysis methods of Laplace's, Fourier and Hartley and Wavelet Transforms ,
4. Study the analysis and conventional mitigation methods,
5. Study about various devices used to enhance power quality.

OUTCOME

At the end of the course the student should be able to:

1. Know the different characteristics of electric power quality in power systems,
2. One can learn about the applications of non-linear loads ,
3. Know the applications of Hartley and Wavelet Transforms ,
4. One can learn to mitigate the power quality problems
5. One can learn about the application of FACTS device on DG side.

UNIT I INTRODUCTION **9**

Introduction - Characterisation of Electric Power Quality: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation, Power acceptability curves - power quality problems: poor load power factor, Non linear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage - Power quality standards.

UNIT II NON-LINEAR LOADS **9**

Single phase static and rotating AC/DC converters, Three phase static AC/DC converters, Battery chargers, Arc furnaces, Fluorescent lighting, pulse modulated devices, Adjustable speed drives.

UNIT III MEASUREMENT AND ANALYSIS METHODS **9**

Voltage, Current, Power and Energy measurements, power factor measurements and definitions, event recorders, Measurement Error - Analysis: Analysis in the periodic steady state, Time domain methods, Frequency domain methods: Laplace's, Fourier and Hartley transform - The Walsh Transform - Wavelet Transform.

UNIT IV ANALYSIS AND CONVENTIONAL MITIGATION METHODS **9**

Analysis of power outages, Analysis of unbalance: Symmetrical components of phasor quantities, Instantaneous symmetrical components, Instantaneous real and reactive powers, Analysis of distortion: On-line extraction of fundamental sequence components from measured samples - Harmonic indices - Analysis of voltage sag: Detorit Edison sag score, Voltage sag energy, Voltage Sag Lost Energy Index (VSLEI)- Analysis of voltage flicker, Reduced duration and customer impact of outages, Classical load balancing problem: Open loop balancing, Closed loop balancing, current balancing, Harmonic reduction, Voltage sag reduction.

UNIT V POWER QUALITY IMPROVEMENT **9**

Utility-Customer interface -Harmonic filters: passive, Active and hybrid filters -Custom power devices: Network reconfiguring Devices, Load compensation using DSTATCOM, Voltage regulation using DSTATCOM, protecting sensitive loads using DVR, UPQC -control strategies: P-Q theory, Synchronous detection method - Custom power park -Status of application of custom power devices.

L = 45 T=15 TOTAL = 45

TEXT BOOKS

1. Arindam Ghosh "Power Quality Enhancement Using Custom Power Devices", Kluwer Academic Publishers, 2002
2. G.T.Heydt, "Electric Power Quality", Stars in a Circle Publications, 1994 (2nd edition)
3. R.C. Duggan, Power Quality.,McGraw-Hill, New York, 1996.
4. A.J. Arrillga, “Power system harmonics”, Wiley; 1st edition, 1997
5. Derek A. Paice, “Power electronic converter harmonics”, Ieee Press, 1995

PPD204 LINEAR AND NONLINEAR SYSTEM THEORY
Common to M.TECH(PED)/M.TECH(PSE)

4 CREDITS

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

At the end of the course 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 9

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 9

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 9

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 **9**

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

UNIT V MODEL CONTROL **9**

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

REFERENCES:

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.

PAL704 DIGITAL SIGNAL PROCESSORS
Common to M.TECH (A.E)

L	T	P	C
3	1	0	4

GOAL

To familiarize the students with modern digital processing techniques with emphasis on special processors for motor control.

OBJECTIVES

The course will enable the students :

(i) To understand about the architecture and algorithms of DSPs.Algorithms for signal processing- Basic architecture of DSPs

(ii) To understand the students about the architecture, addressing modes, instruction set, programming.

(iii) To know the students different I/O devices for DSPs at different Applications.Peripherals-Memory-Applications.

(iv) To study the D to A interface and DMA, Serial Ports.

(v) To familiarize the students about special processors available for motor control.

OUTCOME

After completion of the course the students are expected to be able :

(i) To get clear idea about the basic structure of DSPs.

(ii) To write programming in Texas Processors once they understand the instruction set.

(iii) To know the students different I/O devices for DSPs for different Applications.Peripherals-Memory-Applications

(iv) To get exposure to interface different external I/O devices with processor.

(v) To implement different control techniques of special purpose DSPs for various applications.

UNIT I INTRODUCTION **9**

Algorithms for signal processing - Basic architecture of DSPs.

UNIT II TEXAS PROCESSORS **9**

Architecture - Addressing modes - Instruction set - Programming

UNIT III PERIPHERALS INTERFACES OF DSP **9**

Peripherals - memory - Applications.

UNIT IV EXTERNAL INTERFACE **9**

Digital and analog Interface - Host interface - Memory interface - DMA ports - Serial ports.

UNIT V SPECIAL PROCESSORS FOR MOTOR CONTROL **9**

Architecture - Special features - PWM generation - controller implementation

L = 45 T=15 TOTAL = 60

REFERENCES

1. K.Padmanabhan et al. "A Practical approach to Digital Signal Processing", New Age Publications, 2001.

2. B. Venkataramani et al. "Digital Signal Processor - Architecture, Programming and Applications" , TMH, New Delhi 2002.

3. Texas Instruments - Manuals.

PPS705 WIND ENERGY CONVERSION SYSTEMS
Common to M.TECH(PSE)

L	T	P	C
3	1	0	4

OBJECTIVE

To introduce the principle of wind turbines and wind energy conversion systems.

OUTCOME

To gain the knowledge about wind energy conversion that connected to the grid.

UNIT I INTRODUCTION **9**

Components of WECS-WECS schemes-Power obtained from wind-simple momentum theory-Power coefficient-Sabinin's theory-Aerodynamics of Wind turbine

UNIT II WIND TURBINES **9**

HAWT-VAWT-Power developed-Thrust-Efficiency-Rotor selection-Rotor design considerations-Tip speed ratio-No. of Blades-Blade profile-Power Regulation-yaw control-Pitch angle control-stall control-Schemes for maximum power extraction.

UNIT III FIXED SPEED SYSTEMS **9**

Generating Systems- Constant speed constant frequency systems -Choice of Generators-Deciding factors-Synchronous Generator-Squirrel Cage Induction Generator- Model of Wind Speed- Model wind turbine rotor - Drive Train model-Generator model for Steady state and Transient stability analysis.

UNIT IV VARIABLE SPEED SYSTEMS **9**

Need of variable speed systems-Power-wind speed characteristics-Variable speed constant frequency systems synchronous generator- DFIG- PMSG -Variable speed generators modeling - Variable speed variable frequency schemes.

UNIT V GRID CONNECTED SYSTEMS **9**

Stand alone and Grid Connected WECS system-Grid connection Issues-Machine side & Grid side controllers-WECS in various countries

L = 45 T = 15 TOTAL =60

REFERENCES

1. L.L.Freris "Wind Energy conversion Systems", Prentice Hall, 1990
2. Ion Boldea, "Variable speed generators", Taylor & Francis group, 2006.
3. E.W.Golding "The generation of Electricity by wind power", Redwood burn Ltd., Trowbridge,1976.
4. S.Heir "Grid Integration of WECS", Wiley 1998.

PCS708 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY IN SYSTEM DESIGN

L	T	P	C
3	1	0	4

GOAL

To study source of EMI, standards, testing equipments and compatibility measures for equipments and PCBs.

OBJECTIVES

The course will enable the students to:

(i) Acquire Knowledge about the Electromagnetic interference concepts and its environment

(ii) Learn different kinds of EMI coupling.

(iii) Learn the EMI/EMC standards and to know the various measurement arrangements and methods.

(iv) Study different types EMI control techniques .

(v) Gain Knowledge about Electro Magnetic Compatibility design for PCB's

OUTCOME

After completion of the course, the students will be able to:

(i) Analyse EMI concepts and its environment .

(ii) Have adequate knowledge in different kinds of EMI Coupling

(iii) Gain sound knowledge in EMI/EMC standards , various measurement arrangements and techniques

(iv) Understand EMI controlling techniques.

(v) Understand the concepts of EMC and to design PCB's with the inherent EMC.

UNIT I EMI ENVIRONMENT **9**

EMI/EMC concepts and definitions, Sources of EMI, conducted and radiated EMI, Transient EMI, Time domain Vs Frequency domain EMI, Units of measurement parameters, Emission and immunity concepts, ESD.

UNIT II EMI COUPLING PRINCIPLE **9**

Conducted, Radiated and Transient Coupling, Common Impedance Ground Coupling, Radiated Common Mode and Ground Loop Coupling, Radiated Differential Mode Coupling, Near Field Cable to Cable Coupling, Power Mains and Power Supply coupling.

UNIT III EMI/EMC STANDARDS AND MEASUREMENTS **9**

Civilian standards - FCC,CISPR,IEC,EN,Military standards - MIL STD 461D/462, EMI Test Instruments /Systems, EMI Shielded Chamber, Open Area Test Site, TEM Cell, Sensors/Injectors/ Couplers, Test beds for ESD and EFT, Military Test Method and Procedures (462).

UNIT IV EMI CONTROL TECHNIQUES **9**

Shielding, Filtering, Grounding, Bonding, Isolation Transformer, Transient Suppressors, Cable Routing, Signal Control, Component Selection and Mounting.

UNIT V EMC DESIGN OF PCBs **9**

PCB Traces Cross Talk, Impedance Control, Power Distribution Decoupling, Zoning, Motherboard Designs and Propagation Delay Performance Models.

L=45 T=15 Total =60

REFERENCES

1. Henry W.Ott, "Noise Reduction Techniques in Electronic Systems", John Wiley and Sons, NewYork. 1988.
2. C.R.Paul, "Introduction to Electromagnetic Compatibility" , John Wiley and Sons, Inc, 1992
3. V.P.Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press, 1996.
4. Bernhard Keiser, "Principles of Electromagnetic Compatibility", Artech house, 3rd Ed, 1986.