ACADEMIC REGULATIONS

PROGRAM STRUCTURE AND DETAILED SYLLABUS

ELECTRICAL & ELECTRONICS ENGINEERING DEPARTMENT

(Applicable For Batches Admitted From 2019 – 2020)

VIGNAN'S INSTITUTE OF INFORMATION TECHNOLOGY
(AUTONOMOUS)

DUVVADA - VISAKHAPATNAM – 530 049

(An Autonomous Institute, Accredited by NAAC, Affiliated to JNTUK, Kakinada, AP)

VIGNAN'S INSTITUTE OF INFORMATION TECHNOLOGY

(AUTONOMOUS)

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ACADEMIC REGULATIONS

(VR 19)

VIGNAN'S INSTITUTE OF INFORMATION TECHNOLOGY (AUTONOMOUS)

VISAKHAPATNAM

ACADEMIC REGULATIONS for M. Tech. (Regular)

(Applicable for the batches admitted from 2019 onwards)

The selection for category A and B seats shall be as per Govt. of Andhra Pradesh rules.

1. Award of M. Tech. Degree

A student will be declared eligible for the award of the M. Tech. Degree if he/she fulfills the following academic regulations.

Pursued a course of study for not less than two academic years and not more than four academic years.

Candidate has to register for 68 credits and shall secure 68 credits with all courses.

Students who fail to register for their two years course of study within four years or fail to acquire the 68 credits for the award of the degree within four academic years from the year of their admission shall forfeit their seat in M. Tech course and their admission shall stand cancelled.

2. Programs of Study

The following programs of study are offered at present for specialization in the M. Tech. Course.

Specialization Code	Specialization	Department
15	Machine Design (MD)	Mechanical Engineering (ME)
22	Transportation Engineering (TE)	Civil Transportation (CE)
25	Software Engineering (SE)	Computer Science & Engineering (CSE)
38	Digital Electronics & Communication Systems (DECS)	Electronics & Communication Engineering (ECE)
40	Information Technology (IT)	Information Technology (IT)
42	Power & Industrial Drives (P & ID)	Electrical & Electronics Engineering (EEE)
58	Computer Science & Engineering (CSE)	Computer Science & Engineering (CSE)
70	Electronics & Communication Engineering (ECE)	Electronics & Communication Engineering (ECE)
*Code has to be released by University	Artificial Intelligence and Machine learning	Computer Science & Engineering (CSE)

And any other courses as approved by the Board of studies and Academic council from time to time.

3. Registration

A student shall register for courses in each semester as per the courses offered by the concerned

department.

4. Curricular Program

The Curriculum of the two year M. Tech Course has been designed to achieve a healthy balance between theory & lab hours, industry experience and to develop technical skills required for a career in the industry or a career in research.

5. Distribution and Weightage of Marks

Theory Courses including electives (100Marks)

For the theory subjects 70 marks shall be awarded based on the performance in the End Semester Examination and 30 marks shall be awarded based on the Internal Evaluation. The internal evaluation shall be made based on the average of the marks secured in the two Mid Term-Examinations conducted-one in the middle of the Semester and the other immediately after the completion of instruction.

The semester end examinations will be conducted for 70 marks consist of five questions carrying 14 marks each. Each of these questions is from one unit and may contain sub-questions. For each question there will be an "either" "or" choice, which means that there will be two questions from each unit and the student should answer either of the two questions.

Laboratory Course (100Marks)

For practical subjects, 70 marks shall be awarded based on the performance in the End Semester Examinations and 30 marks shall be awarded based on the day-to-day performance as Internal Marks.

a) Internal 30 marks shall be awarded as follows:
i)Day to day assessment including record – 10 marks
ii) Internal examination – 20 marks
b) External examination shall be conducted for 70 marks.
i) Aim, theory and procedure – 15marks, ii) Execution – 25 marks
iii) Results/Program output – 15 marks, iv) Viva-voce – 15 marks

External Laboratory examinations for M. Tech courses must be conducted with two Examiners. Laboratory class teacher acts as internal examiner and external examiner shall be appointed by the Chief Superintendent of Examinations from the panel of experts recommended by the HOD.

Mini project with seminar (100 Marks)

For Mini Project with Seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Project Review Committee (PRC) consisting of

Head of the Department, supervisor/mentor and two other senior faculty members of the department. For Mini Project with Seminar, there **will be only internal evaluation** of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.

Mini project report is evaluated for 100 marks.

a) Assessment by the supervisor /guide for 30 marks
b) Assessment by PRC for 40 marks (20 marks x 2 reviews)
c) Seminar presentations for 30 marks (department level committee assessment)

Audit courses: List of the audit courses will be notified from time to time. An indicative list of the courses is as shown below.

All audit courses will be "Pass/Fail" courses with no specific credit point allotted. The result of the student in the audit course will be notified in the marks memo. A student must pass all the audit courses registered to be eligible for the award of M.Tech. degree.
Note: Audit course will be totally internal evaluation. Mid and End semester examinations shall be conducted for all Audit courses. It is mandatory to pass all Audit Courses**.**

Project/Dissertation

Every candidate shall be required to submit a thesis or dissertation on a topic approved by the Project Review Committee (PRC).

i) Continuous assessment of Dissertation-I and Dissertation-II during the semester(s) will be monitored by the PRC.

ii) **Dissertation- I/Industrial project**: In Dissertation- I, literature review, design calculations and a prototype model are to be prepared within 16 weeks.

iii) In case of Industrial project, students have to complete coursework related to the particular semester through MOOCs

iv) The evaluation of Dissertation-I/Industrial project will be purely internal for 100 marks based on the presentation of literature review, design calculations and demonstration of prototype model.

v) In **Dissertation – II**, experimentation, analysis (analytically or using modern software tools), results & discussion and conclusions are to be prepared and submitted.

vi) A candidate shall submit his status report after each review. Minimum three reviews at PRC level shall be conducted in a gap of one month each for both Dissertation – I & II.

vii) Viva-Voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the external examiner who adjudicated the Thesis. The Board shall jointly evaluate the candidate's work for a maximum of 100 marks.

6. Attendance Requirements

Aggregate 75% of the attendance is required for promotion to next semester.

Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted by the College Academic Committee based on genuine medical grounds. ***This privilege is given to any student only once during the entire program of study.***

A stipulated fee shall be payable towards condonation of shortage of attendance.

Shortage of attendance may be considered for the students who participate in prestigious sports, co-curricular and extra-curricular activities if their attendance is in the minimum prescribed limit.

Note: Shortage of Attendance below 65% in aggregate shall not be condoned in any case.

7. Academic Requirements

The following academic requirements have to be satisfied in addition to the attendance requirements.

For all courses**,** student is considered to be passed upon securing minimum 40% marks in the external examination alone and minimum 50% marks from both internal and external examination put together.

Note: For courses where there is no internal evaluation pass mark is 50% from external & vice-versa.

8. Supplementary Examinations

There is no supplementary examination for PG course.

9. Examinations and Evaluation

9.1. General guidelines

i. All the semester end examinations are conducted for duration of three hours under the supervision of the Chief Superintendent of Examinations.

ii. **Pattern of end examination paper (for theory courses):**

a. External examination shall be conducted for 70 marks.

b. The semester end examinations will be conducted for 70 marks consist of five questions carrying 14 marks each. Each of these questions is from one unit and may contain sub-questions. For each question there will be an "either" "or" choice, which means that there will be two questions from each unit and the student should answer either of the two questions.

iii. Dean of Evaluation, who reports to the Chief Superintendent of Examinations is responsible for planning, conduct of the examinations and declaring results etc.,

iv. The Controller of the examinations ensures that all the four sets of question papers received from the external paper setters comply with the guide lines.

v. Chief Superintendent of Examinations picks up a question paper at random from a set of four papers submitted by the Controller of the Examinations, three hours before the commencement of the examinations.

vi. Moderation: Moderation is carried in order to verify whether all the questions given fall within the framework of prescribed syllabus and Unit wise distribution.

vii. Controller of the Examinations with the support of Additional Controller of Examinations gets the question papers printed course-wise in the required number.

viii. With the help of special invigilators, question papers are distributed to the examination halls five minutes prior to the commencement of Examination.

ix. Special Inspection Squad headed/nominated by Chief Superintendent of Examination makes surprise visit to the Examination Halls to ensure the proper conduct of Examination.

x. The spot valuation is completed within 15 days after the conduct of every examination by following the regular process of coding and decoding of the answer scripts.

xi. Chief Examiner / Evaluators for the respective courses are identified and nominated by the Head of the Department. Evaluators will comprise of internal and external course experts.

xii. Two level evaluation methodologies are adopted for the sake of paper evaluations with one internal and one external evaluator. If the difference of the marks from both the evaluations is more than 15%, then such papers are sent for third evaluation. If the difference of the marks awarded by the internal expert and the external expert is less than or equal to 15% then the highest mark among the two is awarded for the student.

xiii. For laboratory examinations, the evaluation is done by internal examiner and one external examiner.

xiv. Results shall be announced within 30 days after the completion of the last examination.

9.2. Revaluation

There is a provision for revaluation of theory courses if student fulfils the following norms.

The request for revaluation must be made in the prescribed format duly recommended by the Chief Superintendent of Examination through Additional Controller along with the prescribed revaluation fee.

9.3. Challenge Revaluation

If the student is very confident, there is a provision for challenge revaluation for the courses as per the following norms.

i. The challenge revaluation will be carried out by a three-member committee comprising of an external course expert nominated by Principal / Chief Superintendent of Examinations, the faculty member who taught the course chosen by student from the same institute and the third member is the Head of the respective department/faculty nominated by HOD.

ii. The candidate will forfeit the challenging revaluation fee if the difference in the marks awarded by the committee and the initial awarded marks is not more than or equals to 15%. If the difference in marks is more than 15%, the challenge fee will be returned to the candidate. The marks awarded in the Challenge revaluation will be the final.

10. Grading System

Absolute grading system shall be followed for the award of grades

Grade Point

It is a numerical weight allotted to each letter grade on a 10-point scale.

Grades and Grade Points

Marks Range (in %)	Letter Grade	Level	Grade Point
≥ 90	O	Outstanding	10
≥80 to <90	A	Excellent	9
≥70 to <80	B	Very Good	8
≥60 to <70	C	Good	7
≥50 to <60	D	Satisfactory	6
<50	F	Fail	0
		Absent	-1
		Withheld	-2
		Malpractice	-3

Computation of SGPA

The following procedure is to be adopted to compute the Semester Grade Point Average. (SGPA) and Cumulative Grade Point Average (CGPA):

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.

$$SGPA\ (Si) = \Sigma(Ci \times Gi) / \Sigma Ci$$

Where Ci is the number of credits of the i^{th} course and Gi is the grade point scored by the student in the i^{th}course.

Computation of CGPA

- The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme,i.e.
- $CGPA = \Sigma(Ci \times Si) / \Sigma Ci$
- Where Si is the SGPA of the i^{th} semester and Ci is the total number of credits in that semester.
- Equivalent Percentage = (CGPA – 0.75) X10

11. Award of Class

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M. Tech. Degree, he shall be placed in one of the following three classes:

Class Awarded	CGPA to be secured	
First Class with Distinction	≥ 7.75 with no subject failures	**Based on CGPA secured from 68 Credits**
First Class	≥ 6.75	
Second Class	≥ 5.75 to < 6.75	

12. General Instructions

Where the words 'he', 'him', 'his', occur they imply 'she', 'her', 'hers', also.

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

In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Chairman, Academic Council is final.

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

13. Transitory Regulations

If a student is detained and has to get Re-admitted and follow the same regulation of year

of admission.

Transcripts

After successful completion of the entire program of study, a transcript containing performance of all academic years will be issued as a final record. Partial transcript will also be issued up to any point of study to a student on request, after payment of requisite fee.

The Academic Calendar consisting of instruction period of the program is released for every academic year before the commencement of the class work.

There shall be no program transfers after the completion of the admission process. There shall be no transfer from one college/stream to another.

14. Withholding of Results

If the student has not paid the fee dues, if any, to the Institute or in any case of indiscipline is pending against him, the result of the student will be withheld. His degree will be withheld in such cases.

15. Disciplinary Action Guidelines for Malpractices

S.No	Nature of Malpractices/ Improper conduct	Punishment
1 (a)	If the candidate possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the course of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the course of the examination)	Expulsion from the examination hall and cancellation of the performance in that course only.
(b)	If the candidate gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that course only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2	If the candidate has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the course of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the courses of that Semester/year. The Hall Ticket of the candidate is to be

		cancelled.
3	If the candidate impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate, who has been impersonated, shall be cancelled in all the courses of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4	If the candidate smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5	If the candidate uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that course.
6	If the candidate refuses to obey the orders of the Chief Superintendent/Assistant - Superintendent / any officer on duty	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that

	or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	course and all other courses the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the courses of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7	If the candidate leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8	If the candidate possesses any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations

		of the courses of that semester/year. The candidate is also debarred and forfeits the seat.
9	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the college, expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and. a police case will be registered against them.
10	If the candidate comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year.
11	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that course and all other courses the candidate has appeared including practical examinations and project work of that semester/year examinations.
12	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the Academic committee of the Institute for further action to award suitable punishment.	

15.1. For Malpractices identified by squad or special invigilators

Punishments to the candidates will be given as per the above guidelines.

16. UGC recommended punishment for Ragging

i. Suspension from attending classes and academic privileges

ii. Withholding/withdrawing scholarships/fellowship and other benefits.

iii. Debarring from appearing in any test/examination or other evaluation process

iv. Withholding results

v. Debarring from representing the institution in any regional, national or international meet, tournament, youth festival etc.

vi. Suspension/expulsion from the hostel

vii. Cancellation of admission

viii. Rustication from the institution for period ranging from 1 to 4semesters.

ix. Expulsion from the institution and consequent debarring from admission to any other institution for a specified period.

x. Fine may extend up to Rs. 2.5lakh.

PROGRAMMESTRUCTURE&SYLLABUSfor M.TechEEECommonfor

I. **PowerElectronics(PE)**

II. **PowerandIndustrialDrives(P&ID)**

III. **PowerElectronicsandElectricalDrives(PE&ED)**

IV. **PowerElectronicsandDrives(PE&D)**

V. **PowerElectronicsandsystems(PE&S)**

VI. **ElectricalMachinesandDrives(EM&D)**

Programme

(Applicableforbatchesadmittedfrom2019-2020)

PROGRAMMESTRUCTURE
M.Tech (P&ID)

ISemester

S.No	Course code	CourseName		L	T	P	C
1	2042191100	ElectricalMachineModelingandAnalysis		3	0	0	3
2	2042191101	AnalysisofPowerElectronicConverters		3	0	0	3
3	**Program Elective -1**	2042191150	ModernControlTheory	3	0	0	3
		2042191151	PowerQualityandCustomPowerDevices				
		2042191152	ProgrammableLogicControllers&Applications				
4	**Program Elective-2**	2042191153	ArtificialIntelligenceTechniques	3	0	0	3
		2042191154	RenewableEnergyTechnologies				
		2042191155	HVDCTransmissionand FlexibleACTransmissionSystems				
5	2000191100	ResearchMethodologyandIPR		2	0	0	2
6	2042191110	PowerElectronicsSimulationLaboratory		0	0	4	2
7	2042191111	PowerConvertersLaboratory		0	0	4	2
8	2000191130	soft skills (Audit course)		2	0	0	0

II Semester

S.No.	Course Code	Courses		L	T	P	Credits
1	2042191200	Switched Mode Power Conversion		3	0	0	3
2	2042191201	Power Electronic Control of Electrical Drives		3	0	0	3
3	2042191250	**Program Elective - III**	Control & Integration of Renewable Energy Systems	3	0	0	3
	2042191251		Hybrid Electric Vehicles				
	2042191252		Digital ControlSystems				
4	2042191253	**Program Elective - IV**	Advanced Digital Signal Processing	3	0	0	3
	2042191254		Applications of PowerConverters				
	2042191255		Microcontrollers				

5	2042191210	Electric Drives Simulation Laboratory	0	0	4	2
6	2042191211	Electric Drives Laboratory	0	0	4	2
7	2000191230	**Constitution of India (Audit Course)**	2	0	0	0
8	2042191270	Mini Project with Seminar	0	0	4	2
Total credits						**18**

II Year – Sem- I							
S. No	**Course code**	**Courses**		**L**	**T**	**P**	**Credits**
1	2042192150	**Program Elective-5**	1. Digital Signal Processing Controlled Drives	3	1*	0	3
	2042192151		2. Smart Grid Technologies				
	2042192152		3. Modeling & Simulation of PowerElectronic Systems				
2	2042192160	**Open Elective**	1. MOOCs(NPTEL/SWAYAM)-Any 12 Week Course on Engineering/ Management/ Mathematics offered by other than parent department	3	0	0	3
			2. Course offered by other departments in the college				
3	2042192170	**Dissertation-I/ Industrial Project #**		0	0	20	10
Total Credits							**16**

Students going for Industrial project / Thesiswill complete these courses through MOOCs

II Year – Sem- II						
S. No	**Course code**	**Courses**	**L**	**T**	**P**	**Credits**
1	2042192270	**Dissertation-II**	0	0	32	16

Open Electives offered by the Department of EEE for other Department students

Course Code	**Course Title**
2042192161	Renewable Energy Systems
2042192162	Optimization Techniques
2042192163	Programmable Logic Controller

M.Tech

I Year – I Semister
(Detailed Syllabus)

Subject Code	ElectricalMachinesModelingandAnalysis	L	T	P	C
2042191100		3	0	0	3

Pre-requisite:

Electricalmachines&Specialmachines.

CourseEducationalObjectives:

- Toknowtheconceptsofgeneralizedtheoryofelectricalmachines.
- TorepresenttheDCandACmachinesasBasicTwoPolemachine.
- Tomodeltheelectricalmachineswithvoltage,current,torqueandspeedequations.
- Toinvestigatethesteadystateandtransientbehavioroftheelectricalmachines.
- TounderstandthedynamicbehavioroftheACmachines.

CourseOutcomes:

Attheendofthecourse,studentwillbeableto

- Analyzethecharacteristicsofdifferenttypesof DCmotorstodesignsuitablecontrollersfordifferentapplications.
- Applytheknowledgeofreferenceframetheoryfor ACmachinestomodeltheinductionandSynchronous machines.
- Evaluatethesteadystateandtransientbehaviorofinductionandsynchronousmachinestoproposethesuitabilityofdrivesfordifferentindustrialapplications
- Analyzethebehaviorofinductionmachinesusingvoltageandtorqueequations.

UNIT–1:

BasicconceptsofModeling

Basictwo-polemachinerepresentationofCommutatormachines,representationsof3-phasesynchronousmachinewithandwithoutdamperbarsand3-phaseinductionmachine,Kron‟sprimitiveMachinevoltage,currentandtorqueequations.

UNIT–2:

DCMachineModeling

MathematicalmodelofseparatelyexcitedD.Cmotor–Steadystateanalysis-transientStateanalysis-

suddenapplicationofinertiaload-transferfunctionofseparatelyexcitedD.Cmotor-MathematicalmodelofD.CSeriesmotor,Shuntmotor-Linearizationtechniquesforsmallperturbations.

UNIT–3:

Referenceframetheory&ModelingofsinglephaseInductionMachines

Lineartransformation-Phasetransformation-threephasetotwophasetransformation(abctoαβ0)andvice-versa,transformationtorotatingreferenceframe,(αβ0todqo)andviceversa-Powerequivalence-Mathematicalmodelingofsinglephaseinductionmachines.

UNIT–4:

ModelingofthreephaseInductionMachine

Generalizedmodelinarbitraryreferenceframe-Derivationofcommonlyusedinductionmachinemodels-Synchronouslyrotatingreferenceframemodel,Statorreferenceframemodel-Rotorreferenceframemodel--powerequation,electromagnetictorqueequation,statespacemodelininductionmotorwithfluxlinkagesasvariables

UNIT–5:

ModelingofSynchronousMachine

Synchronousmachineinductances–derivationofvoltageequationsintherotor‟sdq0referenceframeelectromagnetictorque-currentintermsoffluxlinkages-threephasesynchronousmotor.Statespacemodelswithfluxlinkagesasvariables.

TextBooks

1. AnalysisofElectricMachineryandDriveSystems,3rdEdition-Wiley-IEEEPress-PaulKrause,OlegWasynczuk,ScottD.Sudhoff,StevenPekarek,Junr2013.
2. ElectricMotorDrives-Modeling,Analysis&control-R.Krishnan-PearsonPublications.

ReferenceBooks:

1. GeneralizedtheoryofElectricalMachines-Fifthedition,KhannaPublishersP.S.Bimbhra,1985.
2. DynamicsimulationofElectricmachineryusingMATLAB/Simulink–CheeMunOng-PrenticeHall,2003.
3. Magnetoelectricdevicestransducers,transformersandmachines-G.R.Slemon-WileyinNewYork,London,1966.

Subject Code	ANALYSISOFPOWERELECTRONICCONVERTERS	L	T	P	C
2042191101		3	0	0	3

Pre-Requisite:

PowerElectronics.

CourseEducationalObjectives:

- Tounderstandthecontrolprincipleofactoacconversionwithsuitablepowersemi-conductordevices.
- Tohavetheknowledgeofactodcconversionanddifferentactodcconvertertopologies.
- Tounderstandtheeffectofoperationofcontrolledrectifiersonp.f.andimprovementofp.f.withPFCconverters
- Toacquiretheknowledgeondc-acconvertersandtoknowthedifferentcontroltechniquesofdc-acconverters.
- Toknowmultilevelinverterconfigurationtoimprovethequalityoftheinverteroutputvoltage.

CourseOutcomes:

Attheendofthecourse,studentwillbeableto

- DescribeandanalyzetheoperationofAC-DCconverters.
- Analyzetheoperationofpowerfactorcorrectionconverters.
- AnalyzetheoperationofthreephaseinverterswithPWMcontrol.
- Studytheprinciplesofoperationofmulti-levelinvertersandtheirapplications.

UNIT–I:

OverviewofSwitchingDevices:

PowerMOSFET,IGBT,GTO,GaNdevices-staticanddynamiccharacteristics,gatedrivecircuitsforswitchingdevices.

UNIT–II:

AC-DCconverters:

SinglephasefullycontrolledconverterswithRLload–Evaluationofinputpowerfactorandharmonicfactor-ContinuousandDiscontinuousloadcurrent,Powerfactorimprovements,Extinctionanglecontrol,symmetricalanglecontrol,PWMcontrol.ThreePhaseAC-DCConverters,fullycontrolledconvertersfeedingRLloadwithcontinuousanddiscontinuousloadcurrent,Evaluationofinputpowerfactorandharmonicfactor-threephasedualconverters.

UNIT–III:

PowerFactorCorrectionConverters:

Single-phasesinglestageboostpowerfactorcorrectedrectifier,powercircuitprincipleofoperation,andsteadystate-analysis,threephaseboostPFCconverter

UNIT–IV:

PWMInverters:

ofoperation-Voltagecontrolofsinglephaseinverters-sinusoidalPWM–modifiedPWM–phasedisplacementControl–
Trapezoidal,staircase,stepped,harmonicinjectionanddeltamodulation.VoltageControlofThree-PhaseInverters-SinusoidalPWM-60^0PWM-ThirdHarmonicPWM-SpaceVectorModulation-ComparisonofPWMTechniques-Threephasecurrentsourceinverters-Variabledclinkinverter.

UNIT–V:

Multilevelinverters: Introduction,MultilevelConcept,TypesofMultilevelInverters-Diode-ClampedMultilevelInverter,PrincipleofOperation,FeaturesofDiode-ClampedInverter,ImprovedDiode-ClampedInverter-Flying-CapacitorsMultilevelInverter-PrincipleofOperation,FeaturesofFlying-CapacitorsInverter-CascadedMultilevelInverter-PrincipleofOperation-FeaturesofCascadedInverter-SwitchingDeviceCurrents-DC-LinkCapacitorVoltageBalancing-FeaturesofMultilevelInverters-ComparisonsofMultilevelConverters.

TextBooks

1. PowerElectronics:Converters,Applications,andDesign-NedMohan,ToreM.Undeland,WilliamP.Robbins,JohnWiley&Sons,2ndEdition,2003.
2. PowerElectronics-Md.H.Rashid–PearsonEducationThirdEdition-FirstIndianReprint-2008.

ReferenceBooks:

1. Power ElectronicsDanielW.Hart-McGraw-Hill,2011.
2. ElementsofPowerElectronics–PhilipT.Krein,OxfordUniversitypress,2014.
3. ConverterCircuits–WilliamShepherd&LiZhang-YesDeeCRCPress,2004.

Subject Code	MODERNCONTROLTHEORY (ELECTIVE-I)	L	T	P	C
2042191150		3	0	0	3

Pre-requisite:

ControlSystems,differentialequations.

CourseEducationalObjectives:

- Tofacilitatetheevolutionofstatevariableapproachfortheanalysisofcontrolsystems.
- Toexaminetheimportanceofcontrollabilityandobservabilityinmoderncontrolengineering.
- Toenablestudentstoanalyzevarioustypesofnonlinearities&constructionoftrajectoriesusingdescribingfunctionsandphaseplaneanalysis.
- Tostudytheanalysisofstabilityandinstabilityofcontinuoustimeinvariantsystem.

CourseOutcomes:

- Attheendofthecourse,studentwillbeableto
- Formulateandsolvethestateequationsofdynamicsystems,analyzecontrollabilityandobservability.
- Designastatefeedbackcontroller;designanobserver.
- Linearizeanonlinearsystemmodel;analyzenon-linearsystemsthroughdescribingfunctions.
- Determinethestabilityofagivensystem;generateaLyapunovfunction.
- Minimizeagivenfunctional,designanoptimalfeedbackgainmatrix.

UNIT–1

StateVariableAnalysis

Theconceptofstate–StateEquationsforDynamicsystems–SolutionofLinearTimeInvariantContinuous-TimeStateEquations,Statetransitionmatrixandit‟sproperties.ControllabilityandObservabilityofstatemodelinJordanCanonicalform-ControllabilityandObservabilityCanonicalformsofStatemodel.

UNIT–2

Designusingstatevariabletechnique

Designofstatefeedbackcontrollerthroughpoleplacementtechnique-Necessaryandsufficientcondition-Ackermann‟sformula.Conceptofobserver-Designoffullorderstateobserver-reducedorderobserver.

UNIT–3

NonLinearSystems

ClassificationofNonlinearities-commonphysicalnonlinearities–Characteristicsofnonlinearsystems-SingularPoints–Linearizationofnonlinearsystems–Describingfunction–describingfunctionanalysisofnonlinearsystems-StabilityanalysisofNonlinearsystemsthroughdescribingfunctions.

UNIT–4

StabilityAnalysis

StabilityinthesenseofLyapunov,Lyapunov‟sstabilityandLyapunov‟sinstabilitytheorems–StabilityAnalysisofLinearContinuoustimeinvariantsystemsbyLyapunovmethod–GenerationofLyapunovfunctions–Variablegradientmethod–Krasooviski‟smethod.

UNIT–5

IntroductiontoOptimalControl

Minimizationoffunctionalofsinglefunction–Constrainedminimization–Minimumprinciple–Controlvariableinequalityconstraints–Controlandstatevariableinequalityconstraints–EulerLagrangineequation.

Typicaloptimalcontrolperformancemeasures-optimalcontrolbasedonQuadraticperformancemeasures-Quadraticoptimalregulatorsystems-Stateregulatorproblems–Outputregulatorproblems,trackingproblems;Riccatiequation-Infinitetimeregulatorproblem-ReducematrixRiccatiequation-determinationofoptimalfeedbackgainmatrix.

TextBooks:

1.ModernControlEngineering–byK.Ogata,PrenticeHallofIndia,3rdedition,1998.

2.AutomaticControlSystemsbyB.C.Kuo,PrenticeHallPublication.

ReferenceBooks:

1.ModernControlSystemTheory–byM.Gopal,NewAgeInternationalPublishers,2ndedition,1996

2.ControlSystemsEngineeringbyI.J.NagarathandM.Gopal,NewAgeInternational(P)Ltd.

3.DigitalControlandStateVariableMethods–byM.Gopal,TataMcGraw–HillCompanies,1997.

4.SystemsandControlbyStainslawH.Zak,OxfordPress,2003.

5.Optimalcontroltheory:anIntroductionbyDonaldE.KirkbyDoverpublications.

6.Moderncontrolsystems,RichardC.DorfandRobertH.Bishop,11thEdition,PearsonEdu,India,2009

Subject Code	POWERQUALITYANDCUSTOMPOWERDEVICES (ELECTIVE-I)	L	T	P	C
2042191151		3	0	0	3

Prequisite:

Knowledgeonelectriccircuitanalysis,powersystemsandpowerelectronicsandconceptofreactivepowercompensationtechniques.

CourseEducationalObjectives:

- Tounderstandsignificanceofpowerqualityandpowerqualityparameters.
- Toknowtypesoftransientovervoltagesandprotectionoftransientvoltages.
- Tounderstandharmonics,theireffects,harmonicindicesandharmonicminimizationtechniques.
- Tounderstandtheimportanceofpowerdevicesandtheirapplications.
- Tounderstanddifferentcompensationtechniquestominimizepowerqualitydisturbances.

CourseOutcomes:

- Attheendofthecourse,studentwillbeableto
- Identifytheissuesrelatedtopowerqualityinpowersystems.
- Addresstheproblemsoftransientandlongdurationvoltagevariationsinpowersystems.
- Analyzetheeffectsofharmonicsandstudyofdifferentmitigationtechniques.
- Identifytheimportanceofcustompowerdevicesandtheirapplications.
- Acquireknowledgeondifferentcompensationtechniquestominimizepowerqualitydisturbances.

UNIT–1

Introductiontopowerquality: OverviewofPowerQuality,ConcernaboutthePowerQuality,GeneralClassesofPowerQualityProblems,VoltageUnbalance,WaveformDistortion,Voltagefluctuation,PowerFrequency Variations,PowerQualityTerms,VoltageSags,swells,flickerandInterruptions-Sourcesofvoltageandcurrentinterruptions,Nonlinearloads.

UNIT–2

TransientandLongDurationVoltageVariations: SourceofTransientOverVoltages-PrinciplesofOverVoltageProtection,DevicesforOverVoltageProtection,UtilityCapacitorSwitchingTransients,UtilityLightningProtection,LoadSwitchingTransientProblems.

PrinciplesofRegulatingtheVoltage,DeviceforVoltageRegulation,UtilityVoltageRegulatorApplication,CapacitorforVoltageRegulation,End-userCapacitorApplication,RegulatingUtilityVoltagewithDistributedgeneration.

UNIT–3

HarmonicDistortionandsolutions: Voltagevs.CurrentDistortion,Harmonicsvs.Transients-PowerSystemQuantitiesunderNon-sinusoidalConditions,HarmonicIndices,Sourcesofharmonics,LocatingSourcesofHarmonics,SystemResponseCharacteristics,EffectsofHarmonicDistortion,Interharmonics,HarmonicSolutionsHarmonicDistortionEvaluation,DevicesforControllingHarmonicDistortion,HarmonicFilterDesign,StandardsonHarmonics.

UNIT–4

CustomPowerDevices: Custompowerandcustompowerdevices,voltagesourceinverters,reactivepowerandharmoniccompensationdevices,compensationofvoltageinterruptionsandcurrentinterruptions,staticseriesandshuntcompensators,compensationindistributionsystems,interactionwithdistributionequipment,installationconsiderations.

UNIT–5

Applicationofcustompowerdevicesinpowersystems: StaticandhybridSourceTransferSwitches,Solidstatecurrentlimiter-Solidstatebreaker.P-Qtheory–ControlofPandQ,DynamicVoltageRestorer(DVR):Operationandcontrol–InterlinePowerFlowController(IPFC):OperationandcontrolofUnifiedPowerQualityConditioner(UPQC);Generalizedpowerqualityconditione

TextBooks:

1.ElectricalPowerSystemsQuality,DuganRC,McGranaghanMF,SantosoS,andBeatyHW,SecondEditio n,McGraw-Hill,2002.

2.UnderstandingPowerQualityProblems:VoltageSagsandInterruptions,BollenMHJ,FirstEdition,IEEEP ress;2000.

3.GuidebookonCustomPowerDevices,TechnicalReport,PublishedbyEPRI,Nov2000

4.PowerQualityEnhancementUsingCustomPowerDevices– PowerElectronicsandPowerSystems,GerardLedwich,ArindamGhosh,KluwerAcademicPublishers, 2002.

ReferenceBooks:

1.PowerQualityPrimer,KennedyBW,FirstEdition,McGraw-Hill,2000.

2.PowerSystemHarmonics,ArrillagaJandWatsonNR,SecondEdition,JohnWiley&Sons,2003.

3.ElectricPowerQualitycontrolTechniques,W.E.KazibweandM.H.Sendaula,VanNostradReinhold,New York.

4.PowerQualityc.shankaran,CRCPress,2001

5.HarmonicsandPowerSystems–FranciscoC.DELARosa-CRCPress(Taylor&Francis).

6.PowerQualityinPowersystemsandElectricalMachines-EwaldF.fuchs,MohammadA.S.Masoum-Elsevier

7.PowerQuality,C.Shankaran,CRCPress,2001

8.InstantaneousPowerTheoryandApplicationtoPowerConditioning,H.Akagiet.al.,IEEEPress,2007.

9.CustomPowerDevices-AnIntroduction,ArindamGhoshandGerardLedwich,Springer,2002

10.AReviewofCompensatingTypeCustomPowerDevicesforPowerQualityImprovement,YashPalet.al.,J ointInternationalConferenceonPowerSystemTechnologyandIEEEPowerIndiaConference,2008.PO WERCON2008.

Subject Code	PROGRAMMABLELOGICCONTROLLE	L	T	P	C

2042191152	RS&APPLICATIONS(ELECTIVE-I)	3	0	0	3

Pre-requisite:

Knowledgeonrelaylogicanddigitalelectronics.

CourseEducationalObjectives:

- TohaveknowledgeonPLC.
- ToacquiretheknowledgeonprogrammingofPLC.
- TounderstanddifferentPLCregistersandtheirdescription.
- TohaveknowledgeondatahandlingfunctionsofPLC.
- ToknowhowtohandleanalogsignalandconvertingofA/DinPLC.

CourseOutcomes:

Attheendofthecourse,studentwillbeableto

- UnderstandthePLCsandtheirI/Omodules.
- DevelopcontrolalgorithmstoPLCusingladderlogicetc.
- ManagePLCregistersforeffectiveutilizationindifferentapplications.
- HandledatafunctionsandcontroloftwoaxisandtheiraxisrobotswithPLC.
- DesignPIDcontrollerwithPLC

UNIT–I:

PLCBasic :

PLCsystem,I/Omodulesandinterfacing,CPUprocessor,programmingequipment,programmingformats,construc tionofPLCladderdiagrams,devicesconnectedtoI/Omodules.

UNIT–II:

PLCProgramming:

Inputinstructions,outputs,operationalprocedures,programmingexamplesusingcontactsandcoils.Drillpress operation.Digitallogicgates,programmingintheBooleanalgebrasystem,conversionexamples.Ladderdiagramsforprocesscontrol:Ladderdiagramsandsequencelistings,ladderdiagramconstructionandflowchartforsprayprocesssystem.

UNIT–III:

PLCRegisters:

CharacteristicsofRegisters,moduleaddressing,holdingregisters,inputregisters,outputregisters.PLCFunctions:TimerfunctionsandIndustrialapplications,counters,counterfunctionindustrialapplications,Arithmeticfunctions,Numbercomparisonfunctions,numberconversionfunctions.

UNIT–IV:

DataHandlingfunctions:

SKIP,MastercontrolRelay,Jump,Move,FIFO,FAL,ONS,CLRandSweepfunctionsandtheirapplications.BitPatternandchangingabitshiftregister,sequencefunctionsandapplications,controllingoftwoaxisandthreeaxisRobotswithPLC,Matrixfunctions.

UNIT–V:

AnalogPLCoperation:

Analogmodulesandsystems,Analogsignalprocessing,multibitdataprocessing,analogoutputapplicationexamples,PIDprinciples,positionindicatorwithPIDcontrol,PIDmodules,PIDtuning,PIDfunctions.

TextBooks:

1.ProgrammableLogicControllers–PrincipleandApplicationsbyJohnW.WebbandRonaldA.Reiss,FifthEdition,PHI

2.ProgrammableLogicControllers–ProgrammingMethodandApplicationsbyJR.HackworthandF.DHackworthJr.–Pearson,2004.

ReferenceBooks:

1. IntroductiontoProgrammableLogicControllers-GaryDunning-CengageLearning.ProgrammableLogicControllers–W.Bolton-Elsevierpublisher.

Subject Code	ARTIFICIALINTELLIGENCETECHNIQUES(ELECTIVE-II)	L	T	P	C
2042191153		3	0	0	3

Pre–requisite:

FundamentalsofNeuralnetworksandFuzzyLogic

CourseEducationalObjectives:

- Tohaveknowledgeonconceptofneuralnetwork.
- Toknowdifferenttypesofneuralnetworksandtrainingalgorithms.
- Tounderstandtheconceptofgeneticalgorithmanditsapplicationinoptimization.
- Tohavetheknowledgeonfuzzylogicanddesignoffuzzylogiccontrollers.
- ToknowtheapplicationsofAITechniquesinelectricalengineering.

CourseOutcomes:

Attheendofthecourse,studentwillbeableto

- DifferentiatebetweenAlgorithmicbasedmethodsandknowledgebasedmethods.
- UseappropriateAIframeworkforsolvingpowersystemproblems.
- Todesignfuzzylogiccontrollersforpowerengineeringapplications.

UNIT–I:

Introduction

ArtificialNeuralNetworks(ANN)–definitionandfundamentalconcepts–Biologicalneuralnetworks–Artificialneuron–activationfunctions–settingofweights–typicalarchitectures–biasesandthresholds–learning/traininglawsandalgorithms.Perceptron–architectures,ADALINEandMADLINE–linearseparability-XORfunction

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UNIT–II:

ANNParadigms

ADALINE–feedforwardnetworks–BackPropagationalgorithm-numberofhiddenlayers–gradientdecentalgorithm–RadialBasisFunction(RBF)network.Kohonen‟sselforganizingmap(SOM),LearningVectorQuantization(LVQ)anditstypes–FunctionalLinkNetworks(FLN)–BidirectionalAssociativeMemory(BAM)–HopfieldNeuralNetwork

UNIT–III:

ClassicalandFuzzySets

Introductiontoclassicalsets-properties,Operationsandrelations;Fuzzysets,Membership,Operations,Properties,Fuzzyrelations,Cardinalities, Membershipfunctions.

UNIT–IV:

FuzzyLogicController(FLC)

Fuzzylogicsystemcomponents:Fuzzification,Inferenceengine(developmentofrulebaseanddecisionmakingsystem),Defuzzificationtocrispsets-Defuzzificationmethods.

UNIT–V:

ApplicationofAITechniques

SpeedcontrolofDCmotorsusingfuzzylogic–loadflowstudiesusingbackpropagationalgorithm,singleareaandtwoarealoadfrequencycontrolusingfuzzylogic.

TextBooks:

1. IntroductiontoArtificialNeuralSystems-JacekM.Zuarda,JaicoPublishingHouse,1997.
2. FuzzylogicwithFuzzyApplications–T.JRoss–McGrawHillInc,1997.

ReferenceBooks:

1. NeuralNetworks,Fuzzylogic,Geneticalgorithms:synthesisandapplicationsbyS.RajasekaranandG.A.VijayalakshmiPai–PHIPublication.
2. ModernpowerElectronicsandACDrives–B.K.Bose-PrenticeHall,2002
3. GeneticAlgorithms-DavidEGoldberg.Pearsonpublications.
4. IntroductiontoNeuralNetworksusingMATLAB6.0bySNSivanandam,SSumathi,SNDeepaTMGH
5. IntroductiontoFuzzyLogicusingMATLABbySNSivanandam,SSumathi,SNDeepaSpringer,2007.

Subject Code	RENEWABLEENERGYTECHNOLOGIES	L	T	P	C

2042191154	(ELECTIVE-II)	3	0	0	3

Prerequisite:

UGpowerElectronics.

CourseEducationalObjectives:

- Tolearntechnicalchallengesinrenewableenergy.
- Tolearnbasicsofwindenergyconversion&PVpowergeneration.
- Toanalyzetheoffuelcellsystem.

CourseOutcomes:

Attheendofthecourse,studentwillbeableto

- Understandvariousgeneralaspectsofrenewableenergysystems.
- Analyzeanddesigninductiongeneratorforpowergenerationfromwind.
- DesignMPPTcontrollerforsolarpowerutilization.
- Utilizefuelcellsystemsforpowergeneration.

UNIT–I:

Introduction: RenewableSourcesofEnergy;DistributedGeneration;RenewableEnergyEconomics-CalculationofElectricityGenerationCosts;Demand-SideManagementOptions;Supply-SideManagementOptions;ControlofrenewableenergybasedpowerSystems

UNIT–2

InductionGenerators: PrinciplesofOperation;RepresentationofSteady-StateOperation;PowerandLossesGenerated-Self-ExcitedInductionGenerator;MagnetizingCurvesandSelf-Excitation-MathematicalDescriptionoftheSelf-ExcitationProcess;InterconnectedandStand-aloneoperation-SpeedandVoltageControl.

UNIT–3

WindPowerPlants: SiteSelection;EvaluationofWindIntensity;Topography;PurposeoftheEnergyGeneration-GeneralClassificationofWindTurbines;RotorTurbines;Multiple-BladeTurbines;DragTurbines;LiftingTurbines-GeneratorsandSpeedControlUsedinWindPowerEnergy;AnalysisofSmallwindenergyconversionsystem.

UNIT–4

PhotovoltaicPowerPlants: SolarEnergy;GenerationofElectricitybyPhotovoltaicEffect;DependenceofaPV

CellonTemperatureandirradianceinput-outputCharacteristics-EquivalentModelsandParametersforPhotovoltaicPanels;MPPTschemes:P&O,INC,effectofpartialshadedcondition.ApplicationsofPhotovoltaicSolarEnergy-EconomicalAnalysisofSolarEnergy

UNIT–5

FuelCells: TheFuelCell;Low-andHigh-TemperatureFuelCells;CommercialandManufacturingIssues-ConstructionalFeaturesofProtonExchange-MembraneFuelCells;Reformers;ElectrolyzerSystems;AdvantagesandDisadvantagesofFuelCells-FuelCellEquivalentCircuit;PracticalDeterminationoftheEquivalentModelParameters;AspectsofHydrogenforstorage.

TextBooks:

1. FelixA.Farret,M.GodoySimo`es,IntegrationofAlternativeSourcesofEnergy,JohnWiley&Sons,2006.
2. RemusTeodorescu,MarcoLiserre,PedroRodríguez,GridConvertersforPhotovoltaicandWindPowerSystems,JohnWiley&Sons,2011.

ReferenceBooks:

1. GilbertM.Masters,RenewableandEfficientElectricPowerSystems,JohnWiley&Sons,2004

Subject Code	HVDCTRANSMISSIONANDFLEXIBLE ACTRANSMISSIONSYSTEMS (ELECTIVE-II)	L	T	P	C
2042191155		3	0	0	3

Pre-requisite:

KnowledgeonPowerElectronics,PowerSystemsandHighVoltageEngineering

CourseEducationalObjectives:

- TolearnvariousschemesofHVDCtransmission.
- TolearntheoperationandanalysisofdifferentHVDCconvertercircuits.
- TolearnthecontrolofHVDCsystems.
- TolearnthebasictypesofFACTScontrollers.
- Tolearntheseriesandshuntcompensators.

CourseOutcomes:

Attheendofthecourse,studentwillbeableto

- CompareHVDCandEHVACtransmissionsystems
- AnalyzeconverterconfigurationsusedinHVDCandevaluatetheperformancemetrics.
- Understandcontrollersforcontrollingthepowerflowthroughadclinkandcomputefilter Parameters.
- Applyimpedance,phaseangleandvoltagecontrolforrealandreactivepowerflowinactransmissionsystemswithFACTScontroller.
- AnalyzeandselectasuitableFACTScontrollerforagivenpowerflowcondition.

UNIT–1

PowerFlowAnalysisinAC/DCSystems

ModellingofDClinks,solutionsofAC-DCPowerflow**FlexibleACTransmissionSystems(FACTS):**FACTSconceptsandgeneralsystemconditions:PowerflowinACsystems,Relativeimportanceofcontrollableparameters,BasictypesofFACTScontrollers,shuntandseriescontrollers,CurrentsourceandVoltagesourceconverters.

UNIT–2

StaticShuntCompensators:

ObjectivesofshuntcompensationMethodsofcontrollableVARgeneration,StaticVarCompensator,itscharacteristics,TCR,TSC,STATCOM,basicoperatingprinciple,controlapproachesandcharacteristics.

StaticSeriesCompensators:

Objectivesofseriescompensator,variableimpedancetypeofseriescompensators,TCSC,TSSC-operatingprinciplesandcontrolschemes,SSSC,PowerAnglecharacteristics,ControlrangeandVARrating,Capabilitytoprovidereactivepowercompensation,externalcont.

UNIT–3

HVDCTransmission:

DCPowerTransmission:Needforpowersysteminterconnections,EvolutionofACandDCtransmissionsystems,ComparisonofHVDCandHVACTransmissionsystems,TypesofDClinks,relativemerits,ComponentsofaHVDCsystem,ModerntrendsinDCTransmissionsystems.

UNIT–4

AnalysisofHVDCConverters:

Pulsenumber,choiceofconverterconfigurations,AnalysisofGraetzcircuitwithandwithoutoverlap,voltagewaveforms,Analysisoftwoandthreevalveconductionmode,ConverterBridgecharacteristics,Invertermodeofoperation,voltagewaveforms

UNIT–5

HVDCControl:

PrinciplesofDClinkcontrol,ConverterControlcharacteristics,ControlhierarchyConstantcurrentControl,CEAControl,firinganglecontrolofvalves,startingandstoppingofadclink,Powercontrol.

HarmonicsandFilters:

EffectsofHarmonics,sourcesofharmonicgeneration,Typesoffilters–DesignexamplesIntroductiontoUnifiedPowerFlowController,Basicoperatingprinciples,Conventionalcontrolcapabilities,Independentcontrolofrealandreactivepower.

TextBooks:

1.NarainG.Honorani,LaszloGyugyi:UnderstandingFACTS–ConceptsandTechnologyofFlexibleACTransmissionSystems,Wiley-IEEEPress,2000.

2.K.R.Padiyar:HVDCPowerTransmissionSystems–TechnologyandSystemInteractions,NewAgeInternationalPublishers,2011.

ReferenceBooks:

1.Kimbark:DirectCurrentTransmission,1971.

2.JosArrillaga:HighVoltageDirectCurrentTransmission,TheInstitutionofelectricalEngineers,1998.

3.YongHuaSong,AllanTJohns:FlexibleACTransmissionSystems,TheInstitutionofelectricalEngineers,1999.

Subject Code	RESEARCHMETHODOLOGYA NDIPR	L	T	P	Credits
2000191100		2	0	0	2

UNIT-I:

Meaningofresearchproblem,Sourcesofresearchproblem,CriteriaCharacteristicsofagoodresearchproblem, Errorsinselectingaresearchproblem,Scopeandobjectivesofresearchproblem.Approachesofinvestigationof solutionsforresearchproblem,datacollection,analysis,interpretation,Necessaryinstrumentations

UNIT-II:

Effectiveliteraturestudiesapproaches,analysisPlagiarism,Researchethics,Effectivetechnicalwriting,howto writereport,PaperDevelopingaResearchProposal,Formatofresearchproposal,apresentationandassessment byareviewcommittee.

UNIT-III:

NatureofIntellectualProperty:Patents,Designs,TradeandCopyright.ProcessofPatentingandDevelopment:t echnologicalresearch,innovation,patenting,development.InternationalScenario:Internationalcooperationo nIntellectualProperty.Procedureforgrantsofpatents,PatentingunderPCT.

UNIT-IV:

PatentRights:ScopeofPatentRights.Licensingandtransferoftechnology.Patentinformationanddatabases.G eographicalIndications.

UNIT-V:

NewDevelopmentsinIPR:AdministrationofPatentSystem.NewdevelopmentsinIPR;IPRofBiologicalSyste ms,ComputerSoftwareetc.TraditionalknowledgeCaseStudies,IPRandIITs.

References:

1.StuartMelvilleandWayneGoddard,"Researchmethodology:anintroductionforscience&engineeringstude nts""

2.WayneGoddardandStuartMelville,"ResearchMethodology:AnIntroduction"

3.RanjitKumar,2ndEdition,"ResearchMethodology:AStepbyStepGuideforbeginners"

4.Halbert,"ResistingIntellectualProperty",Taylor&FrancisLtd,2007.

5.Mayall,"IndustrialDesign",McGrawHill,1992.

Subject Code	POWERELECTRONICSSIMULATION LABORATORY	L	T	P	C
2042191110		0	0	4	2

CourseEducationalObjectives:

ToanalyzetheoperationofDC-DCconverters,AC-DCconvertersandDC-ACconvertersbysimulation.

CourseOutcome:

TounderstandtheoperationofDC-DCconverters,AC-DCconverters,ACvoltageregulatorsandDC-ACconvertersbysimulation.

Any10ofthefollowingexperimentsaretobeconducted**.**

ListofExperiments:

1.SimulationofBuckconverterusingsmallsignalmodel.

2.SimulationofBoostconverterusingsmallsignalmodel.

3.Simulationofsinglephasehalfbridgeinverter.

4.Simulationofsingle-phasefullbridgeinverterusingUni-polar&Bi-polarPWMtechniques.

5.Simulationofthreephaseinverterusingsine-trianglePWM.

6.SimulationofthreephaseinverterusingspacevectorPWM.

7.SimulationofthreelevelthreephaseNPCinverter.

8.StudyofneutralpointvoltagefloatinginNPCthreelevelinverter

9.Simulationof3-levelflyingcapacitorinverter&evaluationofcapacitorvoltagebalancedmethods.

10.SimulationofsinglephaseACvoltageregulator.

11.SimulationofthreephaseACvoltageregulator.

12.Comparisonofharmonicprofileoftwolevel&threelevelinverter(FFTanalysis).

13.Simulationof5-levelinverterusingcarrierbasedPWMmethods.

14.SimulationofthreephasefullconverterwithRL&RLEloads.

15.Simulationofthree-phasedualconverter.

Subject Code	POWERCONVERTERSLABORATORY	L	T	P	C
2042191111		0	0	4	2

CourseEducationalObjectives:

Tostudyandunderstandthedifferentconvertersandinvertersforsingleandthreephaseloads.

CourseOutcomes:

Studentsareabletoimplementtheconverterandinvertersinrealtimeapplications.

Any10ofthefollowingexperimentsaretobeconducted.

Listofexperiments

1.StudyofDC-DCnon-isolatedconverterssuchasBuck&Boostconverter.

2.StudyofDC-DCBuck-BoostandCukconverters.

3.Studyof1-ϕdualconverter.

4.Determinationofinputp.f.andharmonicfactorfor1-ϕsemi-converterand1-ϕfull-converter(Inductiveload)

5.Studyofp.f.improvementin1-ϕfull-converterwithsymmetricandextinctionanglecontrol.

6.Studyof1-ϕsquarewaveandsinusoidalPWMinverter.

7.Studyof3-ϕinverterwith120^{o}and180^{o}modeofoperation.

8.Studyof3-ϕsinusoidalPWMinverter.

9.Studyof3-levelNPCinverter.

10.Studyof5-levelcascadedH-bridgeinverter.

11.Determinationofinputp.f.andharmonicfactorfor3-ϕfullconverter(Inductiveload).

12.Determinationofinputp.f.andharmonicfactorfor3-ϕsemiconverter(Inductiveload).

13.StudythecharacteristicsofIGBT,MOSFET&GTO‟s.

14.DesignofgatedrivecircuitsforIGBT&MOSFET‟s.

Subject Code	SOFT SKILLS AUDITCOURSE-1	L	T	P	C
2000191130		2	0	0	0

Course Objectives:

The student will be taught

1. To prepare project title.
2. To prepare a project report.
3. To identify gaps in literature.
4. To improve writing and presentation skills of the project .

Course Outcomes:

At the end of the course the student will be able to

1. **Teamwork** – learning to connect and work with others to achieve a set task.
2. **Leadership** – assessing the requirements of a task, identifying the strengths within the team, utilizing the diverse skills of the group to achieve the set objective, awareness of risk/safety.

Course Content:

Unit-I:

Planning and Preparation, Word Order, Breaking up long sentences. Structuring Paragraphs and Sentences, Being concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

Unit-II:

Clarifying Who Did What, Highlighting your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.

Unit-III:

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check.

Unit-IV:

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, useful phrases, how to ensure paper is as good as it could possibly be the first-time submission.

Unit-V:

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, and skills are needed when writing the Conclusions.

Text Book:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on GoogleBooks)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge UniversityPress
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM Highman‟s book.
4. Adrian Wall work, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London,2011.

M.Tech

I Year – II Semester

(Detailed Syllabus)

Subject Code	SWITCHED MODE POWER CONVERSION	L	T	P	C
2042191200		4+1		0	3

Pre-requisite: Concepts of electrical circuit analysis and power electronics.

Course Educational Objectives:

- To understand the control operation of non-sinusoidal DC-DCconverters.
- To understand the basic operation of resonantconverters.
- To understand the control operation of isolated DC-DCconverters.
- To understand the control schemes of DC-DC converters and designing of magneticcomponents.
- To understand the modeling and control design of switch mode conversion based onlinearization.
- To understand how to analyze the switch mode converters using small-signalanalysis.

UNIT– 1

Non-isolated switch mode converters:

Control of DC-DC converters: Buck converters, Boost converters, Buck-Boost converter, CUK Converter, continuous and discontinuous operation, Converter realization with non-idealcomponents.

UNIT– 2

Isolated switched mode converters:

Forwarded converter, flyback converter, push-pull converter, half-bridge converter, full bridge converter.

UNIT– 3

Resonant converters:

Basic resonant circuit concepts, series resonant circuits, parallel resonant circuits, zero current switching quasi-resonant buck converter, zero current switching quasi-resonant boost converter, zero voltage switching quasi-resonant buck converter, zero voltage switching quasi-resonant boost converter.

UNIT– 4

Control schemes of switching converters:

Voltage control, Current mode control, control scheme for resonant converters.
Magnetic design consideration: Transformer design, inductor and capacitor design.

UNIT– 5

Modelling and Controller design based on linearization

Formulation of averaged models for buck and boost converters:state space analysis, average circuit models, linearization and small – signal analysis, small-signal models.
Control design based on linearization: Transfer function of converters, control design, large signal issues in voltage-mode and current-mode control.

Course Outcomes: At the end of the course, student will be able to

- Analyze operation and control of non-isolated and isolated switch modeconverters.
- Design of non-isolated and isolated switch modeconverters.
- Analyze operation and control of resonantconverters.
- Feedback design of switch mode converters based on linearizedmodels.

Text Books:

1. Fundamentals of Power Electronics-Erickson, Robert W., Maksimovic, Dragan, Springer,2011.
2. Power switching converters-Simon Ang, Alejandro Oliva, CRC Press,2010.
3. Elements of Power Electronics – Philip T. Krein, Oxford University press,2014.
4. Design of Magnetic Components for Switched Mode Power Converters- Umanand, S.P. Bhat, John Wiley & Sons Australia,1992.

Reference Books:

1. Power Electronics: Essentials and applications- L. Umanand, Wileypublications
2. Switching Power Supply Design-Abraham I. Pressman, McGraw-Hill Ryerson, Limited,1991.
3. Power Electronics – IssaBatareseh, Jhon Wiley publications,2004.
4. Power Electronics: converters Applications & Design – Mohan, Undeland, Robbins-Wiley publications.

Subject Code	POWER ELECTRONIC CONTROL OF ELECTRICAL DRIVES	L	T	P	C
2042191201		4+1		0	3

Pre-requisite: Knowledge of Power Electronics and Electrical Machines.

Course Educational Objectives:

- To familiarize with advanced control schemes for induction motor drives and controltechniques for PMSM, BLDC and SRMdrives.

UNIT– 1

Vector Control of Induction Motor Drive:

Principle of scalar and vector control, direct vector control, indirect vector control, rotor flux oriented control, stator flux oriented control, air gap flux oriented control, decoupling circuits.

UNIT– 2

Sensor less Control of induction Motor Drive:

Advantages of speed sensor less control, voltage current based speed sensor less control, MRAS-model reference adaptive systems, Extended Kalman filter observers.

UNIT– 3

Direct Torque Control of Induction Motor Drive:

Principle of Direct torque control (DTC), concept of space vectors, DTC control strategy of induction motor, comparison between vector control and DTC, applications, space vector modulation based DTC of induction motors.

UNIT– 4

Control of Permanent Magnet Synchronous Machines (PMSM) and Brushless DC (BLDC) Motor Drives:

Advantages and limitations of Permanent magnet machines, operating principle of PMSM,modeling of PMSM, operating principle of BLDC, modeling of BLDC, similarities and difference between PMSM and BLDC, need for position sensing in BLDC motors, control strategies for PMSM and BLDC, methods of reducing torque ripples of BLDCmotor.

UNIT– 5

Control of Switched Reluctance Motor (SRM) Drive:

SRM structure, Merits and limitations, stator excitation, converter topologies, SRM waveforms, Torque control schemes, speed control of SRM, torque ripple minimization, instantaneous -torque control using current controllers and flux controllers.

Course Outcomes: After the completion of the course, student will be able to

- Understand the concepts of scalar and vector control methods for drivesystems.
- Analyze and design controllers and converters for induction motor, PMSM and BLDCdrives.
- Select and implement proper control techniques for induction motor and PMSM for specific applications.
- Analyze and design control techniques and converters for SRMdrives.

Text Books:

1. BoseB.K.,"PowerElectronicsandVariableFrequencyDrives",IEEEPress,StandardPublisher Distributors.2001.
2. Krishnan R., "Electric Motor Drives – Modeling, Analysis and Control", Prentice Hall of India PrivateLimited.

Reference Books:

1. Switched Reluctance Motors and Their Control-T. J. E. Miller, Magna Physics,1993.
2. Power electronic converters applications and design-Mohan, Undeland,Robbins-Wiley publications

Subject Code	CONTROL & INTEGRATION OF RENEWABLE ENERGY SYSTEMS (ELECTIVE -III)	L	T	P	C
2042191250		4+1		0	3

Pre-requisite: Power Electronics

Course Educational Objectives:

- To understand different conventional & non-conventional dynamic energy conversion technologies.
- To learn the principles of static energy conversiontechnologies.
- To understand the basics of real & reactive power control with renewablegenerators.
- To learn the principles of standalone and grid connectedsystems.

UNIT-1

Introduction: Electric grid introduction, Supply guarantee and power quality, Stability, Effects of renewable energy penetration into the grid, Boundaries of the actual grid configuration, Consumption models and patterns, static and dynamic energy conversion technologies, interfacing requirements .

UNIT-2

Dynamic Energy Conversion Technologies: Introduction to different conventional and nonconventional dynamic generation technologies, principle of operation and analysis of reciprocating engines, gas and micro turbines, hydro and wind based generation technologies, control and integrated operation of different dynamic energy conversion devices.

UNIT-3

Static Energy Conversion Technologies: Introduction to different conventional and nonconventional static generation technologies, principle of operation and analysis of fuel cell, photovoltaic based generators, and wind based generation technologies, different storage technologies such as batteries, fly wheels and ultra-capacitors, plug-in-hybrid vehicles, control and integrated operation of different static energy conversion devices.

UNIT-4

Real and reactive power control: Control issues and challenges in Diesel, PV, wind and fuel cell based generators, PLL, Modulation Techniques, Dimensioning of filters, Linear and nonlinear controllers, predictive controllers and adaptive controllers, Fault-ride through Capabilities, Load frequency and Voltage Control.

UNIT-5

Integration of different Energy Conversion Technologies: Resources evaluation and needs, Dimensioning integration systems, Optimized integrated systems, Interfacing requirements, integrated Control of different resources, Distributed versus Centralized Control, Synchro Converters, Grid connected and Islanding Operations, stability and protection issues, load sharing, Cases studies

Course Outcomes: After the completion of the course, student will be able to

- Gain knowledge on different renewable energy sources and storagedevices
- Recognize, model and simulate different renewable energysources
- Analyze, model and simulate basic control strategies required for gridconnection
- Implement a complete system for standalone/grid connectedsystem

Text books:

1. Ali Keyhani Mohammad Marwali and Min Dai, "Integration and Control of Renewable Energy in Electric Power System" John Wiley publishingcompany
2. S. Chowdhury, S. P. Chowdhury, P. Crossley, "Microgrids and Active Distribution Networks", IET Power Electronics Series,2012
3. G. Masters, "Renewable and Efficient Electric Power Systems", IEEE-Wiley Publishers,2013

References:

1. Quing-Chang Zhong, "Control of Power Inverters in Renewable Energy and Smart Grid Integration", Wiley, IEEE Press
2. Bin Wu, Yongqiang Lang, NavidZargari, "Power Conversion and Control of Wind Energy Systems", Wiley2011.

Subject Code	HYBRID ELECTRIC VEHICLES (ELECTIVE -III)	L	T	P	C
2042191251		4+1		0	3

Pre-requisite: Knowledge of Power Electronics and Electric Drives

Course Educational Objectives:

- To learn the concept of hybrid vehicles, types of electric drives used in hybrid vehiclesand theircontrol.

UNIT– 1

Introduction:

History of hybrid vehicles, architectures of HEVs, series and parallel HEVs, complex HEVs.

UNIT– 2

Hybridization of Automobile:

Fundamentals of vehicle, components of conventional vehicle and propulsion load; Drive cycles and drive terrain; Concept of electric vehicle and hybrid electric vehicle; Plug-in hybrid vehicle, constituents of PHEV, comparison of HEV and PHEV; Fuel Cell vehicles and itsconstituents.

UNIT– 3

Plug-in Hybrid Electric Vehicle:

PHEVs and EREVs blended PHEVs, PHEV Architectures, equivalent electric range of blended PHEVs; Fuel economy of PHEVs, power management of PHEVs, end-of-life battery for electric power grid support, vehicle to grid technology, PHEV batterycharging.

UNIT– 4

Power Electronics in HEVs:

Rectifiers used in HEVs, voltage ripples; Buck converter used in HEVs, non-isolated bidirectional DC-DC converter, regenerative braking, voltage source inverter, current source inverter, isolated bidirectional DC- DC converter, PWM rectifier in HEVs, EV and PHEV battery chargers.

UNIT– 5

Battery and Storage Systems

Energy Storage Parameters; Lead–Acid Batteries; Ultra capacitors; Flywheels - Superconducting Magnetic Storage System; Pumped Hydroelectric Energy Storage; Compressed Air Energy Storage - Storage Heat; Energy Storage as an Economic Resource

Course Outcomes: At the end of the course, student will be able to

- Know the concept of electric vehicles and hybrid electricvehicles.
- Familiar with different motors used for hybrid electricvehicles.
- Understand the power converters used in hybrid electricvehicles
- Know different batteries and other energy storagesystems.

Text Books

1. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press,2014.
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press,2003.

Reference Books:

1. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press,2004.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley,2003.
3. H. Partab: Modern Electric Traction – Dhanpat Rai & Co,2007.

Research Books:

1. Pistooa G., "Power Sources , Models, Sustanability, Infrastructure and the market", Elsevier2008
2. Mi Chris, Masrur A., and Gao D.W., " Hybrid Electric Vehicle: Principles and Applications with Practical Perspectives"1995.

Subject Code	DIGITAL CONTROL SYSTEMS (ELECTIVE-III)	L	T	P	C
2042191252		4+1		0	3

Pre-Requisite: Control Systems, digital control systems.

Course Educational objectives:

- To understand fundamentals of digital circuits and devices using Z-transforms and Inverse Z- Transforms
- To understand the controllability and observability in digitaldomain
- To understand the stability and controller design in digitaldomain
- To understand the design anobserver
- To understand the solving of a given optimal controlproblem

UNIT– 1

Introduction

Introduction to analog and digital control systems – Advantages of digital systems – Typical examples– Sample and hold devices – Sampling theorem and data reconstruction-Transfer functions and frequency domain characteristics of zero order hold and first order hold. Review of Z–transforms and Inverse Z– transforms- solving differential equations. Mapping between the S–Plane and the Z–Plane – Primary strips and Complementary Strips

UNIT– 2

State space analysis and the concepts of Controllability and observability

State Space Representation of discrete time systems – State transition matrix properties and evaluation – Solution of state equations- Discretization of continuous-time state equations – controllability and observability – concepts, conditions and tests, Principle of duality.

UNIT– 3

Stability Analysis and Controller Design

Stability criterion– ModifiedRouth‟s stability criterion and Jury‟s stability test, Lyapunov‟s stability analysis.
Design of state feedback controller through pole placement techniques, Necessary and sufficient conditions, Ackermann‟s formula, controller for deadbeat response, control system with reference input, Design of full order observer-reduced order observer.

UNIT– 4

State Observer

Necessary and sufficient condition for state Observation-Full order state observer- error dynamics – design of prediction observers- Ackermann‟s formula-effect of the addition of observer on closed loop System-Current observer- minimum order observer observed – state feedback control system with minimum order observer -control system with referenceinput.

UNIT– 5

Quadratic Optimal Control Systems

Quadratic optimal control Problems-Solution by minimization method using Lagrange multipliers- Evolution of the minimum performance index – discretize quadratic optimal control – Steady state Riccati equations-Lyapunov approaches to the solution of the Steady state quadratic optimal regulator problem and optimal control problem - Quadratic optimal control of a servo system.

Course Outcomes: At the end of the course, student will be able to

- Analyze digital control systems using Z-transforms and InverseZ-Transforms.
- Evaluate the state transition matrix and solve state equation for discrete model for continuoustime systems, investigate the controllability andobservability.
- Determine the stability; design state feedbackcontroller.
- Design anobserver.
- Solve a given optimal controlproblem.

Text Book:

1. Discrete–Time Control systems – K. Ogata, Pearson Education/PHI, 2ndEdition.
2. B. C. Kuo,"Digitalcontrolsystems"-HoltSaunder's InternationalEdition,1991.

Reference Books:

1. M. Gopal: Digital control engineering**,** New Age Int. Ltd., India,1998.
2. K. Ogata, **"**Modern control engineering"- PHI,1991.

Subject Code	ADVANCED DIGITAL SIGNAL PROCESSING (ELECTIVE-IV)	L	T	P	C
2042191253		4+1		0	3

Pre-requisite: Signals &Systems

Course EducationalObjectives:

- To understand the various digital filterstructures
- To design the FIR and IIRFilters
- To know the importance of FFT algorithm for computation of Discrete FourierTransform
- To analyze the finite word length effects on variousfilters
- To learn the concepts of power spectrum estimation of periodic and non-periodicsignals

UNIT– 1

Digital Filter Structure: Block diagram Representation-Equivalent Structures-FIR and IIR digital filter Structures All pass Filters-tunable IIR Digital Filters-IIR tapped cascaded Lattice Structures-FIR cascaded Lattice Structures-Parallel-Digital Sine-cosine Generator-Computational complexity of digital filter structures.

UNIT– 2

Digital filter design: Preliminary Considerations-Bilinear transformation method of IIR filter design- design of lowpass, high pass-band pass, and band stop- IIR digital filters-Spectral transformations of IIR filters, FIR filter design-based on windowed Fourier series- design of FIR digital filters with least –mean- square-error-constrained least-square design of FIR digital filters

UNIT– 3

DSP algorithm implementation: Computation of the discrete Fourier transform- number representation- arithmetic operations handling of overflow-tunable digital filters-function approximation.

UNIT– 4

Analysis of finite Word length effects: The quantization process and errors- quantization of fixed -point and floating -point Numbers-Analysis of coefficient quantization effects, Analysis of arithmetic round-off errors, dynamic range scaling-signal- to- noise ratio in low -order IIR filters-low-sensitivity digital filters- Reduction of Product round-off errors using error feedback-Limit cycles in IIR digital filters, Round-off errors in FFT Algorithms.

UNIT– 5

Power Spectrum Estimation: Estimation of spectra from finite duration observations signals – Non- parametric methods for power spectrum estimation – parametric method for power spectrum estimation, estimation of spectral form-finite duration observation of signals-non-parametric methods for power spectrum estimation-Walsh methods-Blackman & torchy method.

Course Outcomes: At the end of the course, student will be able to

- Describe structure of digitalfilters.
- Design digital filters with differenttechniques.
- Understand the implementation aspects of signal processingalgorithms.
- Know the effect of finite word length in signalprocessing.
- Analyze different power spectrum estimationtechniques.

Text Books:

1. Digital signal processing-Sanjit K. Mitra-TMH second edition,2002.
2. Discrete Time Signal Processing – Alan V.Oppenheim, Ronald W.Shafer - PHI-1996 1st edition- 9threprint

Reference Books:

1. Digital Signal Processing and principles, algorithms and Applications – John G.Proakis -PHI –3rd edition-2002.
2. Digital Signal Processing – S.Salivahanan, A.Vallavaraj, C. Gnanapriya – TMH - 2nd reprint-2001
3. Theory and Applications of Digital Signal Proceesing-LourensR.Rebinar&Bernold.
4. Digital Filter Analysis andDesign-Auntonian-TMH.

Subject Code	APPLICATIONS OF POWER CONVERTERS (ELECTIVE-IV)	L	T	P	C
2042191254		4+1		0	3

Pre-requisites: Analysis of Power Electronic Converters

Course Educational Objectives:

- To understand the inverters for induction heatingapplications
- To understand the power converters for different industrialapplications
- To understand modeling of high voltage power supplies using the power converters for radar and spaceapplications
- To understand modeling of low voltage and high current power supplies using the power converters for microprocessors and computerloads
- To understand the applications of DC-DCconverters

UNIT-1

Inverters for Induction Heating: For induction cooking, induction hardening, melting, and welding applications.

UNIT-2

Power Converters for Lighting, pumping and refrigeration Systems:

Electronic ballast, LED power drivers for indoor and outdoor applications. PFC based grid fed LED drivers, PV / battery fed LED drivers. PV fed power supplies for pumping/refrigeration applications.

UNIT-3

High Voltage Power Supplies - Power supplies for X-ray applications - power supplies for radar applications - power supplies for space applications.

UNIT-4

Low voltage high current power supplies: Power converters for modern microprocessor and computer loads

UNIT-5

Bi-directional DC-DC (BDC) converters: Electric traction, automotive Electronics and charge/discharge applications, Line Conditioners and Solar Charge Controllers

Course Outcomes: At the end of the course, the student will be able to

- Analyze power electronic applicationrequirements.
- Identify suitable power converter from the availableconfigurations.
- Develop improved power converters for any stringent applicationrequirements.
- Improvise the existing control techniques to suit the application. Design of Bi-directional converters for charge/dischargeapplications

Text books:

1. Ali Emadi, A. Nasiri, and S. B. Bekiarov: Uninterruptible Power Supplies and Active Filters, CRC Press, 2005.

2. M. Ehsani, Y. Gao, E. G. Sebastien and A. Emadi: Modern Electric, Hybrid Electric and Fuel Cell Vehicles, 1st Edition,CRC Press,2004.

References:

1. William Ribbens: Understanding Automotive Electronics, Newnes,2003.

2. Currentliterature

Subject Code	MICROCONTROLLERS (ELECTIVE-IV)	L	T	P	C
2042191255		4+1		0	3

Pre-requisite: Basic micro-processors & micro controllers.

Course Educational Objectives:

- To learn about microcontrollersarchitecture.
- To learn about DSP architecture and assembly programming for DSPprocessors.
- To learn about basics of FPGAcontrollers.

UNIT– 1

PIC Microcontrollers

PIC Microcontrollers: Overview and Features, PIC 16C6X/7X, FSR(File Selection Register) [Indirect Data Memory Address Pointer], PIC Reset Actions, PIC Oscillator Connections, PIC Memory Organizations, PIC PIC 16C6X/7X Instructions, Addressing Modes, I/O Ports, Interrupts in PIC 16C61/71, PIC 16C61/71 Timers, PIC 16C71 Analog-to-Digital Converter (ADC)

UNIT– 2

Introduction to DSP

Introduction to the C2xx DSP core and code generation, The components of the C2xx DSP core, Mapping external devices to the C2xx core , peripherals and Peripheral Interface , System configuration registers , Memory , Types of Physical Memory , memory Addressing Modes , Assembly Programming using C2xx DSP, Instruction Set, SoftwareTools.

UNIT– 3

I/O & Control Registers

Pin Multiplexing (MUX) and General Purpose I/O Overview, Multiplexing and General Purpose I/O Control Registers .Introduction to Interrupts, Interrupt Hierarchy, Interrupt Control Registers, Initializing and Servicing Interrupts in Software.

UNIT– 4

ADC & Event Manager

ADC Overview , Operation of the ADC in the DSP , Overview of the Event manager (EV), Event Manager Interrupts , General Purpose (GP) Timers , Compare UNITs, Capture UNITs And Quadrature Enclosed Pulse (QEP) Circuitry , General Event Manager Information

UNIT– 5

Introduction to Field Programmable Gate Arrays – CPLD Vs FPGA – Types of FPGA , Xilinx C3000 series , Configurable logic Blocks (CLB), Input/Output Block (IOB) – Programmable Interconnect Point (PIP) – Xilinx 4000 series – HDL programming – overview of Spartan 3E and Virtex II pro FPGA boards- casestudy.

Course Outcomes: At the end of the course, student will be able to

- Design the interfacing circuits for input and output to PIC micro controllers and DSPprocessors.
- Write ALP for DSPprocessors.
- Design PWM controller for power electronic circuits usingFPGA.

Text Books:

1. Microcontrollers-Theory and Applications - Ajay V Deshmukh, McGraw Hills,2005.
2. DSP Based Electro Mechanical Motion Control -Hamid.A.Toliyat and Steven G.Campbell, CRC Press New York,2004.

Reference Books:

1. The 8051 Microcontroller-Kennith J ayala, Thomsonpublishers,2005.
2. Microprocessor and Microcontrollers by ProfC.R.Sarma.
3. XC 3000 series datasheets (version 3.1). Xilinx,Inc.,USA,1998.
4. Wayne Wolf," FPGA based system design ", Prentice hall,2004

Subject Code	ELECTRIC DRIVES SIMULATION LABORATORY	L	T	P	C
2042191210		--		4	2

Pre-requisite: Power electronics & Drives

Course Educational Objectives:

The student should be able to understand the simulate different electrical machines and drives

Any 10 of the following experiments are to be conducted.

List of Experiments:

1. Simulation of DC shunt machine as motor &generator.
2. Simulate the speed control of DC motor using chopperconverter.
3. Simulation of induction motor modes using d-qmodel.
4. Simulate the speed control of induction motor by using V/fcontrol.
5. Simulate the BLDC motor and observe the speedtransients.
6. Simulate speed control of induction motor by using vectorcontrol.
7. Compare the transient performance of induction motor controlled by v/f control & vector control methods.
8. Simulate PMSM motor by using d-qmodel.
9. Simulate the multi-level inverter fed induction motordrive.
10. Simulate the re-generative braking of inverter fed inductionmotor.
11. Study of PWM controlled inverter fed PMSMdrive.
12. Evaluation of switching frequency effect on electricdrive

Course Objectives:

The student should analyze the performance of different electrical machines and drives

Subject Code	ELECTRIC DRIVESLABORATORY	L	T	P	C
2042191211		--		4	2

Course Educational Objectives:

To study the speed control methods of DC & AC drives.

Any 10 of the following experiments are to be conducted.

List of experiments:

1. Study of armature controlled separately excited DC drive with 1-ϕ fullconverter.
2. Study of chopper controlled separately excited DCdrive.
3. Study of armature controlled separately excited DC drive with 3-ϕ fullconverter
4. Study of dynamic braking of DCdrives.
5. Study of regenerative braking of DCdrive.
6. Study of performance characteristics of a 3-ϕ induction motor using V/fcontrol.
7. Vector control based speed control of inductionmotor.
8. Study of direct torque control of inductionmotor.
9. Speed control of PMSM drive with 3-ϕinverter.
10. Speed control of BLDC drive with 3-ϕinverter.
11. Speed control of switched reluctance motordrive.

Course Outcome: The student should Understand the performance of DC & AC drives.

Subject code	CONSTITUTION OF INDIA	L	T	P	C
2000191230		3	0	0	0

Course Overview: This course introduces students to the Constitution of India. It begins by providing an overview of the history of the making of Indian Constitution. It then discusses the preamble and the basic structures of the Constitution. The fundamental rights, duties and the directive principles of state policy will be discussed thoroughly, followed by a discussion of the legislature, the executive and the judiciary. Some of the important sections of the Constitution that have influenced the history of India since independence will also be taken up for study. These include emergency powers and special provisions.

Course Objectives:

1. To Enable the student to understand the importance of constitution
2. To understand the structure of executive, legislature and judiciary
3. To understand philosophy of fundamental rights and duties
4. To understand the autonomous nature of constitutional bodies like Supreme Court and high court controller and auditor general of India and election commission of India.
5. To understand the central and state relation financial and administrative

	Course outcome	Bloom's cognitive level	PO
CO1	Have general knowledge and legal literacy and thereby to take up competitive examinations.	Understanding	PO-6 PO-8 PO-9
CO2	Understand state and central policies, fundamental duties.	Understanding	PO-6 PO-8 PO-9
CO3	Understand Electoral Process, special provisions.	Understanding	PO-6 PO-8 PO-9
CO4	Understand powers and functions of Municipalities, Panchayats and Cooperative Societies	Understanding	PO-6 PO-8 PO-9

Unit-I: **No. of lecture hours: 6**

Introduction to Indian Constitution: Constitution' meaning of the term, Indian Constitution - constitutional history, Features - Citizenship, Preamble, Fundamental Rights and Duties

Outcome: After completion of this unit student will

- Understand the concept of Indian constitution
- Apply the knowledge on directive principle of state policy
- Analyze the History, features of Indian constitution
- Evaluate Preamble Fundamental Rights and Duties

Outcome: After completion of this unit student will

- Understand the structure of Indian government
- Differentiate between the state and central government
- Explain the role of President and Prime Minister
- Know the Structure of supreme court and High court

Activity: role play of model parliament

Unit-III: **No. of lecture hours: 6**

State Government and its Administration Governor - Role and Position - CM and Council of ministers, State Secretariat: Organization, Structure and Functions

Outcome: After completion of this unit student will

- Understand the structure of state government
- Analyze the role Governor and Chief Minister
- Explain the role of state Secretariat
- Differentiate between structure and functions of state secrateriate

Activity: Quiz role play of model assembly.

Unit-IV: **No. of lecture hours: 6**

A.Local Administration - District's Administration Head - Role and Importance, Municipalities - Mayor and role - CEO of Municipal Corporation PachayatiRaj: Functions ZilaPanchayat, CEO ZilaPanchayat

Outcome: After completion of this unit student will

- Understand the local Administration
- Compare and contrast district administration role and importance
- Analyze the role of Myer and elected representatives of Municipalities
- Evaluate Zillapanchayat block level organisation

Activity: Debate on pros and cons of local governance

Unit-V: **No. of lecture hours: 6**

Election Commission: Election Commission- Role of Chief Election Commissioner and Election Commissionerate State Election Commission:,

Outcome: After completion of this unit student will

- Know the role of Election Commission apply knowledge
- Contrast and compare the role of Chief Election commissioner and Commissiononerate
- Analyze role of state election commission
- Evaluate various commissions of viz SC/ST/OBC and women

Activity: Debate on election system in India

Text Books:

1. Civics, Telugu Academy

References:

1. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt. Ltd.. New Delhi
2. SubashKashyap, Indian Constitution, National Book Trust
3. J.A. Siwach, Dynamics of Indian Government & Politics
4. D.C. Gupta, Indian Government and Politics
5. H.M.Sreevai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)
6. J.C. Johari, Indian Government andPolitics Hans
7. J. Raj IndianGovernment and Politics
8. M.V. Pylee, Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt. Ltd.. New Delhi
9. Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Right), Challenges to Civil Rights Guarantees in India, Oxford University Press 2012

Subject Code	MINI PROJECT WITH SEMINAR	L	T	P	C
2042191270		--		4	2

For Mini Project with Seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Project Review Committee (PRC) consisting of Head of the Department, supervisor/mentor and two other senior faculty members of the department. For Mini Project with Seminar, there **will be only**
internal evaluation of 100 marks. A candidate has to secure a minimum of 50% of marks to
be declared successful.

Mini project report is evaluated for 100 marks.

a) Assessment by the supervisor /guide for 30 marks
b) Assessment by PRC for 40 marks (20 marks x 2 reviews)
c) Seminar presentations for 30 marks (department level committee assessment)

M.Tech

II Year
(Detailed Syllabus)

Course Code	DIGITAL SIGNAL PROCESSOR CONTROLLED DRIVES (PROGRAM ELECTIVE - V)	L	T	P	C
2042192150		3	1	0	3

Pre-requisite: Applications of Digital Signal Processors, Power Electronic control of Electrical Drives.

Course Educational Objectives:

- To study DSPcontrollers.
- TolearncodinginDSP"stocontroltheelectricdrivespeed.
- To learn speed control methods for induction motor, PMSM, BLDCmotors.

UNIT-1

Overview of TMS320LF2407 DSP controller:

Review ofInstruction Set, Interrupts, normalization and number formatting.

UNIT-2

Clarke's and Park's transformations:

Review ofClarke's and Park's transformations, Implementation of Clarke's and Park's transformation using TMS320LF2407 DSP

UNIT-3

Implementation of PWM Techniques for 3-Ph VSI:

Implementation of Sine-triangle and SVPWM withTMS320LF2407 DSP using the concept of imaginary switching time

UNIT-4

Control of BLDC Motor:
Principle of operation with Drive control system, implementation of control system using TMS320LF2407 DSP

UNIT-5

Control of PMSM:
Principle of operation with drive control system, implementation of vector control using TMS320 LF2407DSP

Control of Induction Motor: Implementation of field-oriented control for the speed control of Induction Motor using TMS320LF2407 DSP.

Course Outcomes: At the end of the course, student will be able to

- Interface the DSP platform with sensors such as hall-effect voltagesensors,
- Use hall-effect current sensors, shaft encoder for data acquisition for motor driveapplications
- Scale and normalize the data to suit the requirements of the drivesystem
- Exploit the architectural features of the DSP platform to design andimplement
- Use algorithms for the realization of controllers, Pulse Width Modulators andobservers

Text Books:

1. Hamid A. Toliyat: DSP Based Electromechanical Motion Control, 1st Edition, CRC Press,2004

2. Ned Mohan, T.M. Undeland and William P. Robbins: Power Electronics: Converters, Applications, 3rd Edition, John Wiley & Sons,2009

Reference:

1. Application Notes from the website of Texas Instruments.

Course Code	SMART GRID TECHNOLOGIES (PROGRAM ELECTIVE–V)	L	T	P	C
2042192151		3	1	0	3

Pre-requisite: Basic knowledge on smart concept communication protocols, renewable energy systems and electronic circuits.

Course Educational Objectives:

- To understand concept of smart grid and developments on smart grid.
- To understand smart grid technologies and application of smart grid concept inhybrid electric vehiclesetc.
- To have knowledge on smart substations, feeder automation and application

UNIT – 1

Introduction to Smart Grid: 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 on Smart Grid. Case study of SmartGrid.

UNIT – 2

Smart Grid Technologies: Part 1: Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers.

UNIT – 3

Smart Grid Technologies: 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).

UNIT – 4

Micro grids and Distributed Energy Resources: Concept of micro grid, need & applications of microgrid, formation of microgrid, Issues of interconnection, protection & control of microgrid. Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel cells, microturbines, Captive power plants, Integration of renewable energy sources.

UNIT – 5

Power Quality Management in Smart Grid: Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

Information and Communication Technology for Smart Grid: Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN).monitoring and protection.

Course Outcomes:

At the end of this course, the student will be able to:

- Understand smart grids and analyze the smart grid policies and developments in smart grids.
- Develop concepts of smart grid technologies in hybrid electrical vehiclesetc.
- Understand smart substations, feeder automation, GISetc.
- Analyze micro grids and distributed generation systems.
- Analyze the effect of power quality in smart grid and to understand latest developmentsin ICT for smart grid.

Text Books:

1. Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green andRenewable Energy in Electric Power Systems",Wiley
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency andDemand Response", CRCPress

Reference Books:

1. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications",Wiley
2. Jean Claude Sabonnadière, NouredineHadjsaïd, "Smart Grids", Wiley Blackwell19
3. Peter S. Fox Penner, "Smart Power: Climate Changes, the Smart Grid, and the Future of Electric Utilities", Island Press; 1 edition 8 Jun 2010
4. S. Chowdhury, S. P. Chowdhury, P. Crossley, "Microgrids and Active Distribution Networks." Institution of Engineering and Technology, 30 Jun2009
5. Stuart Borlase, "Smart Grids (Power Engineering)", CRCPress
6. Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability: 1", Artech House Publishers July2011

Course Code	MODELING AND SIMULATION OF POWER ELECTRONIC SYSTEMS (PROGRAM ELECTIVE–V)	L	T	P	C
2042192152		3	1	0	3

Pre-requisites: Analysis of Power Electronic Converters

Course Educational Objectives:

- To learn the simulation techniques in Power ElectronicConverters.
- To learn the modeling the Power ElectronicConverters.
- To simulate control methods for Power ElectronicConverters.

UNIT-1

Introduction:

Challenges in computer simulation - Simulation process - mechanics of simulation, Solution techniques for time domain analysis - Equation solvers, circuit-orientedsimulators.

UNIT-2

Simulation of power electronic converters part-1

MNA and ST Approaches- Nodal Analysis, Modified Nodal Analysis, The Spare Tableau Approach, Nonlinear Circuits - The Newton-Raphson Method, Computation Time, Convergence Issues, Nonlinear Circuit Equations, Introduction to Transient Simulation - Introduction, Discretization of Time, Transient Analysis, Accuracy and Stability, Explicit and Implicit Schemes.

UNIT-3

Simulation of power electronic converters part-2

Methods for Transient Simulation - FE, BE and TRZ, Transient Analysis in Circuit Simulation, Equivalent Circuit Approach: RC Circuit, Buck Converter; Some Practical Aspects: Undamped Oscillations, Ringing, Global Error in Switching Circuits, Round-off Error, Assessment of Accuracy, Singular Matrix Problem, Trapezoidal integration, M & N method for simulating power electronic converters (with buck converter as a representative example).

UNIT-4

Switching function:

Introduction, Application of the switching function technique, Properties of the switching function, Voltage-Current relations in switched circuits - Single Switch, Parallel Switch, Pulse Width Modulation- Unipolar, PWM Signal of a composite function, bipolar square wave modulation, Mathematical Modeling of Buck Converter, Modeling using switching function-buck converter, Rectifier, 3-phase VSI inverter, matrix converter, m-phase rectifier. PWM rectifier topologies, Modeling of power electronic converters - PWM rectifier in different frames- abc, alpha-beta and d-q.

UNIT-5

Modeling, simulation of switching converters with state space averaging, hybrid model:

State space approach, averaging method, State Space Averaging Technique – Modeling AND linearization of converter transfer functions- Hybrid Modeling for DC-DCconverter.

Course Outcomes: After the completion of the course, student will be able to

- Understand the back ground activities i.e. numerical solution used in the simulationsoftware.
- Can judge or properly choose the required numerical solver to be used foranalysis.
- Can understand and debug the convergence problems occurring duringsimulation.

Text book:

1. M. B. Patil, V. Ramnarayanan, V. T. Ranganathan**:** Simulation of Power Electronic Converters**,** 1st ed., Narosa Publishers, 2010

Reference book:

1. Ned Mohan, Undeland and Robbins**, "**Power Electronics: Converters, Design and control**"-** 2nd ed., John Wiley.

Course Code	RENEWABLE ENERGY SYSTEMS (OPEN ELECTIVE)	L	T	P	C
2042192161		3	1	0	3

Course Overview:

This course deals with the basic solar radiation measurements, thermal systems, Photovoltaic Systems. Wind energy aerodynamics, electrical machines for renewable energy conversion. Analysis of wind and PV systems, Hybrid renewable energy systems

Course Objectives:

- To study the solar radiation data, extraterrestrial radiation, radiation on earth's surface.
- To study solar thermal collections.
- To study solar photo voltaic systems.
- To study maximum power point techniques in solar PV.
- To study wind energy conversion systems, Betz coefficient, tip speed ratio.
- To study basic principle and working of tidal, biomass, fuel cell and

UNIT–I:

Fundamentals of Energy Systems and Solar energy

Energy conservation principle – Energy scenario (world and India) – various forms of

renewable energy - Solar radiation**:** Outside earth's atmosphere – Earth surface – Analysis of solar radiation data – Geometry – Radiation on tilted surfaces

UNIT–II:

Solar Thermal Systems

Liquid flat plate collectors **(**Theoretical Treatment only), Introduction to solar air heaters – Concentrating collectors, solar pond and solar still – solar thermal plants.

Solar photovoltaic cell, module, array – construction – Efficiency of solar cells – Developing technologies – Cell I-V characteristics – Equivalent circuit of solar cell –Applications, Maximum power point techniques**:** Perturb and observe (P&O) technique.

UNIT–III:

Wind Energy

Sources of wind energy - Wind patterns – Types of turbines – Horizontal axis and vertical axis machines - Kinetic energy of wind – Betz coefficient – Tip–speed ratio – Efficiency – Power output of wind turbine.

UNIT–IV:

Hydro and Tidal power systems

Basic working principle – Classification of hydro systems**:** Large, small, micro.

Tidal power – Basics – Kinetic energy equation – Turbines for tidal power (No Numerical)

Wave power – Basics – Kinetic energy equation – Wave power devices.

UNIT–V:

Biomass and fuel cells

Biomass Energy**:** Fuel classification – Pyrolysis – Direct combustion of heat – Different Digesters.

Fuel cell**:** Classification of fuel for fuel cells – Fuel cell voltage– Efficiency – V-I characteristics.

Learning Outcomes:

Student should be able to

- Analyze solar radiation data, extraterrestrial radiation, and radiation on earth's surface.
- Design solar thermal collectors, solar thermal plants.
- Design solar photo voltaic systems.
- Develop maximum power point techniques in solar PV and wind energy systems.
- Explain wind energy conversion systems, wind generators, power generation.
- Explain basic principle and working of hydro, tidal, biomass, fuel cell and geothermal systems.

Text Books:

1. Solar Energy**:** Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K.

Nayak, TMH, New Delhi, 3rd Edition.

2. Renewable Energy Resources, John Twidell and Tony Weir, Taylor and Francis -

second edition,2013.

Reference Books:

1. Energy Science**:** Principles, Technologies and Impacts, John Andrews and Nick Jelly, Oxford University Press.
2. Renewable Energy- Edited by Godfrey Boyle-oxford university. press,3rd edition,2013.
3. Handbook of renewable technology Ahmed and Zobaa, Ramesh C Bansal, World scientific, Singapore.
4. Renewable Energy Technologies /Ramesh & Kumar /Narosa.
5. Renewable energy technologies – A practical guide for beginners – Chetong Singh Solanki, PHI.
6. Non conventional energy source –B.H.khan- TMH-2nd edition.

Course Code	OPTIMIZATION TECHNIQUES (OPEN ELECTIVE)	L	T	P	C
2042192162		3	1	0	3

Course Overview:

Optimization techniques have gained importance to solve many engineering design problems by developing linear and nonlinear mathematical models.

Course educational objectives:

- The aim of this course is to educate the student to develop a mathematical model by defining an objective function and constraints in terms of design variables and then apply a particular mathematical programming technique.
- This course covers classical optimization techniques, linear programming, nonlinear programming and Swarm Optimization algorithms.

UNIT–I: Introduction and Classical Optimization Techniques:

Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems.

Unit-II: Classical Optimization Techniques

Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints. Solution by method of Lagrange multipliers – multivariable Optimization with inequality constraints – Kuhn – Tucker conditions.

Unit-III: Linear Programming

Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm - Duality in Linear Programming – Dual Simplex method.

Unit-IV: Nonlinear Programming:

Unconstrained cases - One – dimensional minimization methods: Classification, Fibonacci method and Quadratic interpolation method - Univariate method, Powell's method and steepest descent method.

Constrained cases - Characteristics of a constrained problem, Classification, Basic approach of Penalty Function method; Basic approaches of Interior and Exterior penalty function methods. Introduction to convex Programming Problem.

Unit-V: Introduction to Swarm Intelligence Systems:

Swarm intelligence programming methods - Basic Partial Swarm Optimization – Method – Characteristic

features of PSO procedure of the global version – Parameters of PSO (Simple PSO algorithm – Operators selection criteria – Fitness function constraints) – Comparison with other evolutionary techniques – Engineering applications of PSO.

Course Outcomes: At the end of the course, student will be able to

- Define an objective function and constraint functions in terms of design variables, and then state the optimization problem.
- Solve single variable and multi variable optimization problems, without and with constraints.
- Apply linear and non-linear programming technique to an optimization problem.
- Explain basic principles of Genetic Algorithms and Particle Swarm Optimization methods

Reference Books:

1. "Engineering optimization: Theory and practice"-by S. S.Rao, New Age International (P) Limited, 3rd edition, 1998.
2. Soft Computing with Matlab Programming by N.P.Padhy&S.P.Simson, Oxford University Press – 2015

Course Code	PROGRAMMABLE LOGIC CONTROLLER (OPEN ELECTIVE)	L	T	P	C
2042192163		3	1	0	3

Course Overview: In most of the industry applications, computer control is gaining importance,PLCisanindustrycomputer, hence thiscoursePLCmakesthestudentstoacquire knowledge required forindustry.

Course Objectives:

- To have knowledge onPLC.
- To acquire the knowledge on programming ofPLC.
- To understand different PLC registers and theirdescription.
- To have knowledge on data handling functions ofPLC.
- To know how to handle Hardware configuration and develop logic for different IndustrialApplications.

Course Outcomes: After completion of the course, students are able to:

- Understand the PLCs and their I/Omodules.
- Develop control algorithms to PLC using ladderlogic.
- ManagePLCregistersforeffectiveutilizationindifferentapplications.
- DesignHardwareconfigurationanddeveloplogicfordifferentIndustrialApplications.

Unit-I: PLC Basics

PLC system, I/O modules and interfacing, CPU processor, programming equipment, programming formats, construction of PLC ladder diagrams, devices connected toI/O modules.

Unit-II: PLC Programming

PLC Programming: Input instructions, outputs, operational procedures, programming examples using contacts and coils. Digital logic gates, programming in the Boolean algebra system, conversion examples. Ladder diagrams and sequence listings, ladder diagram construction.

Unit-III: Programmable Timers and Counters

Timer instructions – On delay timer instruction – Off delay timer instruction – Retentive timer – Counter instructions – Up counter – Down counter - Cascading counters – Incremental encoder – Counter applications – Combining counter and timer functions.

Unit-IV: Program Control and Other Instructions

Master control reset instruction – Jump instructions and sub routines – Immediate input and output instructions.Data manipulation – Data transfer operation – Data compare instruction – Data manipulation programs – Numerical data I/O interfaces – Math instructions – Addition, subtraction, multiplication & division instruction – Sequential instructions – Sequence programs – Shift registers – Word shift registers.

Unit-V: Applications

Controlofwaterlevelindicator–Alarmmonitor-Conveyormotorcontrol–Parkinggarage– Ladder diagram for process control – PIDcontroller.

Text Books:

1. ProgrammablelogiccontrollersbyFrankD.Petruzella-McGrawHill–3rdEdition.
2. ProgrammableLogicControllers–PrincipleandApplicationsbyJohnW.Webband Ronald A. Reiss, Fifth Edition,PHI

Reference Books:

1. ProgrammableLogicControllers–ProgrammingMethodandApplicationsbyJR. Hackworth and F.D Hackworth Jr. – Pearson,2004.
2. IntroductiontoProgrammableLogicControllers-GaryDunning-CengageLearning.
3. Programmable Logic Controllers –W.Bolton-Elsevierpublisher

II Year – I & II Semester

(DISSERTATION)

PHASE – I & PHASE - II

Every candidate shall be required to submit a thesis or dissertation on a topic approved by the Project Review Committee (PRC).

Continuous assessment of Dissertation-I and Dissertation-II during the semester(s) will be monitored by the PRC.

DISSERTATION – I:

Dissertation- I/Industrial project: In Dissertation- I, literature review, design calculations and a prototype model are to be prepared within 16 weeks.

In case of Industrial project, students have to complete coursework related to the particular semester through MOOCs

The evaluation of Dissertation-I/Industrial project will be purely internal for **100 marks** based on the presentation of literature review, design calculations and demonstration of prototype model.

DISSERTATION– II:

In **Dissertation – II**, experimentation, analysis (analytically or using modern software tools), results & discussion and conclusions are to be prepared and submitted.

A candidate shall submit his status report after each review. Minimum three reviews at PRC level shall be conducted in a gap of one month each for both Dissertation – I & II.

Viva-Voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the external examiner who adjudicated the Thesis. The Board shall jointly evaluate the candidate's work for a maximum of **100 marks.**