



RAJAGIRI SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS

M.Tech - INDUSTRIAL DRIVES AND CONTROL

CURRICULUM BOOK (KTU)

Vision of the Institution:

To evolve into a premier technological and research institution, moulding eminent professionals with creative minds, innovative ideas and sound practical skill, and to shape a future where technology works for the enrichment of mankind.

Mission of the Institution:

To impart state-of-the-art knowledge to individuals in various technological disciplines and to inculcate in them a high degree of social consciousness and human values, thereby enabling them to face the challenges of life with courage and conviction.

Vision of the Department:

To excel in Electrical and Electronics Engineering education with focus on research to make professionals with creative minds, innovative ideas and practical skills for the betterment of mankind.

Mission of the Department:

To develop and disseminate among the individuals, the theoretical foundation, practical aspects in the field of Electrical and Electronics Engineering and inculcate a high degree of professional and social ethics for creating successful engineers.



KERALA TECHNOLOGICAL UNIVERSITY
CET Campus, Thiruvananthapuram, Kerala -695 016

ORDINANCE

For

Master of Technology - M.Tech.

In exercise of the Powers conferred under Clause 44 of the Ordinance, the Executive Committee of the University hereby promulgate the Ordinance for the University for the Academic Year 2015-2016.

The Academic ordinance will come into effect from the date of publication in the Gazette.

INDEX

- 01 Admission to the M. Tech. Programme**
- 02 Duration of the Programme**
- 03 Post Graduate Programme Clusters**
- 04 Specialization Streams in M.Tech., Programme**
- 05 M.Tech., Programme Structure**
- 06 Course Registration and Enrolment**
- 07 Recommended Credit distribution over the semesters**
- 08 Academic Assessment/Evaluation**
- 09 Course Completion and earning of credits**
- 10 End Semester and Supplementary Examinations**
- 11 Conduct of End Semester Examination**
- 12 Award of M.Tech., Degree**
- 13 Amendments to Ordinance**
- 14 Miscellaneous provisions**
 - i) Stream of Specializaion**
 - ii) Language of Instruction**
 - iii) Academic Calendar**
 - iv) Eligibility to continue with the programme**
 - v) Seminar**
 - vi) Project work**
 - vii) Faculty Advisor, Class Committee**
 - viii) Award of Grades**
 - ix) Grades and Grade Points**
 - x) Academic Auditing**

- xi) **Revaluation and Grade Improvement**
- xii) **Grade Cards**
- xiii) **Academic Discipline and Malpractices in Examinations**
- xiv) **Student's Welfare Committee**
- xv) **Grievances and Appeals Committee**
- xvi) **Attendance**
- xvii) **Leave of Absence**
- xviii) **Project Evaluation**
- xix) **Project Work outside the College**
 - Ragging**
 - Calculation of SGPA/CGPA**

O-1 Admission to the M. Tech. Programme

Candidates who have been awarded or qualified for the award of the Bachelor's degree in Engineering / Technology, from an Institution approved by AICTE are eligible for admission to the M. Tech., Programme. Eligibility of candidates having MCA/MSc qualifications will be decided from time to time by following the guidelines issued by All India Council for Technical Education (AICTE) and the Government of Kerala and notified separately. Other important eligibility criteria are as listed out by the Director of Technical Education with the approval of the Government of Kerala.

O-1.1 Candidates qualified in Graduate Aptitude Test in Engineering (GATE) and admitted to the M. Tech. programme are eligible to receive Half Time Teaching Assistantship (HTTA) as per the rules of the All India Council for Technical Education (AICTE)/Ministry of Human Resource Development (MHRD).

O-1.2 Sponsored candidates from Industries, R&D organizations, National Laboratories as well as Educational Institutions, with a bachelor's degree in engineering are eligible for admission to the M. Tech. programme.

O-1.3 Foreign nationals whose applications are received through Indian Council of Cultural Relations, Government of India are also eligible for admission to the M. Tech. programme.

O-1.4 Announcements for M. Tech. Programmes will be made by the DTE, Government of Kerala.

O-1.5 Selection of candidates for the M. Tech programme will be done centrally or monitored by the Directorate of Technical Education as per the guidelines given on this by the Government of Kerala

- O-1.6 The number of candidates to be admitted to each M. Tech stream will be as per the approval of the University which shall be based on decision on this given by the All India Council for Technical Education.
- O-1.7 Admission will be complete only on meeting all the other requirements mentioned in the letter of admission and on payment of the fees.
- O-1.8 Candidates who have the Associate Membership of Professional Bodies that are approved by the University and have qualified in GATE shall also be eligible for admission to the M. Tech. programme.
- O-1.9 The reservation policy of the Government of Kerala and the Government of India shall be followed in admission to the M. Tech. programme.
- O-1.10 All admission will be governed by the procedure laid down for this by the Director of Technical Education, Kerala and the Government of Kerala.
- O-1.11 Notwithstanding all that is stated above, the admission policy may be modified from time to time by the University, particularly to conform to directions from the Government of Kerala and the Government of India.

O-2 Duration of the Programme

The normal duration of the M. Tech programme, including the project work, shall be four semesters.

O-3 Post Graduate Programme Clusters

The University shall identify clusters of colleges offering M. Tech programmes in different streams and allow them to formulate procedures for the smooth conduct of all academic activities associated with the M. Tech programme, in line with the ordinances/regulations of the University. These clusters shall have academic autonomy, regulated by a Cluster level Graduate Committee [CGPC] consisting of all the principals of the colleges in the cluster. The Chairman of CGPC shall be an eminent academician nominated by the Vice Chancellor. The CGPC will be responsible for all academic matters including the curriculum, syllabi, course plans, internal evaluations, end semester examinations, and grading for all streams of M. Tech. programme offered by the colleges in the cluster. The CGPC can formulate additional rules for other academic aspects that are not covered by this Ordinance.

O-4 Specialization Streams in M. Tech., Programme

The M. Tech. programme streams offered by each cluster as well as the eligibility of candidates of different B. Tech. branches or having other qualifications, for each of them shall be approved by the CGPC.

O-5 M. Tech. Programme Structure

- i) The M. Tech programme in all streams of specialization will be structured on a credit based system following the semester pattern with continuous evaluation.
- ii) The University permits regular as well as external registration (part time) for those in employment.
- iii) The duration for the M. Tech. programme in all streams of specialization will normally be 4 semesters. The maximum duration is 6 semesters.
- iv) For students admitted on external registration, the normal duration will be 6 semesters. Here the maximum duration is 7 semesters.
- v) The University permits a regular student to change over to external registration during the programme, under specific circumstances like initiating a start up venture or to take up a job.
- vi) Each semester shall have a minimum of 72 instruction days followed by the end semester examination.
- vii) A common course structure for the M. Tech programmes in all streams of specialization is to be followed and consists of the following.
 - Core Courses
 - Elective Courses
 - Laboratory Courses
 - Seminar
 - Project
- viii) Every stream of specialisation in the M. Tech. programme will have a curriculum and syllabi for the courses. The curriculum should be so drawn up that the minimum number of credits for successful completion of the M. Tech. programme in any stream of specialization is not less than 64 and not more than 68.
- ix) Credits are assigned as follows, for one semester
 - 1 credit for each lecture hour per week
 - 1 credit for each tutorial hour per week
 - 1 credit for each laboratory/ practical of 2 or 3 hours per week
 - 2 credits for the seminar
 - 2 credits for Mini Project
 - 6 credits for Project in the 3rd Semester
 - 12 credits for Project in the 4th Semester
- x) A pass is mandatory in all core courses. In case of failure in an elective course, there is the provision to choose another elective listed in the curriculum.

xi) On their request, CGPC shall examine the academic records and permit candidates with B. Tech (Honours) who have earned credits for any relevant graduate level courses to transfer credits towards the M. Tech. programme. Candidates who received B. Tech (Honours) degree just prior to their M. Tech admission are permitted to transfer up to 9 credits. For those who received the B. Tech (Honours) degree within three years prior to their M. Tech. admission are permitted to transfer up to 6 credits.

Xii) The maximum number of lecture based courses and laboratory courses in any semester shall not exceed 5 and 2 respectively. The maximum credits in a semester shall be 23.

Xiii) Extension of Programme duration

The normal duration of the programme shall be four semesters.

In case of prolonged illness or other personal exigencies, the university may allow a student who has earned credits for at least one semester, to extend the programme up to the maximum duration of six semesters.

Students who have earned credits for the courses listed in the first two semesters are permitted to transfer their registration as external candidates if they take up a job. However, they have to complete the programme within six semesters.

O-6. Course Registration and Enrolment

All students have to register for the courses they desire to attend in a semester. Students admitted to the first semester are advised to register for all courses offered in the first semester. They do not have to enrol for the semester. All other students are required to register at the end of the semester for the courses they desire to take in the next semester. Later they have to enrol for these courses in the new semester based on the results in the previous semester. This allows them to make minor changes in the list of courses already registered for. Before enrolment, students should clear all dues including any fees to be paid and should not have any disciplinary proceedings pending. The dates for registration and enrolment will be given in the academic calendar. Any late registration or enrolment, allowed only up to 7 working days from the commencement of the semester, will attract a late fee.

A student can drop a course or substitute one already registered for by another, for valid reasons with the approval of the faculty advisor. However this has to be done within 7 working days from the commencement of the semester.

The maximum number of credits a student can register for in a semester is limited to 24.

O-7 Recommended Credit distribution over the semesters

First Semester	: 20 to 23 credits
Second Semester	: 18 to 19 credits
Third Semester	: 14 credits

O-8. Academic Assessment/Evaluation

The University follows a continuous academic evaluation procedure.

The Assessment procedure and corresponding weights recommended are as follows:-

For theory courses

- i) Two internal tests, each having 15%
- ii) Tutorials/Assignments/ Mini projects having 10%
- iii) End Semester examination having 60%

All the above are mandatory requirements to earn credits.

Students who have missed either the first or the second test can register with the consent of the faculty member and the Head of the Department concerned for a re-test which shall be conducted soon after the completion of the second test and before the end semester examination. The re-test will cover both the first and the second test course plans. If a student misses both the scheduled tests, there is no provision for any retests and zero marks will be given for each test. In case of serious illness and where the attendance is above 70% the Principal may permit the conduct of the tests for a student based on his application and other relevant medical reports. Such cases are to be reported to CGPC.

For Laboratory /Practical courses

- i) Practical Records /outputs 40%
- ii) Regular Class Viva-Voce 20%
- iii) Final Test (Objective) 40%

O-9. Course Completion and earning of credits

Students registered and later enrolled for a course have to attend the course regularly and meet the attendance rules of the University and appear for all internal evaluation procedures for the completion of the course. However, earning of credits is only on completion of the end semester/supplementary examination and on getting a pass grade. Students, who had completed a course but could not write the end semester/supplementary examination for genuine health reasons or personal exigencies, if otherwise eligible are permitted to write the semester examination, at the next opportunity and earn credits without undergoing the course again. Failed candidates having more than 45% marks in their internals can also avail of this option. However, those who are not eligible to appear for the end semester examination have to register and undergo the course again, whenever it is offered, to earn the credits.

O-10. End Semester and Supplementary Examinations

At the end of the semester, the end semester examination will be conducted in all courses offered in the semester and will be of three hours duration unless otherwise specified. Supplementary examinations are to be conducted for eligible candidates registered for them, before the commencement of the next semester.

O-10.1 Eligibility to write the End Semester Examination and Grading

Eligibility criteria to appear for the semester examination are the attendance requirements in the course, 45% or more marks in the internal evaluation and having no pending disciplinary action. The minimum attendance for appearing for the semester examination is 85% in the course. In case of serious illness there is a relaxation for attendance [O-14.xvi]. Those who do not meet the eligibility criteria shall be awarded an FE Grade and have to register again for the course.

A student should have a minimum of 45% marks in the end semester examination to be eligible for grading in a course. Otherwise he/she will be considered to have failed in the course and an F grade will be awarded.

O-10.2 Eligibility to write the Supplementary Examination

Only failed students and those who could not write the semester examination due to health reasons or other personal exigencies that are approved by the Principal can register for the supplementary examination provided they meet the eligibility requirements given in O-10.1. Grades awarded in the supplementary examination will be taken as the semester grades in these courses.

O-11. Conduct of End Semester Examination

The Clusters will prepare the question papers, conduct the end semester examinations, organize the valuation of the answer scripts, finalise the results and submit it to the University, as per the academic calendar.

O-12. Award of M. Tech., Degree

The award of the M. Tech. Degree shall be in accordance with the Ordinances and Procedures given by the University.

A student will be eligible for the award of M. Tech. Degree of the University on meeting the following requirements;

- i) Registered and earned the minimum credits, as prescribed in the curriculum, for the stream of specialization.
- ii) No pending disciplinary action.

O-13. Amendments to Ordinance:

Notwithstanding all that has been stated above, the University has the right to modify any of the above provisions of the ordinance from time to time.

O- 14. Miscellaneous provisions:

- i) Stream of Specialization:

The streams of specializations are to be in line with the approval given on this by the All India Council for Technical Education.

ii) Language of Instruction

Unless otherwise stated, the language of instruction shall be English.

iii) Academic Calendar

The University shall publish in its website the academic calendar for every academic semester indicating the date of commencement of the semester as well as instruction. It will specify the course registration and enrolment dates, the schedule for mandatory internal tests for theory courses, dates by which laboratory/practical evaluations are to be completed, date for finalization of internal marks, last instruction day in the semester, planned schedule of end semester examinations and result declaration as well as approved holidays falling within the semester. Schedules for the supplementary examinations and result declaration dates are to be included in the calendar. Additionally colleges may publish their academic calendar, in line with the University academic calendar, indicating other schedules and events they plan to conduct during the semester.

iv) Eligibility to continue with the programme

A student has to earn a minimum number of credits in a semester to register for higher semester courses. This should be at least $2/3^{\text{rd}}$ of the credits for the courses listed in for the semester. CGPC shall formulate the rules based on this and spell out the procedure to proceed with the programme.

Failed students who have more than 45% marks in the internal course evaluation are permitted to write the semester examination without registering and undergoing the course. Those with less than 45% in internal course evaluation have to register again for the course, attend the classes and earn the credits.

v) Seminar

Students have to register for the seminar and select a topic in consultation with any faculty member offering courses for the programme. A detailed write-up on the topic of the seminar is to be prepared in the prescribed format given by the Department. The seminar shall be of 30 minutes duration and a committee with the Head of the department as the chairman and two faculty members from the department as members shall evaluate the seminar based on the report and coverage of the topic, presentation and ability to answer the questions put forward by the committee.

Suggested evaluation procedure:-

Faculty member in charge of the seminar and another faculty member in the department nominated by the Head of the Department are the evaluators for the seminar. Distribution of marks for the seminar is as follows.

Marks for the report: 30%

Presentation: 40%

Ability to answer questions on the topic: 30%

vi) Project work

Project work is spread over the third and fourth semesters. Project work is to be evaluated both in the third and the fourth semesters. Based on these evaluations the grade is finalised only in the fourth semester.

Project evaluation weights shall be as follows:-
For convenience the marks are allotted as follows.

Total marks for the Project: 150

In the 3rd Semester:- Marks:50

Project Progress evaluation details:

Progress evaluation by the Project Supervisor	: 20 Marks
Presentation and evaluation by the committee	: 30 Marks

In the 4th Semester:- Marks:100

Project evaluation by the supervisor/s	: 30 Marks
Presentation & evaluation by the Committee	: 40 Marks
Evaluation by the External expert	: 30 Marks

vii) Faculty Advisor, Class Committee

a) Faculty Advisor

The Head of the Department offering the M. Tech. programme shall nominate senior faculty members as faculty advisors who shall advise the students in academic matters and support them in their studies. Their role is to help the students in academics and personal difficulties related to studies. A faculty advisor may support a group of students in a semester.

b) Class Committees are to be in place for all M. Tech. programs in the college.

Class Committee

All M. Tech streams of specialization will have class committees for each semester, constituted by the respective Heads of Departments.

The Chairman of the committee shall be a senior faculty member who does not offer any course for that stream in that semester.

Members:-

- i) All faculty members teaching courses for the stream in that semester.
- ii) Two student representatives nominated by the Head of the Department, from the stream.

Class committees shall meet at least thrice in a semester - one in the beginning and one around the middle of the semester and one at least two weeks before the semester examinations. These committees should monitor the conduct of the courses, adherence to the course plan and time schedule, completion of the

syllabus, standards of internal tests and evaluation process and address the difficulties faced by the students and take suitable remedial actions at the appropriate time. Before the end semester examination, the committee should meet without the student representatives and finalise the internal marks. A report on the student performance in each course should be prepared and submitted to the CGPC by the colleges.

viii) Award of Grades

Grading is based on the marks obtained by the student in a course. [O-14 ix]

The grade card will only show the grades against the courses the student has registered.

The semester grade card will show the grade for each registered course, Semester Grade Point Average (SGPA) for the semester as well as Cumulative Grade Point Average (CGPA).

ix) Grades and Grade Points

Grades and Grade Points as per UGC guidelines are to be followed by the University

Grades	Grade Point	% of Total Marks obtained in the course
O	10	90% and above
A ⁺	9	85% and above but less than 90%
A	8	80% and above but less than 85%
B ⁺	7	70% and above but less than 80%
B	6	60% and above but less than 70%
C	5	50% and above but less than 60%
P	4	45% and above but less than 50%
F	0	Less than 45%
FE	0	Failed due to eligibility criteria [O.10.1]
I		Course Incomplete

Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA) are calculated based on the above grading norms and are explained at the end of this document.

x) Academic Auditing

The University shall have a detailed academic auditing procedure in place comprising of an internal academic auditing cell within the college and an external academic auditing for each college. The internal academic auditing cell in each college shall oversee and monitor all academic activities including all internal evaluations and semester examinations. This cell is to prepare academic audit statements for each semester at regular intervals of four weeks of instruction. These reports are to be presented to the external academic auditor appointed by

the University, who will use it as a reference for his independent auditing and for the final report to the University.

Academic auditing will cover:-

- i) Course delivery covering syllabus, adherence to course plan, quality of question papers for internal examinations, internal evaluation, laboratory experiments, practical assignments, mini projects, conduct of practical classes and their evaluation. Semester examination and academic performance of the students.
- ii) Co-curricular and Extra-curricular activities available for students, and their organization.
- iii) Academic functioning of the college encompassing students, faculty and college administration covering punctuality, attendance, discipline, academic environment, academic accountability, academic achievements and benchmarking.

xi) Revaluation and Grade improvement

There is no provision for revaluation of the semester answer books or for improving the grade.

Students are permitted to check the answer books of the semester examination, after the results are declared. Any discrepancies in evaluation could be brought to the notice of the teacher concerned who will initiate appropriate action on this and report to the CGPC for a final decision on this.

xii) Grade Cards

Students who have written the semester examination will be given the grade cards for the registered courses, in every semester by the respective colleges. On earning the required credits for the degree, a consolidated grade sheet for the M. Tech programme will be issued by the University on the recommendation of the respective CGPC.

The M. Tech. degree will not have any classification like distinction or first class.

xiii) Academic Discipline and Malpractices in Examinations

Every student is required to observe discipline and decorous behaviour.

Any act of indiscipline, misbehaviour and unfair practice in examinations will be referred to the **Disciplinary Action Committee (DAC)**. Malpractices in examinations shall be viewed seriously and any such incident observed or reported by a faculty member or an invigilator associated with the examinations shall be reported to the Principle who in turn shall refer it to DAC. On the basis of the report and evidence available or gathered, DAC shall immediately initiate an enquiry giving the concerned student a chance to explain his/her case. Based on this the committee shall recommend the course of action in line with the guidelines formulated for this by the Controller of Examination of the University and forward it to the Principal for action.

Actions are to be based on the severity of the offence and are to be dealt with, on a course basis. Guidelines on this shall be given by the Controller of Examination which is to be followed by the Disciplinary Action Committee of the college.

DAC shall be headed by a department head and shall have three other faculty members drawn from different departments as members. In case of malpractices in end semester examinations, the report given by the college DAC and the action taken by the Principal shall be intimated to the Controller of Examination of the University

xiv) Student's Welfare Committee

Every college shall have a Student's Welfare Committee, constituted by the Principal of the college. This committee shall have at least three faculty members as members and the chairman shall be a senior faculty member in the rank of a Professor. This committee is entrusted with the task of looking after the welfare of the students by taking appropriate steps with the concurrence of the principal.

xv) Grievances and Appeals Committee

Each college should have a Grievances Redress Committee constituted by the Principal to address the grievances of the students and to consider their appeals on any decisions made by the college. This committee consisting of at least three faculty members and chaired by a senior professor shall look into student's grievances and appeals and give its recommendations to the Principal for action.

xvi) Attendance

Attendance is marked for each course. 85% attendance is mandatory for writing the semester examination in a course. Students who get Part Time Teaching Assistantship (PTTA) or Scholarships from the Central or State Governments or any other agencies are expected to have 100 % attendance. However, under unavoidable circumstances students are permitted to take leave. Leave is normally sanctioned for any approved activity taken up by students outside the college covering sports and other extra-curricular activities. Leave is also permitted on medical grounds or on personal exigencies. Leave of absence for all these is limited to 15 % of the academic contact hours for the course.

In case of long illness or major personal tragedies/exigencies the Principal can relax the minimum attendance requirement to 70%, to write the semester examination. This is permitted for one or more courses registered in the semester. The Principal shall keep all records which led to his decision on attendance, for verification by the Academic Auditor. However this concession is applicable only to any one semester during the entire programme. In case of prolonged illness, break of study is permitted up to two semesters which could extend the programme up to six semesters, the maximum permitted by the regulations.

xvii) Leave of Absence

Students who desire to take leave have to apply for it to the teacher conducting the course. This application together with any supporting documents like doctor's certificate or other relevant information is to be forwarded to the Head of the Department with the recommendation of the teacher indicating the total leave of absence the student has so far availed. Approval for leave is to be given by the head of the department. After any prolonged medical leave, normally exceeding five instruction days, on rejoining, the student has to produce the fitness certificate given by the doctor.

xviii) Project Evaluation

Normally students are expected to do the project within the college. However they are permitted to do the project in an industry or in a government research institute under a qualified supervisor from that organization. Progress of the project work is to be evaluated at the end of the third semester. For this a committee headed by the head of the department with two other faculty members in the area of the project and the project supervisor/s. If the project is done outside the college, the external supervisor associated with the student shall also be a member of the committee.

Final evaluation of the project will be taken up only if the student has earned all course credits listed in the first three semesters. Project evaluation shall be done by the same committee mentioned above with an external expert, either from an academic/R&D organization or from Industry, as an additional member. Final project grading shall take into account the progress evaluation done in the third semester and the project evaluation in the fourth semester. If the quantum of work done by the candidate is found to be unsatisfactory, the committee may extend the duration of the project up to one more semester, giving reasons for this in writing to the student. Normally further extension will not be granted and there shall be no provision to register again for the project.

Xix) Project work outside the College

While students are expected to do their projects in their colleges, provision is available for them to do it outside the college either in an industry or in an institute of repute. This is only possible in the fourth semester and the topic of investigation should be in line with the project part planned in the 3rd semester. Student should apply for this through the project supervisor indicating the reason for this well in advance, preferably at the beginning of the 3rd semester. The application for this shall include the following:-

Topic of the Project:

Project work plan in the 3rd Semester:

Reason for doing the project outside:

Institution/Organization where the project is to be done:

External Supervisor – Name:
Designation:
Qualifications:
Experience:

Letter of consent of the External Supervisor as well as from the organization is to be obtained.

This application is to be vetted by the head of the department and based on the decision taken the student is permitted to do the project outside the college.

Ragging

Ragging of any nature is a criminal and non-bailable offence. Involvement in ragging shall lead to stringent punishment, including imprisonment as per the law of the land. A student, whose involvement in ragging is established, shall be summarily dismissed from the college. Each student of the Institute, along with his/her parent, is required to give an undertaking in this regard and the same is to be submitted at the time of registration.

Calculation of SGPA/CGPA

Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA) are calculated as follows.

$SGPA = \frac{\sum(C_i \times GP_i)}{\sum C_i}$ where C_i is the credit assigned for a course and GP_i is the grade point for that course. Summation is done for all courses registered by the student in the semester. Here the failed courses are also accounted.

$CGPA = \frac{\sum(C_i \times GP_i)}{\sum C_i}$ where C_i is the credit assigned for a course and GP_i is the grade point for that course. Summation is done for all courses registered by the student during all the semesters for which the CGPA is needed. Here the failed courses are also accounted. CGPA of all courses passed may also be given.

Thiruvanthapuram
26-6-2015

Registrar



KERALA TECHNOLOGICAL UNIVERSITY

CLUSTER

ERNAKULAM WEST

SCHEME AND SYLLABUS

FOR

M. Tech. DEGREE PROGRAMME

IN

INDUSTRIAL DRIVES AND CONTROL

(2015 ADMISSION ONWARDS)

SCHEME AND SYLLABUS FOR M. Tech. DEGREE PROGRAMME IN INDUSTRIAL DRIVES AND CONTROL

SEMESTER-1

Exam Slot	Course No:	Name	L- T – P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	06EE 6 01 1 **	Advanced Mathematics	4-0-0	40	60	3	4
B	06EE 6 02 1 *	Analysis of Power Electronic Systems I	4-0-0	40	60	3	4
C	06EE 6 03 1	Electric Drives	4-0-0	40	60	3	4
D	06EE 6 04 1	Modeling & Analysis of Electrical Machines	3-0-0	40	60	3	3
E	06EE 6 X5 1	Elective I	3-0-0	40	60	3	3
	06EE 6 06 1	Research methodology	0-2-0	100	0	0	2
	06EE 6 07 1	Seminar I	0-0-2	100	0	0	2
	06EE 6 08 1	Power Electronics Lab	0-0-3	100	0	0	1

Credits: 23

	Elective I (06 EE 6 X5 1)
06EE 6 15 1**	Systems Theory
06EE 6 25 1	Power Semiconductor Devices
06EE 6 35 1*	Digital Simulation of Power Electronic Systems
06EE 6 45 1***	Energy Management in Electrical Systems

* Common to IDAC/PE/PEPS

** Common to IDAC/PEPS

*** Common to IDAC/PE

SEMESTER-II

Exam Slot	Course No:	Name	L- T – P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	06EE 6 01 2 *	Analysis of Power Electronic Systems II	4-0-0	40	60	3	4
B	06EE 6 02 2	Advanced Control of AC drives	3-0-0	40	60	3	3
C	06EE 6 03 2	Special Electrical Machines and Drives	3-0-0	40	60	3	3
D	06EE 6 X4 2	Elective II	3-0-0	40	60	3	3
E	06EE 6 X5 2	Elective III	3-0-0	40	60	3	3
	06EE 6 06 2	Mini Project	0-0-4	100	0	0	2
	06EE 6 07 2	Electric Drives Lab	0-0-3	100	0	0	1

Credits:19

Elective II - (06EE 6 X4 2)		Elective III- (06 EE 6 X5 2)	
06EE 6 14 2*	Power Quality	06EE 6 15 2	FACTS Technology
06EE 6 24 2	Adaptive Control	06EE 6 25 2	Optimal Control Theory
06EE 6 34 2	Advanced Digital Signal Processing	06EE 6 35 2*	Smart Grid Technology and applications
06EE 6 44 2*	Robotics and automation	06EE 6 45 2	Electric Vehicle Technology

* Common to IDAC/PE/PEPS

SEMESTER-III

Exam Slot	Course No:	Name	L- T – P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	06EE7 X1 1	Elective IV	3-0-0	40	60	3	3
B	06EE7 X2 1	Elective V	3-0-0	40	60	3	3
	06EE 7 03 1	Seminar II	0-0-2	100	0	0	2
	06EE 7 04 1	Project(Phase 1)	0-0-12	50	0	0	6

Credits: 14

Elective-IV(06 EE 7 X1 3)		Elective-V(06 EE 7 X2 3)	
06EE 7 11 1*	Power Electronic control of special electrical machines	06EE 7 12 1*	Soft Computing Techniques
06EE 7 21 1*	Power Electronics for Renewable Energy Systems	06EE 7 22 1*	Distributed Generation and control
06EE 7 31 1*	Embedded Controllers	06EE 7 32 1*	High voltage DC Transmission
06EE 7 41 1	Digital Control Systems	06EE 7 42 1	Bio inspired algorithm and its applications

* Common to IDAC/PE/PEPS

SEMESTER-IV

Exam Slot	Course No:	Name	L- T – P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	06EE 7 01 2	Project (Phase 2)	0-0-21	70	30		12

Credits: 12

Total Credits for all semesters: 68

L – Lecture T - Tutorial P - Practical

Semester I

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 01 1	ADVANCED MATHEMATICS	4-0-0: 4	2015
<p>PRE – REQUISITES:</p> <ol style="list-style-type: none"> 1. Basics of Complex analysis 2. Single variable calculus 3. Vector methods. <p>COURSE OBJECTIVES:</p> <p>To give an understanding of (1) complex transformations (2) various types of Optimization methods (3)some properties of probability distributions which are essential for the core specialization.</p> <p>SYLLABUS:</p> <p>Analytic functions, Transformations, Probability distributions, Markov Process, Correlation, Linear programming, Optimization methods.</p> <p>COURSE OUTCOME:</p> <p>Takers will know the Mathematical tools required to understand the core courses they have to undergo for their graduate programme.</p>			
<p>Text Books & References</p> <ol style="list-style-type: none"> 1. Ahlfors, Complex Analysis, McGraw Hill 2. Peter Henrici, Applied & Computational Complex Analysis, John wiley 3. A Papoulis, Probability, Random variables and Stochastic Processes, McGraw Hill. 4. S.S. Rao, Optimization theory and Applications, Wiley Eastern 			

Course Plan			
MODULE	COURSE NO:06 EE 6 01 1	L – T – P : 4 – 0 – 0	
	COURSE NAME:ADVANCED MATHEMATICS	CREDITS : 4	
	CONTENT	Contact hrs	End Sem Marks %
I	Analytic functions, Cauchy Riemann equations, Complex integration, Liovilli's theorem, Poisson's integral formula, Conformal mapping, Schwarz – Christoffels transformation	10	25%
II	Density functions, Markov chain, Markov process	6	25%
FIRST INTERNAL EXAM			
II	Correlation, Auto correlation, cross correlations	6	
III	Linear programming, Simplex method, Big M method, Integer programming, Gomory's cutting plane method.	12	25%
SECOND INTERNAL EXAM			
IV	Optimization: search methods, Hooke – Jeeves method, Conjugate direction method, Steepest descent method, Interpolation method (quadratic), Lagrange multiplier, Kuhn tucker conditions.	10	25%
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 02 1	ANALYSIS OF POWER ELECTRONIC SYSTEMS I	4-0-0: 4	2015
<p>PRE – REQUISITES:</p> <ol style="list-style-type: none"> 1. Electric circuit theory 2. Network Analysis <p>COURSE OBJECTIVES:</p> <p>To provide an in depth knowledge about the operation and analysis of power converter circuits.</p> <p>SYLLABUS</p> <p>Overview of Power Semiconductor Devices, Analysis of rectifier circuits, Operation and analysis of DC Choppers, Operation and analysis of AC voltage controllers and Cycloconverters, Analysis and control strategies of single phase and three phase inverters , Multilevel Inverters</p> <p>COURSE OUTCOME:</p> <p>The students will be able to</p> <ol style="list-style-type: none"> 1. Acquire knowledge about the concepts and techniques used in power electronics circuits 2. Design and analyze various power converter circuits. 			
<p>TEXTBOOKS:</p> <ol style="list-style-type: none"> 1. K.R.Varmah, Chikku Abraham, Power Electronics, 1st edition, Elsevier, 2014 2. Ned Mohan, Undeland, Robbins, Power Electronics, 3rd edition, John Wiley, 2003 <p>REFERNCES:</p> <ol style="list-style-type: none"> 1. Daniel W. Hart, Power Electronics, McGrawHill, 2011 2. Muhammad H Rashid, Power Electronics, 3rd edition, Pearson, 2007 3. Joseph Vithayathil, Principles of Power Electronics, McGrawHill-1994 			

Course Plan			
MODULE	COURSE NO:06 EE 6 02 1	L – T – P : 4 – 0 – 0	
	COURSE NAME:ANALYSIS OF POWER ELECTRONIC SYSTEMS I	CREDITS : 4	
	CONTENT	Contact Hrs	End Sem Marks %
I	<p>Overview of Power Semiconductor Devices:</p> <p>Ideal and Real switches - static and dynamic performance, loss calculation and selection of heat sink. Power diode, Thyristor, Power BJT, Power MOSFET, IGBT - Static and Dynamic Performance, Driver circuits, Turn ON, Turn OFF and Over Voltage Snubbers for switching devices.</p> <p>Rectifiers: Line current Distortion, THD, DPF, PF, Form factor, Ripple factor, Crest factor, active, reactive, apparent and distortion power. Effect of Single Phase Rectifiers on Neutral Currents in a Three Phase Four wire System.</p> <p>Controlled Rectifiers-Single phase and three phase- Half wave, fully controlled and semi controlled - Analysis with R, RL, RLE loads, RL and RLE loads with Freewheeling Diode- Effect of source inductance – Inversion mode of operation.Dual converters- Circulating and Non circulating modes - Applications.</p>	15	25%
FIRST INTERNAL EXAM			
II	<p>DC Choppers</p> <p>Principle of operation, analysis of single quadrant chopper, two and four quadrant choppers, PWM control, Forced commutation-Voltage and Current commutated choppers – multiphase chopper.</p>	13	25%
III	<p>AC voltage controllers and Cycloconverters</p> <p>Single Phase and Three phase AC Voltage Controllers- Principle of operation-analysis with R and RL loads, Thyristor Controlled Inductor.Cycloconveters:Circulating</p>	13	25%

	and Non circulating types - Analysis with R and RL loads.		
SECOND INTERNAL EXAM			
IV	Single phase half bridge and full bridge inverters - Analysis with R and RL loads. Three phase inverters - 120 and 180 degree conduction mode - Analysis with star connected R load, Voltage control in inverters- Sine triangle modulation- Unipolar and Bipolar modulation, Reduction of Harmonics in inverters. Current source inverter- Single phase and Three phase, Resonant inverters- series and parallel, Multilevel Inverters-Type	15	25%
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 03 1	ELECTRIC DRIVES	4-0-0: 4	2015
<p>PRE – REQUISITES:</p> <ol style="list-style-type: none"> 1. Electrical Machines 2. Control Systems <p>COURSE OBJECTIVES:</p> <p>To provide knowledge in fundamentals of Electric Drives performance and control</p> <p>SYLLABUS</p> <p>Dynamics and Control of Electric Drives, D.C. motor drives, Induction motor drives, Synchronous and Brushless D.C. motor drives.</p> <p>COURSE OUTCOME:</p> <p>The student should gain a workable knowledge in analyzing Electric Drive Systems.</p>			
<p>TEXTBOOKS:</p> <ol style="list-style-type: none"> 1.G.K.Dubey, “Fundamentals of Electrical Drives”, Narosa Publishers,2001. <p>REFERNCES:</p> <ol style="list-style-type: none"> 1. Ion Boldera, S.A.Nasar, “Electric Drives”, Taylor and Francis Publishing company. 2. VedamSubramanyam, “Electric Drives”, Tata McGraw Hill Publishing Company. 			

Course Plan			
MODULE	COURSE NO: 06 EE 6 03 1	L – T – P : 4 – 0 – 0	
	COURSE NAME: ELECTRIC DRIVES	CREDITS : 4	
	CONTENT	Contact hrs	End Sem Marks %
I	Components of electrical Drives – electric machines, power converter, controllers - dynamics of electric drive - torque equation - equivalent values of drive parameters- components of load torques types of load - four quadrant operation of a motor — steady state stability – load equalization – classes of motor duty- determination of motor rating	14	25%
II	DC motor drives – dc motors & their performance (shunt, series, compound, permanent magnet motor, universal motor, dc servomotor) – braking – regenerative, dynamic braking, plugging –Transient analysis of separately excited motor – converter control of dc motors – analysis of separately excited & series motor with 1-phase and 3-phase converters	7	25%
FIRST INTERNAL EXAM			
II	Dual converter –analysis of chopper controlled dc drives – converter ratings and closed loop control – transfer function of self, separately excited DC motors – linear transfer function model of power converters – sensing and feeds back elements – current and speed loops, P, PI and PID controllers – response comparison – simulation of converter and chopper fed DC drive	7	
III	Induction motor drives – stator voltage control of induction motor – torque-slip characteristics – operation with different types of loads – operation with unbalanced source voltages and single phasing – analysis of induction motor fed from non-sinusoidal voltage supply – stator frequency control – variable frequency operation – V/F control, controlled current and controlled slip operation – effect of harmonics and control of harmonics – PWM inverter drives	14	25%

	– multiquadrant drives – rotor resistance control – slip torque characteristic – torque equations, constant torque operation – slip power recovery scheme – torque equation – torque slip characteristics – power factor – methods of improving power factor – limited sub synchronous speed operation – super synchronous speed operation.		
SECOND INTERNAL EXAM			
IV	Synchronous motor drives – speed control of synchronous motors – adjustable frequency operation of synchronous motors – principles of synchronous motor control – voltage source inverter drive with open loop control – self controlled synchronous motor with electronic commutation – self controlled synchronous motor drive using load commutated thyristor inverter.	14	25%
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 04 1	MODELING & ANALYSIS OF ELECTRICAL MACHINES	3-0-0: 3	2015
<p>PRE – REQUISITES:</p> <ol style="list-style-type: none"> 1. Basics of Electric & Magnetic Circuits 2. Knowledge of construction & working of AC & DC Machines <p>COURSE OBJECTIVES:</p> <p>To provide an in depth knowledge about modelling and analysis of AC & DC machines using generalized machine theory.</p> <p>SYLLABUS</p> <p>Fundamental Concepts of Generalized Machine Theory, Modeling and analysis of DC machines, Modeling and analysis of Synchronous Machines, Modeling and analysis of Induction Machines</p> <p>COURSE OUTCOME:</p> <p>The students will be able to</p> <ol style="list-style-type: none"> 1. Model any electrical machine given its parameters. 2. Perform the steady state & transient analysis of electrical machines. 			
<p>TEXTBOOKS:</p> <ol style="list-style-type: none"> 1. PS. Bhimbra, Generalized Theory of Electrical Machines, Khanna Publishers 2. Bimal K Bose, Modern Power Electronics & AC Drives, Pearson Education, 2002 <p>REFERNCES:</p> <ol style="list-style-type: none"> 1. Krauss, Wasyncsuk and Sudhoff, Analysis of Electrical Machines and Drive Systems, John Wiley, 2014 2. Adkins and Harley, General Theory of AC Machines, 1975 			

Course Plan			
MODULE	COURSE NO: 06 EE 6 04 1	L – T – P : 3 – 0 – 0	
	COURSE NAME:MODELING & ANALYSIS OF ELECTRICAL MACHINES	CREDITS : 3	
	CONTENT	Contact hrs	End Sem Marks %
I	Fundamentals of Generalised Machine Theory: Introduction – Unified approach to the analysis of electrical machine – basic two-pole machine – Kron’s primitive machine – voltage, power and torque equation –linear transformation from 3-phase to 2-phase - transformation from rotating axes to stationary axes – power invariance – park’s transformation for 3-phase synchronous and induction machines.	10	25%
II	DC machines: Application of generalized theory to separately excited, shunt, series and compound machines – sudden short circuit of separately excited generator -	5	25%
FIRST INTERNAL EXAM			
II	DC machines: separately excited dc motor - steady state and transient analysis – transfer functions of separately excited dc generator & motor.	5	
III	Synchronous machines: 3-phase synchronous machines – generalized machine equations – steady state analysis of salient pole and non salient pole machines – phasor diagrams – power angle characteristics – reactive power – Synchronous machines: Short circuit ratio – transient analysis – sudden 3-phase short circuit at generator terminals – reactance – time constants	10	25%
SECOND INTERNAL EXAM			
IV	Induction machines: 3-phase induction machine-generalized model – voltage equation – steady state analysis – equivalent circuit – torque-slip characteristics – effect of voltage and frequency variations – electric transients in induction machines – speed control of induction motor – introduction to vector control – single	10	25%

	phase induction motor – generalized model – voltage and torque equations – steady state analysis.		
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 15 1	SYSTEMS THEORY	3-0-0: 3	2015
<p>PRE – REQUISITES:</p> <ol style="list-style-type: none"> 1. Matrix Operations 2. Linear Algebra 3. Ordinary Differential Equations <p>COURSE OBJECTIVES:</p> <p>The course intends to provide knowledge in</p> <ol style="list-style-type: none"> 1. the analysis of continuous time and discrete time linear systems 2. Lyapunov stability techniques. <p>SYLLABUS</p> <p>A Primer to State Representations and Solution – Modeling of Power Electronic Converters – Analysis of Continuous time systems – Design of Continuous and Discrete Time Systems – Lyapunov Stability Techniques.</p> <p>COURSE OUTCOME:</p> <p>A student who completes the course will</p> <ol style="list-style-type: none"> 1. Be able to do the analysis and design of continuous time and discrete time linear systems. 2. Have an in depth knowledge of Lyapunov stability techniques. 			
<p>TEXTBOOKS:</p> <ol style="list-style-type: none"> 1. C.T.Chen, Linear system theory and design, New York,HoltRinechart and Winston , 1984 2. M.Gopal, Digital Control and State Variable methods, TMH, 1997 <p>REFERNCES:</p> <ol style="list-style-type: none"> 1. Thomas Kailath, Linear systems, Prentice Hall Inc 2. K.Ogata, Modern control Engg (Second Edition), Prentice Hall Inc, 1990 3. Richard.C.Dorf and R.T Bishop, Modern Control System, P.H.I 			

Course Plan				
MODULE	COURSE NO:06 EE 6 15 1	L-T-P: 3-0-0		
COURSE NAME: SYSTEMS THEORY		CREDITS : 3		
Contents		Contact Hrs	End Sem Marks %	
I	A Primer to State Representations and Solution: Concept of state, state variable, state space, state trajectory – Significance of eigen values and eigen vector – State Variable Representations – Diagonalization – Similarity transformations – State variable representation of discrete time systems – Discretization of continuous time systems – Solution of homogeneous and non homogeneous state equation.	10	25%	
II	Modeling of Power Electronic Converters: State variable modeling of buck converter, boost converter.	5	25%	
FIRST INTERNAL EXAM				
II	Analysis of Continuous Time Systems: Controllability and Observability for continuous time systems. Kalman and Gilbert test for controllability and observability	5		
III	Design of Continuous and Discrete Time Systems: Pole placement by state feedback – Design of state observers – Full order observer and reduced order observer.	10	25%	
SECOND INTERNAL EXAM				
IV	Lyapunov Stability Techniques: Stability in the sense of Lyapunov – Concept of Asymptotic Stability and Exponential Stability – Local Stability and Global Stability – Lyapunov's indirect method (linearization method) – Lyapunov's direct method (second method) – Lyapunov's stability analysis of LTI continuous time and discrete time systems – Lyapunov's stability analysis of non linear system – Krasovski method.	12	25%	
END SEMESTER EXAM				

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 25 1	POWER SEMICONDUCTOR DEVICES	3-0-0: 3	2015
<p>PRE – REQUISITES:</p> <p>Fundamentals low power semiconductor devices</p> <p>COURSE OBJECTIVES:</p> <p>To provide in depth knowledge about the power semiconductor devices</p> <p>SYLLABUS:</p> <p>Power switching devices overview, Current Controlled Devices, Voltage Controlled Devices, Firing and Protection Circuits.</p> <p>COURSE OUTCOME:</p> <p>The students will be able to acquire knowledge of power semiconductor devices which are used for power converters.</p>			
<p>TEXTBOOKS:</p> <ol style="list-style-type: none"> 1. Ned Mohan, Undeland, Robbins, Power Electronics, 3rd edition, John Wiley, 2003 2. Kassakian J G et al, Principles of Power Electronics, Addison Wesley, 1991. <p>REFERNCES:</p> <ol style="list-style-type: none"> 1. B W Williams, Principles and Elements of Power Electronics, University of Strathclyde, Glasgow, 2006. 2. K.R.Varmah, Chikku Abraham, Power Electronics, 1st edition, Elsevier, 2014 3. Alok Jain, Power Electronics -Devices, Circuits and MATLAB Simulations, Penram International, 2010. 			

Course Plan			
MODULE	COURSE NO:06 EE 6 251	L – T – P : 3 – 0 – 0	
	COURSE NAME:POWER SEMICONDUCTOR DEVICES	CREDITS : 3	
	CONTENT	Contact hrs	End Sem Marks %
I	Introduction: Power switching devices overview – Attributes of an ideal switch, Device selection strategy – On-state and switching losses – EMI due to switching - Power diodes – Types - switching characteristics – rating. Schottky Diode	10	25%
II	Current Controlled Devices: BJT's – Construction, Device Physics, static characteristics, switching characteristics; Negative temperature co-efficient and secondary breakdown; Power Darlington	6	25%
FIRST INTERNAL EXAM			
II	Thyristors – Physical and electrical principle underlying operation, Gate and switching characteristics; converter grade and inverter grade and other types.	5	
III	Voltage Controlled Devices: Power MOSFETs and IGBTs – Principle of voltage controlled devices, construction, types, Device physics, Static and Switching Characteristics- Steady state models of MOSFET and IGBTs	11	25%
SECOND INTERNAL EXAM			
IV	Firing and Protection Circuits: Design of snubbers, Necessity of isolation, pulse transformer, optocoupler – Gate driver circuit: SCR, MOSFET, IGBTs and base driving for power BJT. Over voltage, over current and gate protections; Thermal Protection: Heat transfer – conduction, convection and radiation; Cooling – liquid cooling, vapour – phase cooling; Guidance for heat sink selection – heat sink types and design – Mounting types.	10	25%
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 35 1	DIGITAL SIMULATION OF POWER ELECTRONIC SYSTEMS	3-0-0: 3	2015
<p>PRE – REQUISITES:</p> <ol style="list-style-type: none"> 1.Power Electronics 2.Electric Drives 3.Knowledge in MATLAB software <p>COURSE OBJECTIVES:</p> <p>To provide an in depth knowledge about modelling of Power Electronic Circuits and to analyze the behaviour and performance of Power Electronic circuits</p> <p>SYLLABUS</p> <p>Application of numerical methods to solve transients in D.C; Extension to AC circuits; Modelling of Power semiconductor switches using simulation; Introduction to electrical machine modelling; Simulation of basic electric drives; stability aspects; Dynamic modelling and simulation of DC-DC converters using MATLAB; Simulation of single phase and three phase uncontrolled and controlled (SCR) rectifiers; Simulation of power factor correction schemes; Simulation of converter fed dc motor drives ; Simulation of thyristor choppers; Simulation of single and three phase inverters with thyristors and self-commutated devices.</p>			
<p>COURSE OUTCOME:</p> <p>The students will be able to</p> <ol style="list-style-type: none"> 1. Model Power Electronic Circuits. 2.Analyze the behavior of Power Electronic Circuits 			
<p>TEXTBOOKS:</p> <ol style="list-style-type: none"> 1.Power Electronics Devices, Circuits and Applications: Muhammed H Rashid 2.Simulink Reference Manual, Math works, USA <p>REFERNCES:</p> <ol style="list-style-type: none"> 1. Robert Ericson, 'Fundamentals of Power Electronics', Chapman & Hall, 1997. 2. Issa Batarseh, 'Power Electronic Circuits', John Wiley, 2004 3. Jai P. Agrawal, <i>Power Electronic Systems-Theory and Design</i>, Pearson- 2001 			

Course Plan			
MODULE	COURSE NO:06EE 635 1	L – T – P : 3 – 0 – 0	
	COURSE NAME:DIGITAL SIMULATION OFPOWER ELECTRONIC SYSTEMS	CREDITS : 3	
	CONTENT	Contact hrs	End SemMarks %
I	Review of numerical methods. Application of numerical methods to solve transients in D.C.Switched R, L, R-L, R-C and R-L-C circuits. Extension to AC circuits. Modelling of diode in simulation. Diode with R, R-L, R-C and R-L-C load with ac supply. Modelling of SCR, TRIAC, IGBT and Power Transistors in simulation. Simulation of gate/base drivecircuits, simulation of snubber circuits.	10	25%
II	State space modelling and simulation of linear systems. Introduction to electrical machinemodelling: induction, DC, and synchronous machines,	5	25%
FIRST INTERNAL EXAM			
II	Simulation of basic electric drives, stability aspects. Dynamic modelling and simulation of DC-DC converters using MATLAB	5	
III	Simulation of single phase and three phase uncontrolled and controlled (SCR) rectifiers, converters with self commutated devices- simulation of power factor correction schemes, Simulation of converter fed dc motor drives ,Simulation of thyristor choppers with voltage, current and load commutation schemes, Simulation of chopper fed dc motor.	10	25%
SECOND INTERNAL EXAM			
IV	Modelling and simulation of inverters using MATLAB. Simulation of single and three phase inverters with thyristors and self-commutated devices, Space vector representation, pulse-width modulation methods for voltage control, waveform control. Simulation of inverter fed induction motor drives.	10	25%
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 45 1	ENERGY MANAGEMENT IN ELECTRICAL SYSTEMS	3-0-0: 3	2015

PRE – REQUISITES:

Fundamental knowledge of electrical engineering and its applications

COURSE OBJECTIVES:

1. Enable the students to understand practical methods of Energy Auditing
2. Prepare the students for a successful career in energy management in electrical systems.
3. Enable the students to evaluate energy losses and devise methods to save energy and save our energy resources.

SYLLABUS

Introduction to energy scenario, Introduction to energy management and the related terminologies, Application of energy management in the field of electric motor drives, Application of energy management in the field of transformers and lighting, Reactive power management, peak demand control and load scheduling, Cogeneration, Application of energy management in the field of refrigeration, air conditioning, electrolytic process and water heating, Introduction to Energy management software.

COURSE OUTCOME:

The students will be able to

1. Conduct energy audit in electrical systems.
2. Judge the energy efficiency of electrical systems.
3. Assess the energy performance of home and utility and suggest remedies so as to save money.

TEXTBOOKS & REFERENCES

1. Handbook on Energy Audit and Environment Management, Y P Abbi and Shashank Jain, TERI, 2006
2. Handbook of Energy Audits Albert Thumann , William J. Younger , Terry Niehus , 2009
3. Howard E. Jordan, .Energy-Efficient Electric Motors and Their Applications., Plenum Pub Corp; 2nd edition (1994)
4. Albert Thumann , .Handbook of Energy Audits., Fairmont Pr; 5th edition (1998)
5. Albert Thumann, P.W, -.Plant Engineers and Managers Guide to Energy Conservation. - Seventh Edition-TWI Press Inc, Terre Haute, 2007.
6. IEEE Recommended Practices for Energy Management in Industrial and Commercial Facilities
7. http://www.beeindia.in/energy_managers_auditors/documents/guide_books/

Course Plan			
MODULE	COURSE NO:06 EE 6451	L – T – P : 3 – 0 – 0	
	COURSE NAME:ENERGY MANAGEMENT IN ELECTRICAL SYSTEMS	CREDITS : 3	
	CONTENT	Contact hrs	End Sem Marks %
I	Definition and objectives of energy management - energy scenario- requirements for a successful energy management program – steps in energy action planning-role of an energy manager in an organization-energy accounting -energy monitoring, targeting and reporting-energy audit process. Energy auditing: Types and objectives-audit instruments- - Electricity tariff types –case study.	8	25%
II	Electric motor:Energy efficient controls and starting efficiency- Motor Efficiency and Load Analysis- Energy efficient /high efficient Motors-Case study; Load Matching and selection of motors.	7	25%
FIRST INTERNAL EXAM			
II	Variable speed drives: Pumps and Fans-Efficient Control strategies- Optimal selection and sizing -Optimal operation and Storage; Case study	5	
III	Transformer Loading/Efficiency analysis, Feeder/cable loss evaluation, case study. Reactive Power management: Capacitor Sizing-Degree of Compensation-Capacitor losses-Location-Placement-Maintenance, case study. Peak Demand controls- Methodologies-Types of Industrial loads-Optimal Load scheduling-case study. Lighting- Energy efficient light sources-Energy conservation in Lighting Schemes- Electronic ballast-Power quality issues-Luminaries, case study.	12	25%
SECOND INTERNAL EXAM			
IV	Cogeneration:Types and Schemes-Optimal operation of cogeneration plants-case study; Electric loads of Air conditioning & Refrigeration-Energy conservation measures- Cool storage. Types-Optimal operation-case study; Electric water heating-Geysers-Solar Water Heaters- Power Consumption in Compressors, Energy conservation measures; Electrolytic Process; Computer Controls- software-EMS	10	25%
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 06 1	RESEARCH METHODOLOGY	0-2-0: 2	2015
<p>PRE – REQUISITES:</p> <ol style="list-style-type: none"> 1. Knowledge of sampling and probability theory. 2. Basics knowledge in Data analysis and interpretation <p>COURSE OBJECTIVES:</p> <p>To provide an in depth knowledge in Research Activity.</p> <p>SYLLABUS:</p> <p>Meaning of research, Literature review, problem definition, Sampling theory, Descriptive and inferential statistics, Presentation of reports.</p> <p>COURSE OUTCOME:</p> <p>The students achieve knowledge in various stages of research activity.</p>			
<p>TEXTBOOKS:</p> <ol style="list-style-type: none"> 1. Research Methodology: Methods and techniques , C. R. Kothari ,2nd Edition 2004 2. Research Methodology, Pannerselvam ,2nd Edition ,PHI 2014 <p>REFERNCES:</p> <ol style="list-style-type: none"> 1. Management Research Methodology : K. N. Krishnaswami, Appalyer and M Mathirajan, Pearson Education, Delhi, 2010 2. Research Methodology: Ranjit Kumar, Pearson Education, Delhi, 2009. 			

Course Plan				
	COURSE NO:06 EE 6 06 1	L – T – P : 0 – 2 – 0		
	COURSE NAME:RESEARCH METHODOLOGY	CREDITS : 2		
MODULE	CONTENT	Contact hrs	End Sem Marks%	
I	Meaning of research: Types of research, research methods Vs methodology - stages of research process – Issues of research progress in India - Research in social science and management. Literature review – Problem definition- Research design for exploratory, descriptive and experimental research – Brief introduction to completely randomized design, randomized block design and Latin square designs (description only).	7	25%	
II	Census Vs sample studies: Types of sampling: probability and non-probability sampling. Sampling theory, sampling distribution and sample size determination	3	25%	
FIRST INTERNAL EXAM				
II	Tools and techniques of data collection: Questionnaire and schedule for field surveys, interview, observation, simulation, experimental and case study methods. Collection, recording, editing, coding and scaling of data. Scale classification and types. Measurement of validity, reliability and practicality. Cronbach's Alpha	4		
III	Descriptive and inferential statistics: Data analysis and interpretation –testing of hypothesis, testing of population mean, variance and proportion –Z test – t test – F test - chi square test. Test for correlation and regression –standard error of the estimate. Testing goodness of fit. Brief introduction to non parametric tests, factor analysis, discriminant analysis and path analysis (description only). Use of SPSS and other software.	7	25%	
SECOND INTERNAL EXAM				
IV	Meaning of interpretation and inference: importance and care for interpreting results. Presentation of reports: popular reports and technical reports - structure and style. Oral and written presentations: Parts of a research report in the program specific area. Methods of giving references and appendices: referencing styles – use of computers and internet in research.	7	25%	

	Sample studies and survey on the recent research activities in the area Power Electronics, Industrial drives and Control.		
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 07 1	SEMINAR I	0-0-2: 2	2015
<p>PRE – REQUISITES: Nil</p> <p>COURSE OBJECTIVES:</p> <p>To improve presentation skills and searching ability of research publications in the relevant area of specialization</p> <p>SYLLABUS:</p> <p>The student has to register for the seminar and select a topic in consultation with any of the faculty members in the department (or the faculty member offering courses for the programme).</p> <p>A detailed report on the topic of seminar is to be prepared in the prescribed format given by the department. The seminar shall be of 30 minutes duration and a committee with the Head of the Department as the chairman and two faculty members from the department as members shall evaluate the seminar based on the coverage of the topic, presentation and ability to answer the questions put forward by the committee.</p> <p>COURSE OUTCOME:</p> <p>Takers will</p> <ol style="list-style-type: none"> (1) improve the searching ability to find research publications in the area of specialization (2) be aware of recent developments in the area of specialization (3) improve their presentation skills 			
<p>Reference:</p> <p>IEEE Xplore , Elsevier- Science Direct, Springer Journalsetc</p>			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 08 1	POWER ELECTRONICS LAB	0-0-3: 1	2015
<p>PRE – REQUISITES:</p> <p>Basic knowledge in Power Electronics circuits</p> <p>COURSE OBJECTIVES:</p> <p>To provide an in depth knowledge</p> <p>(1) To model and analyse different power converters and various firing circuits.</p> <p>(2) About software modelling of different power converters and analyse different waveforms.</p> <p>SYLLABUS</p> <p>Modeling of firing circuits and various power converters. Simulation of power converters using MATLAB/Simulink and PSIM.</p> <p>COURSE OUTCOME:</p> <p>The students will be able to</p> <ol style="list-style-type: none"> 1. Model the firing circuits and compare different methods. 2. Model power converter circuits and study its working. 3. Simulate the power converter circuits and observe the waveforms. 4. Compare and analyse the software and hardware results. 			
<p>TEXTBOOKS:</p> <ol style="list-style-type: none"> 1. K.R.Varmah, Chikku Abraham, Power Electronics, 1st edition, Elsevier, 2014 2. Muhammad H Rashid, Power Electronics, 3rd edition, Pearson,2007. <p>REFERENCES:</p> <ol style="list-style-type: none"> 1. Ned Mohan, Undeland, Robbins, Power Electronics,3rd edition, John Wiley, 2003. 2. Joseph Vithayathil, Principles of Power Electronics, McGrawHill-1994. 			

Course Plan		
COURSE NO:06 EE 6 08 1	L – T – P : 0-0-3	
COURSE NAME: POWER ELECTRONICS LAB	CREDITS : 1	
LIST OF EXPERIMENTS	Contact hrs	End Sem Marks %
<ol style="list-style-type: none"> 1. Firing schemes for converters. 2. Single Phase Semi-converter with R-L and R-L-E loads for continuous and discontinuous conduction modes. Single phase full- converter with R-L and R-L-E loads 3. for continuous and discontinuous conduction modes. 4. Three phase full-converter with R-L-E load. Controlled and Uncontrolled rectifier with different types 5. of filters-continuous. And discontinuous modes of operation. 6. Transformer and Inductor design. 7. Voltage and current commutated choppers. 8. MOSFET, IGBT based Choppers. 9. IGBT and MOSFET based inverters. 10. Current source inverter. 11. Single phase AC voltage controller. 12. Light control using optocoupler. 13. Transfer function of a DC Motor. 14. Resonant Inverters. 15. Closed loop control of converter fed DC motor Drives. 16. VSI fed three phase induction motor drive. 17. Three phase synchronous motor and drive. 18. PC based control of power electronic devices. 19. Microcontroller and DSP based control of dc-dc converters. 20. Study of harmonic pollution by power electronics loads. 	30	100 %
<p>At least 15 experiments in the list are to be conducted in the laboratory. Additional experiments and simulation assignments can also be given by the department.</p>		
END SEMESTER – EXAM		

Semester II

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 01 2	ANALYSIS OF POWER ELECTRONIC SYSTEMS II	4-0-0: 4	2015
<p>PRE – REQUISITES:</p> <ol style="list-style-type: none"> 1 Fundamental concepts of power electronic circuits 2 Characteristics of power semi conductor devices 3 Electric circuit theory&Network Analysis <p>COURSE OBJECTIVES:</p> <p>To provide an in depth knowledge about the operation and analysis of modern power converter circuits.</p> <p>SYLLABUS</p> <p>Pulse width modulation(PWM) strategies for Inverters, DC-DC Switch Mode Converters , SMPS topologies, Resonant Converters, PWM Rectifiers and Matrix Converters</p> <p>COURSE OUTCOME:</p> <p>The students will be able to</p> <ol style="list-style-type: none"> 1 Acquire knowledge about the PWM techniques used in inverter circuits 2 Design and analyze modern power converter circuits 			
<p>TEXTBOOKS:</p> <ol style="list-style-type: none"> 1. Daniel W. Hart, Power Electronics, McGrawHill, 2011 2. Ned Mohan, Undeland, Robbins, Power Electronics,3rd edition, John Wiley, 2003 3. D. Grahame Holmes, Thomas A Lipo, Pulse Width Modulation for Power converters- Principles and Practice, John Wiley and sons,2003. <p>REFERNCES:</p> <ol style="list-style-type: none"> 4. K.R.Varmah, Chikku Abraham, Power Electronics, 1st edition, Elsevier, 2014 5. B K Bose, Modern Power Electronics and AC Drives, Pearson Education, 2002. 6. William Shepherd, Li Zhang, Power Converter Circuits, Marcel Decker, 2004 			

Course Plan			
MODULE	COURSE NO:06 EE 6 012	L – T – P : 4 – 0 – 0	
	COURSE NAME:ANALYSIS OF POWER ELECTRONIC SYSTEMS II	CREDITS : 4	
	CONTENT	Contact hrs	End Sem Marks %
I	<p>PWM Strategies for Inverters:</p> <p>Modulation of one inverter phase leg- Fundamental concepts of PWM- Naturally sampled PWM-Regular sampled PWM. Modulation of single and three phase voltage source inverters-introduction only, Space Vector Modulation-comparison of SVM and regular sampled PWM, Overmodulation of an Inverter- Naturally sampled overmodulation of one leg of an inverter. Space vector PWM for multilevel inverters.</p>	14	25%
II	<p>DC-DC Switch Mode Converters:</p> <p>DC-DC converters- Buck, Boost, Buck-Boost and Cuk converters, State space modeling of DC-DC converters.</p>	5	25%
FIRST INTERNAL EXAM			
II	<p>SMPS Topologies- Transformer models- Basic Operation- Waveforms-modes of operation – Output voltage ripple, Push-Pull and Forward Converter Topologies-Basic operation-Waveforms-Voltage Mode Control. Half and Full Bridge Converters - Basic Operation and Waveforms, Fly back Converter, Continuous and Discontinuous mode operation, Waveforms.</p>	9	25%
III	<p>Module 3:Resonant Converters</p> <p>Classification of Resonant Converters, Basic Resonant Circuit Concepts, Load Resonant Converter, Resonant Switch Converter, Zero Voltage Switching - Zero current switching – ZVS Clamped Voltage Topologies, Resonant</p>	14	25%

	dc-link inverters		
SECOND INTERNAL EXAM			
IV	<p>PWM Rectifiers and Matrix Converters:</p> <p>Single phase and three phase PWM Rectifiers - Basic topologies - Control principles.</p> <p>Introduction to Matrix Converters-Matrix converter switches and circuit- control strategies-Venturini control method.</p>	14	25%
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 02 2	ADVANCED CONTROL OF AC DRIVES	3-0-0: 3	2015
<p>PRE – REQUISITES:</p> <ol style="list-style-type: none"> 1 Basics of Electric & Magnetic Circuits 2 Knowledge of construction & working of AC & DC Machines 3 Generalised Machine Theory <p>COURSE OBJECTIVES:</p> <p>To provide an in depth knowledge about analysis and speed control of three phase induction machines.</p> <p>SYLLABUS:</p> <p>Modeling of Induction Machines, Vector Control, Slip ring induction motor control, Sensorless Control</p> <p>COURSE OUTCOME:</p> <p>The students will be able to design and analyze different advanced control schemes of induction machines.</p> <p>TEXTBOOKS & REFERENCES :</p> <ol style="list-style-type: none"> 1. R Krishnan, Electric Motor Drives, PHI 2. B K Bose, Modern Power Electronics and AC Drives, Pearson-2002. 3. Kazmierkowski, Krishnan, Blaabjerg, Control in Power Electronics-Selected Problems, Academic Press, 2002 4. J Holtz, Sensorless Control of Induction Motor Drives, Proceedings of the IEEE, August 2002, PP 1359-1394 			

Course Plan			
MODULE	COURSE NO: 06 EE 6 02 2	L – T – P : 3 – 0 – 0	
	COURSE NAME: ADVANCED CONTROL OF AC DRIVES	CREDITS : 3	
	CONTENT	Contact hrs	End Sem Marks %
I	Modeling: Dynamic d-q modeling of induction machines - stator, rotor and synchronously rotating reference frame models, state space equations and dynamic simulation, Space Phasor model–control principle of the induction motor	11	25%
II	Vector Control: Vector controlled induction motor drive - Basic principle-Direct Rotor flux oriented vector control - Estimation of rotor flux and torque - Implementation with current source and voltage source inverters Stator flux oriented vector control	6	25%
FIRST INTERNAL EXAM			
II	Vector Control: Indirect rotor flux oriented vector control scheme implementation– tuning - Dynamic simulation.Parameter sensitivity and compensation of vector controlled induction motors-Selection of Fluxlevel - Flux weakening operation - Speed controller design,comparison of DTC and FOC	5	
III	Slip Ring Induction Motor Control: Doubly-fed machine speed control by rotor rheostat – static kramer drive – phasor diagram,equivalent – speed control – power factor improvement – Static Scherbius drive – Modes ofoperation - Direct torque control of induction motor – principle – control strategy – spacevector modulation – reduction of torque and flux ripple	10	25%
SECOND INTERNAL EXAM			
IV	Sensor less Control: Principles for speed sensor less control - Sensor less methods for scalar control, Sensor less methods for vector control, Introduction to observer based techniques	10	25%
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 03 2	SPECIAL ELECTRICAL MACHINES AND DRIVES	3-0-0: 3	2015
<p>PRE – REQUISITES:</p> <ol style="list-style-type: none"> 1. Construction, Characteristics & working of AC & DC Machines 2. Different Control System and Microprocessor <p>COURSE OBJECTIVES: To expose the students to the concepts of various types of special electrical machines and their control scheme.</p> <p>SYLLABUS</p> <p>Construction, Principle, Characteristics and different control scheme of the Stepper motor, Switched reluctance motor, Permanent Magnet Brushless DC motor , Permanent Magnet Synchronous motor.</p> <p>COURSE OUTCOME:</p> <p>The students will be able to</p> <ol style="list-style-type: none"> 1. Analyze various special electrical machines by the selection, synthesis and implementation of the established principles, procedures and practices 2. Analyze the different control scheme of special electrical machine. 			
<p>TEXTBOOKS:</p> <ol style="list-style-type: none"> 1. Kenjo T, Sugawara A, Stepping Motors and Their Microprocessor Control, Clarendon Press, Oxford, 1994 2. Miller T J E, Switched Reluctance Motor and Their Control, Clarendon Press, Oxford, 1993. 3. Miller T J E, Brushless Permanent Magnet and Reluctance Motor Drives, Clarendon Press, Oxford, 1989. <p>REFERNCES:</p> <ol style="list-style-type: none"> 1. Kenjo T, Power Electronics for the Microprocessor Age, Oxford University Press, 1990. 2. R Krishnan, Electric Motor Drives – Modeling, Analysis and Control, PHI, 2003. 			

MODULE	COURSE NO: 06 EE 6 03 2	L – T – P : 3 – 0 – 0	
	COURSE NAME: SPECIAL ELECTRICAL MACHINES AND DRIVES	CREDITS : 3	
	CONTENT	Cont act hrs	End Sem Marks %
I	Stepper Motors - Constructional features, principle of operation, modes of excitation, single phase stepping motors, torque production in variable Reluctance (VR) stepping motor, Static and Dynamic characteristics, Drive systems and circuit for open loop control, Closed loop control of stepping motor, microprocessor based controller..	10	25%
II	Switched Reluctance Motors - Constructional features, principle of operation. Torque equation, Power controllers, Characteristics and control.	6	25%
FIRST INTERNAL EXAM			
II	Microprocessor based controller. Sensor less control. Synchronous Reluctance Motors-Constructional features: axial and radial air gap Motors. Operating principle, reluctance torque – Phasor diagram, motor characteristics.-	6	
III	Permanent Magnet Brushless DC Motors - 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 equation, Torque-speed characteristics, Controllers-Microcontroller based control. Sensorless control.	10	25%
SECOND INTERNAL EXAM			
IV	Permanent Magnet Synchronous Motors - Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power controllers, Torque speed characteristics, Self control, Vector control, Current control schemes. Sensor less control.	10	25%
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 14 2	POWER QUALITY	3-0-0: 3	2015
<p>COURSE OBJECTIVES:</p> <ol style="list-style-type: none"> 1. To study the various issues affecting power quality, their production, suppression and mitigation. 2. To study the production of voltages sags, overvoltages and harmonics and methods of control. 3. To understand the effects of various power quality phenomenon in various equipments 4. To understand their mitigation using custom power devices such as distribution static compensator (DSTATCOM), dynamic voltage restorer (DVR). <p>SYLLABUS Introduction to Electric power quality phenomena, Transient Overvoltages - Types, sources and mitigation, Grounding Problems And Solutions, Harmonics -Sources, effects, and mitigation methods, Voltage sags & interruptions – sources & mitigation methods.</p> <p>COURSE OUTCOME: Upon successful completion of this course, students will be able to understand the basic power quality issues, their sources and effects on power system. This course helps to gain knowledge about the various mitigation methods custom power devices such as distribution static compensator (DSTATCOM), dynamic voltage restorer (DVR).</p> <p>REFERENCES:</p> <ol style="list-style-type: none"> 1. “Electrical Power Systems Quality” by Roger C Dugan, Mark. F.McGrannanaghan- 2nd Edition - McGraw Hill Publications. 2. “Understanding Power Quality Problems” by Math H J Bollen - IEEE Press 3.Selected Topics in Power Quality and Custom Power, Course book for STTP, 2004, Ashok S 4. Harmonics and power systems “- Francisco C. De La Rosa Published in 2006 byCRC Press Taylor & Francis Group 5. “FACTS controllers in power transmission and distribution” -K.R Padiyar -New Age International. 			

MODULE	COURSE NO:06 EE 6 14 2	L – T – P : 3 – 0 – 0		
	COURSE NAME:POWER QUALITY	CREDITS : 3		
	CONTENT	Contact hours	End Sem Marks %	
I	Electric power quality phenomena- - IEC and IEEE definitions-General classes of power frequency variations-Transients-Long duration voltage variations-Short duration voltage variations-voltage imbalance-Wave form distortion-voltage fluctuations-power frequency variations-Power quality terms-Power Quality Standards and Guidelines.	7	25%	
II	Transients-Impulsive transients-oscillatory transients-Sources of transient over voltages	4	25%	
FIRST INTERNAL EXAM				
II	Devices for overvoltage protection-switching transient problems with load. Grounding- Definition - reasons for grounding-Wiring and grounding problems –solutions for wiring and grounding problems.	5		
III	Harmonics:- Definition –harmonic distortion -- harmonic phase sequences – triplen harmonics.-Sources of harmonics-Effects of Harmonics-Harmonic Standard-The IEC Standard-IEEE 519-1992- Harmonic Indices-Power system quantities under non sinusoidal conditions:- Active, reactive and apparent Power - power factor- displacement and true power factor-Harmonic distortion evaluation .Harmonic resonance-series and parallel Passive filters-Active Harmonic Filtering-Shunt Injection Filter for single phase , three-phase three-wire and three-phase four-wire systems . d-q domain control of three phase shunt active filters.Series active power filtering techniques for harmonic cancellation and isolation.	15	25%	
SECOND INTERNAL EXAM				
IV	Voltage sag and interruptions-sources of voltage sag and interruptions-Estimating voltage sag performance - Equipment sensitivity to voltage sag- CBEMA and ITIC curve –Fundamental principles of protection-solutions at the end user level-sags due to starting of induction motor DStatcom-Dynamic voltage restorer-unified power quality conditioners.	11	25%	
END SEMESTER EXAM				

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 24 2	ADAPTIVE CONTROL	3-0-0: 3	2015
<p>PRE – REQUISITES:</p> <ol style="list-style-type: none"> 1. Basics of Automatic Control 2. Basics of Sampled data systems <p>COURSE OBJECTIVES:</p> <p>To provide an in depth knowledge about adaptive techniques in the controller design</p> <p>SYLLABUS:</p> <p>Introduction to Adaptive Control, Model-Reference Adaptive Systems, Self-Tuning Regulators, Gain Scheduling</p> <p>COURSE OUTCOME:</p> <p>The students will be able to grasp the basic ideas of adaptive control and compare the different approaches in adaptive control</p>			
<p>TEXTBOOKS & REFERENCES:</p> <ol style="list-style-type: none"> 1. Karl J. Astrom & Bjorn Wittenmark, 'Adaptive Control', Pearson Education (Singapore), Second Edition, 2003. 2. Petros A Ioannou, Jing, Robust Adaptive Control, Prentice-Hall, 1995 			

Course Plan			
MODULE	COURSE NO:06 EE 6 24 2	L – T – P : 3 – 0 – 0	
	COURSE NAME:ADAPTIVE CONTROL	CREDITS : 3	
	CONTENT	Contact hrs	End Sem Marks %
I	Introduction to Adaptive Control: effects of process variation-Adaptive schemes-Adaptive Control problem-Applications Real-Time Parameter Estimation-Introduction-Least Squares and Regression Models-Estimating-Parameters in Dynamical Systems	11	25%
II	Model-Reference Adaptive Systems: Introduction-The MIT Rule-Determination of the Adaptation Gain-Lyapunov Theory-Design of MRAS Using Lyapunov Theory-Bounded-Input-Bounded-Output Stability-Applications to Adaptive control	11	25%
FIRST INTERNAL EXAM			
III	Self-Tuning Regulators: Introduction-Pole Placement Design-Indirect Self-tuning Regulators-Continuous Time Self-tuners-Direct Self-tuning Regulators-Disturbances with Known Characteristics-Relations between MRAS and STR	10	25%
SECOND INTERNAL EXAM			
IV	Gain Scheduling: Introduction- Principle and Design of Gain Scheduling controllers-Nonlinear Transformations applications of Gain Scheduling. Practical Issues and Implementation-Controller and estimator implementation-operational issues.	10	25%
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 34 2	ADVANCED DIGITAL SIGNAL PROCESSING	3-0-0: 3	2015
<p>PRE – REQUISITES: Fundamentals of signals and systems</p> <p>COURSE OBJECTIVES: To provide an in depth knowledge in the area of digital signal processing</p> <p>SYLLABUS Convolution and correlation, Fast Fourier transform, Digital Filter Design and Realization Structures, Analysis of Finite Word-length Effects</p> <p>COURSE OUTCOME: The students will be able to (1)methods and problems related to digital signal processing (2)analyze and design digital filters</p>			
<p>Text Books & References:</p> <ol style="list-style-type: none"> 1 John G. Proakis, and Dimitris G. Manolakis, Digital Signal Processing(third edition), Prentice-Hall of India Pvt. Ltd, New Delhi, 1997. 2. Emmanuel C. Ifeachor, Barrie W. Jervis, Digital Signal Processing-A practical Approach, Addison . Wesley,1993. 3. Abraham Peled and Bede Liu, Digital Signal Processing, John Wiley and Sons, 1976. 4. Oppenheim and Schaffer, ‘Discrete time Signal processing’, PHI, 1999. 			

Course Plan			
MODULE	COURSE NO:06 EE 6 34 2	L – T – P : 3 – 0 – 0	
	COURSE NAME:ADVANCED DIGITAL SIGNAL PROCESSING	CREDITS : 3	
	CONTENT	Contact hrs	End Sem Marks %
I	Convolution and correlation-Sampling of continuous time signals- Discrete time Fourier transform- Discrete Fourier series- Discrete Fourier transform- Z- transform and Properties of different transforms. LTI systems- FIR and IIR systems-Unit sample response- system function-difference equation	10	25%
II	Fast Fourier transform: Radix-2 FFT-Decimation in time and decimation in frequency algorithms- Circular and linear convolution and correlation of two finite length sequences using DFT/FFT -linear convolution through circular convolution and implementation. Sectioned convolutions, overlap add and overlap save method. : Spectral analysis of deterministic signals-bias- frequency resolution-Windowing of data.	6	25%
FIRST INTERNAL EXAM			
II	Estimation of power spectrum of stationary random signals:-periodogram methods-Bartlett's method and Welch method of Power spectrum estimation.	5	
III	Digital Filter Design and Realization Structures: Design of IIR digital filters –Butterworth and Chebyshev filters- from analog filters- Impulse invariance method and Bilinear transformation method- FIR linear phase filter design using window functions- Basic IIR and FIR filter realization structures-direct, cascade and parallel realizations.	11	25%
SECOND INTERNAL EXAM			
IV	Analysis of Finite Word-length Effects Quantization process and errors- Coefficient quantization effects in IIR and FIR filters- A/D conversion noise- Arithmetic round-off errors- Dynamic range scaling- Overflow oscillations and zero input limit cycles in IIR filters. Effect of quantization noise in cascade and parallel operations.	10	25%
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 442	ROBOTICS AND AUTOMATION	3-0-0: 3	2015
<p>PRE – REQUISITES:</p> <ol style="list-style-type: none"> 1. Drive systems. 2. Programming languages. 3. Advanced mathematics. <p>COURSE OBJECTIVES:</p> <p>To provide a complete knowledge of robotics and automation</p> <p>SYLLABUS</p> <p>Geometric configuration of robots – Manipulators – Drive systems – Internal and external sensors— End effectors – Control systems. Robot programming languages. Direct and inverse kinematics – Rotation matrices. Lagrange – Euler formulation, joint velocities. General consideration on trajectory planning joint interpolation & Cartesian path trajectories.</p> <p>COURSE OUTCOME:</p> <p>The student will acquire sound knowledge in robotics and automation.</p>			
<p>TEXTBOOKS:</p> <ol style="list-style-type: none"> 1. Fu K S, Gonzalez R C and Lee C S G, Robotics (Control, Sensing, Vision and Intelligence), McGraw-Hill, 1987. 2. Wesley, E Sryda, Industrial Robots: Computer Interfacing and Control. PHI, 1985. 3. Asada and Slotine, Robot Analysis and Control, John Wiley and Sons, 1986. <p>REFERNCES:</p> <ol style="list-style-type: none"> 1. Saeed B Niku, Introduction to Robotics, Analysis, Systems and Applications, Pearson Education, 2002. 2. Groover M P, Mitchell Wesis, Industrial Robotics Technology Programming andApplications, Tata McGraw-Hill, 1986. 3. Sciavicco L, B Siciliano, Modeling& Control of Robot Manipulators, 2nd Edition, SpringerVerlag, 2000 			

MODULE	COURSE NO: 06 EE 644 2	L – T – P : 3 – 0 – 0	
	COURSE NAME:ROBOTICS AND AUTOMATION	CREDITS : 3	
	CONTENT	Contact hrs	End Sem Marks %
I	Geometric configuration of robots – Manipulators – Drive systems – Internal and external sensors-- End effectors – Control systems – Robot programming languages and applications –Introduction to robotic vision	10	25%
II	Robot Arm Kinematics Direct and inverse kinematics – Rotation matrices – Composite rotation matrices – Euler angle-representation – Homogenous transformation – DenavitHattenberg representation and various arm configurations.	11	25%
FIRST INTERNAL EXAM			
III	Robot Arm Dynamics Lagrange – Euler formulation, joint velocities – Kinetic energy – Potential energy and motion-equations – Generalized D’Alembert equations of motion.	11	25%
SECOND INTERNAL EXAM			
IV	Planning of Manipulator Trajectories General consideration on trajectory planning joint interpolation & Cartesian path trajectories.-Control of Robot Manipulators-PID control computed, torque technique – Near minimum time control – Variable structure control – Non-linear decoupled feedback control – Resolved motion control and adaptive control.	10	25%
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 6 15 2	FACTS TECHNOLOGY	3-0-0: 3	2015
<p>PRE – REQUISITES:</p> <ol style="list-style-type: none"> 1. Electric Power Transmission and Distribution. 2. Power Electronic Converters. <p>COURSE OBJECTIVES: To impart knowledge in FACTS equipment performance and in control of FACTS devices.</p> <p>SYLLABUS: Reactive power control in electric power transmission – Theory of Compensation – Types of FACTS controllers. Variable impedance type static VAR generators – STATCOM – operation and scheme of control. Series compensation – TSSC and TCSC – Stability enhancement and power oscillation damping using series compensators. Unified Power Flow Controller – Principle of operation – control structure – Interline Power Flow Controller – Generalized and Multifunctional FACTS controllers.</p> <p>COURSE OUTCOME: Gaining deep knowledge in FACTS technology.</p>			
<p>TEXTBOOKS:</p> <ol style="list-style-type: none"> 1. N.G. Hingorani and L Gyugyi, “Understanding FACTS” IEEE Press, 2000. 2 Y.H. Song and A.T.Johns “Flexible AC Transmission Systems (FACTS)” IEEE Press, 1999. <p>REFERNCES:</p> <ol style="list-style-type: none"> 1. T J E Miller, “Reactive Power Control in Power Systems” John Wiley, 1982. 2. R. Mohan Mathur and Rajiv K. Varma, “Thyristor based FACTS controllers for Electrical Transmission systems”, Wiley Interscience, IEEE Press 2002. 			

MODULE	COURSE NO: 06EE 6 15 2	L – T – P : 3 – 0 – 0	
	COURSE NAME: FACTS TECHNOLOGY	CREDITS : 3	
	CONTENT	Contact hrs	End Sem Marks %
I	Reactive power control in electrical power transmission lines - uncompensated line– Fundamental theory of compensation: Power factor correction & voltage regulation Shunt Compensation and Series compensation - Approximate reactive power characteristics- Introduction to FACTS - Basic Types of FACTS controller- Brief description and definitions of FACTS controllers – Benefits from FACTS technology.	11	25%
II	Principles of static shunt compensation:Variable impedance type Static Var generators – Switching Converter type Var generators Static Var Compensator (SVC) and Static Compensator (STATCOM): Principle of operation, configuration and control – The Regulation Slope- Transient Stability enhancement and Power Oscillation damping Comparison between STATCOM and SVC	7	25%
FIRST INTERNAL EXAM			
II	Principle of operation, configuration and control – The Regulation Slope- Transient Stability enhancement and Power Oscillation damping Comparison between STATCOM and SVC	4	
III	Aims and objectives of static series compensation Variable Impedance Type series compensators: Thyristor Switched Series Capacitor (TSSC), Thyristor Controlled Series Capacitor (TCSC) - Sub synchronous characteristics Basic NGH SSR Damper Static Synchronous Series Compensator (SSSC): Principle of operation, configuration and control. Stability enhancement and power oscillation damping using series compensation	10	25%
SECOND INTERNAL EXAM			
	Unified Power Flow Controller (UPFC): Principle of operation, Conventional Transmission control capabilities, Comparison of UPFC to Controlled Series Compensators-	10	

IV	Control structure. Interline Power Flow Controller (IPFC) – Basic operating Principles and Characteristics Generalized and multifunctional FACTS controllers		25%
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 6252	OPTIMAL CONTROL THEORY	3-0-0: 3	2015
<p>PRE – REQUISITES:</p> <ol style="list-style-type: none"> 1. Basics of System Theory 2. Basic knowledge of Numerical methods for optimization <p>COURSE OBJECTIVES:</p> <p>To provide an in depth knowledge in optimal Control theory and Systems.</p> <p>SYLLABUS:</p> <p>Optimality Problems in Control Theory , Dynamic Programming , Calculus of Variations , Pontryagin’s Minimum Principle</p> <p>COURSE OUTCOME:</p> <p>The students will be able to</p> <ol style="list-style-type: none"> 1. Formulation of optimal Control problems 2. Solve the optimal control problem using different Numerical methods. 			
<p>TEXTBOOKS:</p> <ol style="list-style-type: none"> 1. Donald E Kirk, Optimal Control Theory-An Introduction, Prentice-Hall Inc,Englewood Cliffs, New Jersey,1970. 2. Sage A P,Optimum Systems Control, Prentice –Hall Inc Englewood Cliffs, New Jersey, 1968 <p>REFERNCES:</p> <ol style="list-style-type: none"> 1.Athans M and P L Falb,Optimal Control-An Introduction to the Theory and its Applications, McGraw Hill Inc,New York, 1966 			

Course Plan			
MODULE	COURSE NO:06EE 6 25 2	L – T – P : 3 – 0 – 0	
	COURSE NAME: OPTIMAL CONTROL THEORY	CREDITS : 3	
	CONTENT	Contact hrs	End Sem Marks %
I	Optimality Problems in Control Theory Mathematical models-selection of performance measures-constraints-classification of problem constraints-problem formulation	10	25%
II	Dynamic Programming Optimal Control Law-Principle of Optimality-application to decision making-routing problem	5	25%
FIRST INTERNAL EXAM			
II	Hamilton Jacobi Bellman equation-Discrete and continuous Linear Regulator Problems	7	
III	Calculus of Variations Basic Concepts-variation of functional – extremals-fundamental theorem in calculus of variation-Euler Equation-Piecewise Smooth extremals-constrained extremals- Hamiltonian-necessary condition for optimal control	10	25%
SECOND INTERNAL EXAM			
IV	Pontryagin's Minimum Principle Minimum Time problem-Minimum Fuel problem-Minimum Energy problem	10	25%
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 635 2	SMART GRID TECHNOLOGY AND APPLICATIONS	3-0-0: 3	2015

PRE – REQUISITES:

1. Basics of power systems, computer and communication networks
2. Knowledge of probability and random variables, linear algebra and complex optimization
3. Basic knowledge in renewable energy resources

COURSE OBJECTIVES:

1. After successfully completing this course, the student will have gained an understanding of various aspects of the smart grid, including technologies, components, architectures and applications.
2. To understand various Smart grid control elements required to monitor and control the grid, such as smart meters, sensors and phasor measurement units.

SYLLABUS

Evolution of Electric Grid; Concept, Need, functions, Opportunities & Barriers of Smart Grid; Resilient & Self-Healing Grid; Smart Meters; Automatic Meter Reading(AMR); Outage Management System(OMS); Plug in Hybrid Electric Vehicles(PHEV); Home & Building Automation; Smart Substations; Geographic Information System (GIS); Intelligent Electronic Devices(IED); Smart storage; Wide Area Measurement System(WAMS); Phase Measurement Unit(PMU); Micro grid, need & applications; Issues of interconnection; protection & control of micro grid; Plastic, Organic and Thin film solar cells; Variable speed wind generators; micro turbines; Captive power plants; Integration of renewable energy sources

COURSE OUTCOME:

The students will be able to

1. Describe the smart grid technologies, components, architectures and applications.
2. Categorise various Smart grid control elements required to monitor and control the grid
3. Explain the smart grid applications within the industry, and design criteria's
4. Learn the need , issues and applications of micro grids and distributed energy sources

TEXTBOOKS:

1. Ali Keyhani, Mohammad N. Marwali, Min Dai “Integration of Green and Renewable Energy in Electric Power Systems”, Wiley
2. Clark W. Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand Response”, CRC Press.

REFERENCES:

1. JanakaEkanayake, KithsiriLiyanage,Jianzhong.Wu, AkihikoYokoyama, Nick Jenkins, “Smart Grid: Technology and Applications”- Wiley
2. Jean Claude Sabonnadière, NouredineHadjsaïd, “Smart Grids”, Wiley Blackwell
3. Peter S. Fox-Penner, “Smart Power: Climate Change, the Smart Grid, and the Future of Electric Utilities”
4. James Momoh, “Smart Grid: Fundamentals of Design and Analysis”-Wiley, IEEE Press, 2012.

MODULE	COURSE NO: 06 EE 635 2	L – T – P : 3 – 0 – 0	
	COURSE NAME: SMART GRID TECHNOLOGY AND APPLICATIONS	CREDITS : 3	
	CONTENT	Contact hrs	End Sem Marks %
I	Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient & Self-Healing Grid, Present development & International policies in Smart Grid. Case study of Smart Grid.	11	25%
II	Part 1: Introduction to Smart Meters, Real Time Pricing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS)	6	25%
FIRST INTERNAL EXAM			
II	Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers.	5	
III	Part 2: Smart Substations, Substation Automation, Feeder Automation. Geographic Information System (GIS), Intelligent Electronic Devices(IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System(WAMS), Phase Measurement Unit(PMU).	10	25%
SECOND INTERNAL EXAM			
IV	Concept of micro grid, need & applications of micro grid, formation of micro grid, Issues of interconnection, protection & control of micro grid. Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel cells, micro turbines, Captive power plants, Integration of renewable energy sources	10	25%
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 45 2	ELECTRIC VEHICLE TECHNOLOGY	3-0-0: 3	2015
<p>PRE – REQUISITES:</p> <p>Fundamentals of power electronics</p> <p>COURSE OBJECTIVES:</p> <p>To provide in depth knowledge about working and analysis of electric vehicle technology</p> <p>SYLLABUS:</p> <p>Basics of vehicles mechanisms, Drive-train Topologies, DC and AC Machines for Propulsion Applications, Energy Sources for EV/HEV, Modelling and analysis of EV/HEV</p> <p>COURSE OUTCOME:</p> <p>The students will be able to analyze and model electric vehicles and hybrid electric vehicles</p> <p>Text Books & References:</p> <ol style="list-style-type: none"> 1. I. Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003. 2. M. Ehsani, Y. Gao, S.E. Gay and Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press. 2005. 3. J. Larminie and J. Lowry, Electric Vehicle Technology Explained, Wiley, 2003. 4. Chris. Mi, M. AbulMasrurand D. W. Gao, Hybrid Electrical Vehicles: Principles and Application with Practical Perspectives, Wiley, 2011. 5. B.D. McNicol and D.A.J. Rand, Power Sources for Electric Vehicles, Elsevier Publications. 1998. 			

Course Plan			
MODULE	COURSE NO:06 EE 6 45 2	L – T – P : 3 – 0 – 0	
	COURSE NAME:ELECTRIC VEHICLE TECHNOLOGY	CREDITS : 3	
	CONTENT	Contact hrs	End Sem Marks %
I	Basics of vehicles mechanisms, Need and importance of Electric Vehicles (EV) and Hybrid Electric Vehicles (HEV), Power/Energy supplies requirements for EV/HEV applications, vehicle power source characterization, and transmission characteristics. Drive-train Topologies: Basics of electric and hybrid traction, Electric and hybrid drive-train topologies, power flow control in drive-train topologies, fuel efficiency analysis.	11	25%
II	DC and AC Machines for Propulsion Applications: Electric system components for EV/HEV, suitability of DC and AC machines for EV/HEV applications, AC and DC Motor drives.	6	25%
FIRST INTERNAL EXAM			
II	Advanced permanent magnet and switch reluctance machines configuration and control of drives.	4	
III	Energy Sources for EV/HEV: Requirements of energy supplies and storage in EV/HEV, Review of batteries, fuel cells, flywheels and ultra-capacitors as energy sources for EV/HEV, characteristics and comparison of energy sources for EV/HEV, hybridization of different energy sources.	10	25%
SECOND INTERNAL EXAM			
IV	Modelling and analysis of EV/HEV drive train, sizing of motor, and design of traction power electronics, various vehicle subsystems. EV/HEV energy management strategies, classification and comparison of various energy management strategies, energy efficiency comparison for various EV and HEV variants.	11	25%
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 07 1	MINI PROJECT	0-0-4: 2	2015
<p>PRE – REQUISITES: Nil</p> <p>COURSE OBJECTIVES:</p> <p>To learn the simulation and/or hardware implementation of a topic based on a research publication in the relevant area of specialization.</p> <p>SYLLABUS:</p> <p>The student has to select a topic and do simulation and/or hardware in consultation with any of the faculty members in the department (or the faculty member offering courses for the programme).</p> <p>A detailed report on the mini project is to be prepared in the prescribed format given by the Department. A committee with the Head of the Department as the chairman and two faculty members from the department as members shall evaluate the mini project based on coverage of the topic, simulation and/or hardware implementation, presentation and ability to answer the questions put forward by the committee.</p> <p>COURSE OUTCOME:</p> <p>Students will</p> <ol style="list-style-type: none"> (1) be aware of recent developments in the area of work (2) improve their simulation and hardware implementation skills <p>References:</p> <ol style="list-style-type: none"> (1) Simulation tools – MATLAB/Simulink , PSIM, PSpiceetc (2) IEEE Xplore , Elsevier- Science Direct, Springer Journalsetc 			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 07 2	ELECTRIC DRIVES LAB	0-0-3: 1	2015
<p>PRE – REQUISITES:</p> <ol style="list-style-type: none"> 1. Knowledge of Power Electronics circuits. 2. Knowledge of basic AC & DC Drives <p>COURSE OBJECTIVES:</p> <p>To provide an in depth knowledge regarding</p> <ol style="list-style-type: none"> (1) The working and performance of various drives. (2) Software modelling of different drives. <p>SYLLABUS</p> <p>Simulation and analysis of different drives using MATLAB/Simulink and PSIM.</p> <p>The working and analysis of AC and DC drives.</p> <p>COURSE OUTCOME:</p> <p>The students will be able to</p> <ol style="list-style-type: none"> 1. Control AC drive from the system. 2. Control DC drive from the system. 3. Model various drives and analyze its performance . 4. Equip themselves to simulate and model various advanced drive based on a literature. 			
<p>TEXTBOOKS:</p> <ol style="list-style-type: none"> 1. R. Krishnan, Electrical Motor Drives, PHI-2003. 2. Ned Mohan, Undeland, Robbins, Power Electronics-3rdedn, John Wiley, 2003 3. Daniel W. Hart, Introduction to Power Electronics, Prentice Hall, 1997 <p>REFERNCES:</p> <ol style="list-style-type: none"> 1. G.K.Dubey, Fundamentals of Electrical Drives, Narosa- 1995. 2. Bimal K Bose, Modern Power Electronics & AC Drives, Pearson Education 3. William Shepherd, Li Zhang., Power Converter Circuits, Marcell Dekker, 2004 			

Course Plan		
COURSE NO:06 EE 6 07 2	L – T – P : 0-0-3	
COURSE NAME:ELECTRIC DRIVES LAB	CREDITS : 1	
LIST OF EXPERIMENTS	Contact hrs	End Sem Marks %
<ol style="list-style-type: none"> 1. Simulation of a Voltage Source Inverter fed three phase Induction Motor. 2. Simulation of a Switched Reluctance Motor Drive. 3. Simulation of a Brushless DC Motor Drive. 4. Simulation of closed loop control of DC-DC converters. 5. FFT Analysis of a single phase full bridge inverter fed load using PSIM or MATLAB/ Simulink 6. FFT Analysis of a three phase full bridge inverter fed load, using PSIM or MATLAB/ Simulink. 7. Closed loop speed control of DCmotors. 8. Closed loop speed control of three phase AC motors. 9. Position and speed control of a Permanent Magnet Synchronous motor. 10. Vector control of a three phase Induction motor. 11. Sensor less speed control of three phase motors. 12. Use of Microcontrollers, DSP and FPGA for the control of motors. 	30	100 %
<p>At least 10 experiments in the list are to be conducted in the laboratory. Additional experiments and simulation assignments can also be given by the department.</p>		
END SEMESTER – EXAM		

Semester III

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 7 11 1	POWER ELECTRONIC CONTROL OF SPECIAL ELECTRICAL MACHINES	3-0-0: 3	2015
<p>PRE – REQUISITES:</p> <ol style="list-style-type: none"> 1. Basics of Power Electronic control circuits 2. Knowledge of construction & working of Machines <p>COURSE OBJECTIVES:</p> <p>To provide a fundamental understanding of the special types of electric machines and their controls for various applications.</p> <p>SYLLABUS</p> <p>Stepping Motors, Construction and principle of operation, characteristics and control- Switched Reluctance Motors & Synchronous Reluctance Motors: Constructional, principle of operation, Characteristics and control- Permanent Magnet Brushless DC Motors : Mechanism of Commutation, different sensors, torque and emf equation, Torques speed characteristics, controllers and control schemes- Permanent Magnet Synchronous Motors: Principle of operation, emf, power input and torque expressions, Phasor diagram, controllers, characteristics, and control schemes.</p> <p>COURSE OUTCOME:</p> <p>The students will be able to</p> <ol style="list-style-type: none"> 1. Model the control circuit for Special Electric Machines. 2. Perform the sensor and sensor less control of Special Electric Machines using different digital controllers. <p>TEXTBOOKS & REFERNCES:</p> <ol style="list-style-type: none"> 1. Kenjo T, Sugawara A, Stepping Motors and Their Microprocessor Control, Clarendon Press,Oxford, 1994. 2. V.V.Athani, Stepper Motor Fundamentals, Application and Design, New Age International(P) Ltd, Publishers, New Delhi, 1997. 3. Miller T J E, Switched Reluctance Motor and Their Control, Clarendon Press, Oxford,1993. 4. Miller T J E, Brushless Permanent Magnet and Reluctance Motor Drives, Clarendon Press,Oxford,1989. 5. R.Krishnan, Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design, and Applications, CRC Press, New York, 2001. 			

Course Plan			
MODULE	COURSE NO:06 EE 7 11 1	L – T – P: 3 – 0–0	
	COURSE NAME:POWER ELECTRONIC CONTROL OF SPECIAL ELECTRICAL MACHINES	CREDITS : 3	
	CONTENT	Contact hrs	End Sem Marks %
I	Stepping Motors: Constructional features, principle of operation, modes of excitation, single phase stepping motors, torque production in variable Reluctance (VR) stepping motor, Dynamic characteristics, Drive Systems and circuit for open loop control, Closed loop control of stepping motor, microprocessor based controller	10	25%
II	Switched Reluctance Motors&Synchronous Reluctance Motors: Switched Reluctance Motors-Constructional features, principle of operation. Torque equation, Power controllers, Characteristics and control. Microprocessor based controller. Sensor less control.	5	25%
FIRST INTERNAL EXAM			
II	Switched Reluctance Motors&Synchronous Reluctance Motors: Synchronous Reluctance Motors-Constructional features: axial and radial air gap Motors. Operating principle, reluctance torque–Phasor diagram, motor characteristics.	5	
III	Permanent Magnet Brushless DC Motors: Introduction-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 equation, Torques speed characteristics, Controllers-Microprocessor based controller. Sensorless control.	11	25%
SECOND INTERNAL EXAM			

IV	Permanent Magnet Synchronous Motors: Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power controllers, Torque speed characteristics, Self control, Vector control, Current control schemes, sensorless control.	11	25%
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDIT S	YEAR
06 EE 721 1	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	3-0-0: 3	2015
<p>PRE – REQUISITES:</p> <ol style="list-style-type: none"> 1. Basics of renewable energy system 2. Knowledge of power electronics <p>COURSE OBJECTIVES:</p> <ol style="list-style-type: none"> 1. To study the various renewable energy options. 2. To conduct qualitative study of power converters <p>SYLLABUS</p> <p>Introduction to Renewable energy system; Qualitative study of different renewable energy resources; Electrical machines for Renewable Energy conversion; Review of reference theory; Power converters for solar and wind energy system; Case studies of Wind- PV system; Maximum Power Point Tracking(MPPT).</p> <p>COURSE OUTCOME:</p> <p>Upon successful completion of this course, students will be able to:</p> <ol style="list-style-type: none"> 1. Understand technology behind green energy harnessing 2. Understand power electronic application to renewable 3. Undertake projects based on grid interconnected green power system. 			
<p>TEXTBOOKS:</p> <ol style="list-style-type: none"> 1. Rashid .M. H, Power Electronics Handbook, Academic press, 2nd edn., 2001. 2. Rai. G.D, Non-conventional Energy Sources, Khanna publishers, 1993. 3. P.S Bimbira, Generalised theory of Electrical machines <p>REFERENCES:</p> <ol style="list-style-type: none"> 1. Rai. G.D, Solar Energy Utilization, Khanna Publishers, 1993. 2. Gary, L. Johnson, Wind Energy System, Prentice Hall Inc, 1995. 3. B.H. Khan, Non-conventional Energy Resources, Tata McGraw-Hill Publishing Company, NewDelhi. 			

COURSE PLAN			
MODULE	COURSE NO:06 EE 721 1	L – T – P :3-0-0	
	COURSE NAME: POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	CREDITS : 3	
	CONTENT	Contact hrs	End Sem Marks %
I	Introduction: 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.	11	25%
II	Electrical machines for Renewable Energy conversion: Review of reference theory.	5	25%
FIRST INTERNAL EXAM			
II	Fundamentals principle of operation and analysis: IG, PMSG, SCIG and DFIG.	6	
III	Power converters - Solar: Block diagram of solar photo voltaic system: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing and array sizing. Wind: three phase AC voltage controllers- AC-DC-AC converters: PWM Inverters, Grid Interactive Inverters - matrix converters.	10	25%
SECOND INTERNAL EXAM			
IV	Hybrid Renewable Energy systems - Need for Hybrid Systems- Wind and PV systems -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. Case studies of Wind-PV- Maximum Power Point Tracking (MPPT).	10	25%
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 7 31 1	EMBEDDED CONTROLLERS	3-0-0: 3	2015
<p>PRE – REQUISITES:</p> <ol style="list-style-type: none"> 1. Basics of 8bit Microcontrollers 2. Knowledge of working of AC & DC drives <p>COURSE OBJECTIVES:</p> <p>To make the students able to design digital measuring and control circuits for power electronic devices</p> <p>SYLLABUS:</p> <p>Use of a typical 8 bit (Intel 8051) Microcontroller for measuring and control of electrical quantities - Architecture and use of peripherals of PIC 16F877Microcontroller(8bit) - Use of microcontrollers for control of Power converters - Fundamentals of DSP controller(TMS LF2407)architecture .DSP based control of Converters</p> <p>COURSE OUTCOME:</p> <p>The students will be able to</p> <ol style="list-style-type: none"> 1. Design digital metering circuits for electrical measurements 2. Design embedded controllers for converters, inverters choppers 			
<p>TEXTBOOKS:</p> <ol style="list-style-type: none"> 1. Muhammad Ali Mazidi, Janice GillispieMazidi, Rolin D. McKinlay, The 8051Microcontroller and Embedded Systems- Using Assembly and C, Prentice Hall of India, New Delhi, 2007 2. John B. Peatman, Design with PIC Microcontrollers, Pearson, 2003. 3. DSP based electro mechanical motion control- Hamid A Toliyat and Steven G Campbell , CRC press <p>REFERENCES:</p> <ol style="list-style-type: none"> 1. Richard H. Barnett, Larry O'Cull, Sarah Alison Cox, Embedded C Programming and the Microchip PIC, Volume 1, Thomson Delmar Learning. 2. SubrataGhoshal, “Embedded Systems & Robots: Projects Using The 805 Microcontroller”, Cengage Learning, 1st Edition, 2009. 3. Bimal K Bose, Modern Power Electronics & AC Drives, Pearson Education, 2002 			

Course Plan			
MODULE	COURSE NO:06 EE 7 31 1	L – T – P : 3 – 0 – 0	
	COURSE NAME: EMBEDDED CONTROLLERS	CREDITS : 3	
	CONTENT	Contact hrs	End Sem Marks %
I	Intel 8051: Architecture - Memory Organization – Instruction set – Addressing modes – Basic Programming. Peripheral: Parallel Ports – Timers and Counters – Interrupts – Serial Communication –ADC, DAC,LCD and keyboard interfacing with 8051. – Assemblers and Compilers – embedded C programming _Generation of .LST and .HEX files for applications using Keil / RIDE IDE. Measurement of voltage, current, speed, power and power factor ,Frequency and PWM implementation using 8051.	10	25%
II	Microchip PIC 16F877: Architecture of PIC 16F877 microcontroller- PIC memory organization - Interrupt structure – Timers / Counters – Capture / Compare / PWM modules - Master Synchronous Serial Port (MSSP) module – USART – A / D Converter module Timers, Comparator module	5	25%
FIRST INTERNAL EXAM			
II	Instruction set – Different addressing modes. Instruction set – Programming - .LST and .HEX files generation for applications using MpLab IDE.Measurement of voltage, current, speed, power and power factor - Frequency measurement - PWM implementation using PIC	5	
III	Digital controllers :Overview of Zero Crossing Detectors - Generation of gating signals for Converters, Inverters and chopper circuit - Control of AC/DC electric drives - Implementation of PID controller - Power quality/power factor correction - Solar Power Conditioning (MPPT)	10	25%
SECOND INTERNAL EXAM			
IV	DSP controller :Introduction toTMS LF2407 DSP controller –peripherals -physical memory – C2xx DSP CPU core-Instruction set -addressing modes – assembly programming - software tools . GPIO – interrupt handling-ADC-Event managers. DSP based implementation of DC_DC BUCK BOOST converter. DSP based control of stepper motor. Space vector PWM technique – DSP implementation	10	25%
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDIT S	YEAR
06 EE 7 41 1	DIGITAL CONTROL SYSTEMS	3-0-0: 3	2015
PRE – REQUISITES: 1. Basics of Difference equations and Z Transform.			

2. Basic knowledge in Control Systems Theory.

COURSE OBJECTIVES:

To provide an in depth knowledge Digital Control System and its analysis.

SYLLABUS

Concepts of sampled data control system, Stability analysis, Digital controller design, Digital estimator and observer design.

COURSE OUTCOME:

The students will be able to

1. Model the digital control system and its analysis.
2. Digital Controller, Estimator and Observer design.

TEXTBOOKS:

1. Gene F Franklin, J David Powell, Michael Workman, Digital control of dynamic systems, Pearson education
2. Benchamin C Kuo ,Digital Control Systems,2nd Edition, Saunders College Publishing,Philadelphia,1992

REFERNCES:

1. K Ogata,Discrete – Time control systems, Pearson education, Asia
2. M Gopal ,Digital control and state variable methods, Tata McGraw-Hill 2009

Course Plan			
MODULE	COURSE NO: 06 EE 7 41 1	L – T – P: 3 – 0 – 0	
	COURSE NAME: DIGITAL CONTROL SYSTEMS	CREDITS : 3	
	CONTENT	Contact hrs	End Sem Marks %
I	Basic concepts in sampled data systems: Discrete time signals-sampling process-effect of sampling-loss of information and noise due to sampling-signal reconstruction-sampling theorem-hold circuits (ZOH,FOH)-z transforms-inverse z transform-difference equations- solution using z transform-system transfer function-poles and zeros-influence of pole location on time response-effect of zeros	10	25%
II	Analysis in z-domain: Stability- Jury's test –Schur Cohn test –bilinear transformation	5	25%
FIRST INTERNAL EXAM			
II	Routh–Hurwitz method in ω plane Discrete Equivalents-Via numerical integration – pole – zero matching –hold equivalents	7	
III	Digital Controller Design: Using transform techniques –by emulation –by root locus in the z-plane –by frequency response methods – Direct Design –method of Ragazzini-Design using State –Space approach-Controllability-Observability-Control Law Design.	10	25%
SECOND INTERNAL EXAM			
IV	Estimator/Observer Design: Full and reduced order observers-regulator design –case with reference input –separation principle Case Studies Case Studies	10	25%
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 7 12 1	SOFT COMPUTING TECHNIQUES	3-0-0: 3	2015
<p>PRE – REQUISITES:</p> <p>1.Basics of Engineering Mathematics 2.Knowledge of MATLAB software</p> <p>COURSE OBJECTIVES:</p> <p>To provide an in depth knowledge about the artificial intelligence techniques and modelling of various systems using this soft computing techniques.</p> <p>SYLLABUS:</p> <p>Artificial Neural Networks and its applications, Fuzzy Logic controllers and applications, System identification and modelling using Least square method, Computer simulation of continuous and discrete systems, Genetic Algorithms and hybrid models.</p> <p>COURSE OUTCOME:</p> <p>The students will be able to</p> <p>1. Model any system using soft computing techniques like ANN, Fuzzy and GA. 2. Model any hybrid systems like Neuro Fuzzy for electrical drives control.</p> <p>TEXTBOOKS:</p> <p>1. J S R Jang, C T Sun, Mizutani, Neuro Fuzzy and Soft Computing. 2. SRajasekharan, VijayaLakhmiPai, Neural Network, Fuzzy logic and Genetic Algorithm, PHI, 2002</p> <p>REFERNCES:</p> <p>1. Simon Haykin, Neural networks 2. David E Goldberg, Genetic Algorithms. 3. C T Lin, C S G Lee, Neural Fuzzy Systems.</p>			

	COURSE NO:06 EE 7 12 1	L – T – P : 3 – 0 – 0	
	COURSE NAME: SOFT COMPUTING TECHNIQUES	CREDITS : 3	
MODULE	CONTENT	Contact hrs	End Sem Marks %
I	Neural Network Different architectures-supervised learning-perceptron-Adaline-Back Propagation-Unsupervised learning-Competitive learning- Kohenonself organizing network-Hebbian learning- Hopfield network- ART network-NNW applications in control, identification and pattern recognition.	10	25%
II	Fuzzy Logic: Basic concepts-set theoretic operations-membership function-fuzzy rules-fuzzy reasoning, fuzzy inference systems	5	25%
FIRST INTERNAL EXAM			
II	Mamdani and Sugeno type -defuzzification- fuzzy controllers-applications in electric drives.	5	
III	System Identification Least Square Method-LSE for non linear load- Validation of simulation model-Computer simulation of continuous and discrete system using Matlab Simulink.	11	25%
SECOND INTERNAL EXAM			
IV	Hybrid Models : Modeling - Neuro fuzzy inference system-controllers-Back propagation through recurrent learning- Reinforced learning. Genetic Algorithms-Basic concepts-design issues-modeling hybrid models.	11	25%
END SEMESTER EXAM			

Course No:	Course Name	Credits	Year
06 EE 722 1	DISTRIBUTED GENERATION AND CONTROL	3-0-0-3	2015

PRE – REQUISITES

1. Electrical power system
2. Power electronics

COURSE OBJECTIVES

- To set a firm and solid foundation in distributed generation.
- To analyze the issues related with grid integration and power quality.
- To study the economic aspects and environmental issues in DG.

SYLLABUS

Distributed Generation Definition; Wind power; Solar technology; Biomass; Tidal; Micro turbine; Energy storage; Grid interconnection; Standards; Different topologies; Protection; Power islanding and power quality issues; Economic and environmental aspects.

COURSE OUTCOME

Student will be able to

- Appreciate the role of distributed generation in current scenario.
- Analyze the issues related with grid interconnection.

TEXT BOOKS

1. GD Rai, “Non Conventional Energy Sources Khanna Publishers”, 2011
2. SP Sukatme, “Solar Energy – Principles of thermal collection and storage, Tata McGraw Hill, 1996

REFERENCE

1. D.Mukherjee, S.Chakrabarti, “Fundamentals of renewable energy systems “New Age International Publishers.
2. Remus Teodorescu, Marco Liserre, Pedro Rodríguez “Grid Converters for Photovoltaic and Wind Power Systems “, Wiley Publishers.
3. Power Electronics and Renewable Energy Systems: Proceedings of ICPERES 2014 edited by ChinnarajKamalakannan, Padma Suresh, SubhransuSekhar Dash, BijayaKetanPanigrahi

Course Plan				
MODULE	COURSE NO:06 EE 722 1	L – T – P : 3 – 0 – 0		
	COURSE NAME:DISTRIBUTED GENERATION AND CONTROL	CREDITS : 3		
	CONTENT	Cont acthr s	End Sem Marks %	
I	Distributed Generation Definition– Wind Power– wind turbine and rotor types, wind speed –power curve – power coefficient – Tip speed ratio – wind energy distribution. Photovoltaic – Solar cell technology – Photovoltaic power characteristics – MPPT – Applications of PV Systems – solar energy collectors and storages– Biomass Power – Fuel cells types –Tidal power generation schemes–different types – mini and micro hydro power schemes – Energy Storage for use with Distributed Generation – Battery Storage – Capacitor Storage – ultra capacitors – Mechanical Storage – Flywheels – Pumped and Compressed Fluids	12	25 %	
II	Standards of interconnection –Power electronic converters in PV, wind power generation – Various control techniques for power converters (Inverters, converters) in grid interactive and stand–alone applications.	4	25 %	
FIRST INTERNAL EXAM				
II	Phase locked loops –synchronization and phase locking techniques – current control. Protection of the converter –DC bus control during grid faults – converter faults during grid parallel and stand –alone operation	6		
III	Intentional and unintentional islanding of distribution systems – Various islanding issues –anti islanding schemes – Active – Passive.	5	25 %	
SECOND INTERNAL EXAM				
III	Reactive power support using DG –Power quality issues in DG environment – voltage dip – Voltage	5		

	fluctuation – Flicker – Harmonics		
IV	Economic aspects of DG– Generation cost, investment –Hybrid energy systems –integrated wind – solar systems –Wind–diesel systems–Distributed generation in the Indian scenario – case studies– permanent magnet alternators –self–excited induction generators – . Merits and demerits of DG.	10	25 %
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 7 32 1	HIGH VOLTAGE DC TRANSMISSION	3-0-0: 3	2015
<p>PRE – REQUISITES:</p> <p>Fundamental knowledge of electrical power systems</p> <p>COURSE OBJECTIVES:</p> <ol style="list-style-type: none"> 1. Enable the students to compare HVAC and HVDC transmission systems and explain the advantages and disadvantages of both. 2. Provide an in depth knowledge about the various parts of a typical HVDC transmission system. 3. Provide an indepth knowledge about the performance of HVDC transmission systems, the methods of control and protection. <p>SYLLABUS</p> <p>Comparison between HVAC and HVDC transmission, Analysis and characteristics of HVDC Converters, Principle of DC link control, Protection of DC lines.AC and DC filters, MTDC systems, Simulation of HVDC systems.</p> <p>COURSE OUTCOME:</p> <p>The students will be able to</p> <ol style="list-style-type: none"> 1. Explain the applications of HVDC transmission systems and their advantages over the conventional HVAC transmission systems. 2. Explain the different components of HVDC transmission systems and their applications. 3. Simulate HVDC transmission systems using a suitable simulation software. 			
<p>TEXTBOOKS:</p> <ol style="list-style-type: none"> 1. K.R.Padiyar, “ HVDC Power Transmission Systems”- New Age International <p>REFERENCES:</p> <ol style="list-style-type: none"> 1. E.W .Kimbark, “ Direct Current Transmission”, Vol I (New York)- John Wiley 2. E.Uhlmann, “Power Transmission by Direct Current”, Springer– Verlag 3. J.Arrillaga, “High Voltage Direct Current Transmission”, (London) Peter Peregrinus. 			

MODULE	COURSE NO: 06 EE 7 32 1	L – T – P: 3 – 0 – 0	
	COURSE NAME: HIGH VOLTAGE DC TRANSMISSION	CREDITS : 3	
	CONTENT	Contact hrs	End Sem Marks %
I	DC power transmission – comparison of AC and DC transmission – Economics of Power transmission – Technical performance – Advantages and disadvantages of DC transmission – Reliability – Application of DC transmission. Types of DC links. Converter Station – Converter Units. Planning for HVDC transmission – Choice of voltage level – Modern trends in DC transmission. Thyristor valve – valve firing – valve design consideration – Grading and damper circuit design – valve protection. Valve tests – Dielectrical and operational tests.	10	25%
II	HVDC Converters – Analysis, Pulse number. Choice of Converter configuration – valve rating – transformer rating .Graetz circuits (simplified analysis only) - with and without overlap. Analysis of 2&3 valve conduction mode and 3 &4 valve conduction mode	7	25%
FIRST INTERNAL EXAM			
II	Converter bridge characteristics – Rectifier and Inverter characteristics of a 6 pulse and 12 pulse converter	4	
III	Principles of DC link control. Converter control characteristics – modification of control characteristics – system control hierarchy- firing angle control- individual phase control – equidistant pulse control. Current and extinction angle control. Starting and stopping of Dc link – power control. Stabilization of AC ties. Converter faults and protection – Converter faults, protection against over current and voltages in a converter station – Surge arrestor- protection against over voltage.	11	25%
SECOND INTERNAL EXAM			
	Smoothing reactors – DC lines – DC line insulators – DC breakers – basic concept, characteristics, types and	10	

IV	applications. Sources of reactive power- static VAR systems- Thyristor controlled reactor – Types of AC filters (Basic concept only)- DC filters – Carrier frequency and RI noise. Multiterminal DC system –Potential. Application and type. Modeling of DC network. Simulation of HVDC system – system simulation – philosophy and tools only.		25%
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDIT S	YEAR
06 EE 7 42 1	BIO INSPIRED ALGORITHM AND ITS APPLICATION	3-0-0: 3	2015
<p>PRE – REQUISITES:</p> <ol style="list-style-type: none"> 1. Fundamental concepts of Biology 2. Basic knowledge of optimization <p>COURSE OBJECTIVES:</p> <p>To provide an in depth knowledge in Bio Inspired Algorithms.</p> <p>SYLLABUS</p> <p>Genetic Algorithm ,Ant Colony Optimization ,Particle Swarm Optimization ,Fire Fly Algorithm</p> <p>COURSE OUTCOME:</p> <p>The students will be able to apply the Bio Inspired Algorithms in real time problems.</p>			
<p>TEXTBOOKS:</p> <ol style="list-style-type: none"> 1. Haupt and Haupt, 'Practical Genetic Algorithms' John Wiley & Sons 2004 2. Dorigo and Stutzle, 'Ant Colony Optimization' 3. Maurice Clerc. Particle Swarm Optimization. ISTE (International Scientific and Technical Encyclopedia), 2006. 4. Xin-She Yang: Nature-Inspired Metaheuristic Algorithms. Luniver Press 2010 <p>REFERNCES:</p> <ol style="list-style-type: none"> 1. Sivanandam S N and S N Deepa :Principles of soft Computing ,Wiley India 2. Melanie Mitchell: An Introduction to Genetic Algorithms. MIT Press, 1996. 			

Course Plan			
MODULE	COURSE NO:06 EE 7 42 1	L – T – P : 3 – 0 – 0	
	COURSE NAME:BIO INSPIRED ALGORITHM AND ITS APPLICATION	CREDITS : 3	
	CONTENT	Contact hrs	End Sem Marks %
I	Genetic Algorithm Application : Modern Heuristic Search Techniques Genetic Algorithm- Introduction- - Encoding-Fitness Function, Premature Convergence, Slow Finishing, Basic Operators, Selection-Tournament Selection, Truncation Selection, Linear Ranking Selection, Exponential Ranking Selection, Elitist Selection, Proportional Selection,-Crossover, Mutation, Control Parameters Estimation, Niching Methods, Parallel Genetic Algorithms, - Application in Drives.- Tuning of membership function using genetic algorithm. Application of GA to neural network.-Tuning of controllers.	10	25%
II	Swarm Intelligence: Ant Colony Optimization: Swarm intelligence general characteristics, Ant Colony Optimization: Basic Concepts-The Ant Colony System-Ants' Foraging Behavior and Optimization,-The Max-Min Ant System Minimum Cost Paths	5	25%
FIRST INTERNAL EXAM			
II	Combinatorial Optimization, Major Characteristics of Ant Colony Search Algorithms-Positive Feedback: Rapid Discovery of Good Solution -Use of Greedy Search and Constructive HeuristicInformation-Ant Colony Optimization Algorithms Applications.	7	
III	Particle swarm optimization: Fundamentals-Concepts of PSO-Comparison with Genetic Algorithm-Application and Implementation	10	25%
SECOND INTERNAL EXAM			
IV	Fire Fly Algorithm: Basic Concepts-Application in optimization, power electronics and power system problems.	10	25%
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 7 03 1	SEMINAR II	0-0-2: 2	2015
<p>PRE – REQUISITES: Nil</p> <p>COURSE OBJECTIVES:</p> <p>To improve presentation skills and searching ability of research publications in the relevant area of specialization</p> <p>SYLLABUS:</p> <p>The student has to register for the seminar and select a topic in consultation with any of the faculty members in the department (or the faculty member offering courses for the programme).</p> <p>A detailed report on the topic of seminar is to be prepared in the prescribed format given by the department. The seminar shall be of 30 minutes duration and a committee with the Head of the Department as the chairman and two faculty members from the department as members shall evaluate the seminar based on the coverage of the topic, presentation and ability to answer the questions put forward by the committee.</p> <p>COURSE OUTCOME:</p> <p>Takers will</p> <ol style="list-style-type: none"> (1) improve the searching ability to find research publications in the area of specialization (2) be aware of recent developments in the area of specialization (3) improve their presentation skills 			
<p>Reference:</p> <p>IEEE Xplore , Elsevier- Science Direct, Springer Journalsetc</p>			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 7 04 1	PROJECT PHASE I	0-0-12: 6	2015
<p>PRE – REQUISITES: Nil</p> <p>COURSE OBJECTIVES:</p> <ol style="list-style-type: none"> (1) conduct literature survey in the area of specialization (2) select a research topic based on literature survey (3) simulation of the selected research topic <p>SYLLABUS:</p> <p>The project (phase-I) shall consist of research work done by the student or a comprehensive and critical review of any recent development in the subject or a detailed report of project work consisting of experimentation/numerical work, design and/or development work that the student has executed.</p> <p>In phase-I, the student should decide a topic of project, which is useful in the field or practical life. The student should refer national and international journals, proceedings of national and international conferences. Emphasis should be given to the introduction to the topic, literature review, and scope of the proposed work along with some preliminary work / experimentation carried out on the project topic.</p> <p>Student should submit two copies of Phase-I project report covering the content mentioned above and highlighting the features of work to be carried out in part-I of the project. The student should follow standard practice of thesis writing.</p> <p>The student will deliver a presentation on the project work and the assessment will be made by a panel of internal examiners one of which will be the Project Supervisor (internal guide). These examiners may give suggestions in writing to the student to be incorporated in project (phase-II).</p> <p>Project evaluation weights shall be as follows:-</p> <p>Project Progress evaluation: 50 Marks</p> <p>Progress evaluation by the Project Supervisor : 20 Marks</p> <p>Presentation and evaluation by the committee : 30 Marks</p>			

COURSE OUTCOME:

Students will be able to

- (1) simulate and analyze the research topic
- (2) identify the drawback of the simulated system
- (3) propose solutions to improve the performance of the system

References:

- (1) IEEE Xplore , Elsevier- Science Direct, Springer Journals etc
- (2) Simulation tools – MATLAB/Simulink , PSIM, PSpice etc

Semester IV

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 7 01 2	PROJECT PHASE II	0-0-21: 12	2015
<p>PRE – REQUISITES: project phase I</p> <p>COURSE OBJECTIVES:</p> <p>(1) Hardware implementation of project phase I simulation</p> <p>(2) Publish research work in a reputed Conference and/or journal</p> <p>SYLLABUS:</p> <p>In the fourth semester the student has to continue the project (phase-I). After the successful completion of the work the student should submit a detailed report (Thesis). The work carried out should lead to a publication in a National / International Conference.</p> <p>Specific weightage will be given to the papers accepted in reputed Conferences/Journals at the time of final project evaluation.</p> <p>Project evaluation weights shall be as follows:-</p> <p>Total Marks: 100 Marks</p> <p>Project evaluation by the supervisor/s : 30 Marks</p> <p>Evaluation by the External expert : 30 Marks</p> <p>Presentation & evaluation by the Committee : 40 Marks</p> <p>COURSE OUTCOME:</p> <p>Students will be able to</p> <p>(1) analyze and implement the research work</p> <p>(2) publish the research work in a reputed conference and/or journal</p> <p>References:</p> <p>(1) IEEE Xplore , Elsevier- Science Direct, Springer Journals etc</p> <p>(2) Hardware – IEEE standards, data sheets of Microchip/Texas Instruments/Atmel make microcontrollers, IC's etc.</p>			