ACADEMIC REGULATIONS PROGRAM STRUCTURE AND DETAILED SYLLABUS

ELECTRICAL & ELECTRONICS ENGINEERING DEPARTMENT

(Applicable For Batches Admitted From 2021 – 2022)

M.TECH.
Power and Industrial Drives (P&ID)

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 21)

VIGNAN'S INSTITUTE OF INFORMATION TECHNOLOGY (AUTONOMOUS)

VISAKHAPATNAM

ACADEMIC REGULATIONS for M. Tech. (Regular)

(Applicable for the batches admitted from 2021 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)
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)
79	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

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.

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.

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.

PROGRAMME STRUCTURE & SYLLABUS for M.Tech EEE Common for

I. **Power Electronics (PE)**

II. **Power and Industrial Drives (P&ID)**

III. **Power Electronics and Electrical Drives (PE &ED)**

IV. **Power Electronics and Drives (PE&D)**

V. **Power Electronics and systems**

VI. **(PE&S) Electrical Machines and Drives (EM&D)**

Programme

(Applicable for batches admitted from 2021-2022)

PROGRAMME STRUCTURE

I year- I Semester							
S.No	**Course code**	**Course Name**		**L**	**T**	**P**	**C**
1	2042211100	Electrical Machine Modeling and Analysis		3	0	0	3
2	2042211101	Analysis of Power Electronic Converters		3	0	0	3
3	**Program Elective -1**	2042211150	Modern Control Theory	3	0	0	3
		2042211151	Hybrid Electric Vehicles				
		2042211152	Programmable Logic Controllers & Applications				
4	**Program Elective-2**	2042211153	Artificial Intelligence Techniques	3	0	0	3
		2042211154	Renewable Energy Technologies				
		2042211155	Power Electronic Applications to Renewable Energy				
5	2000211100	Research Methodology and IPR		2	0	0	2
6	2042211110	Power Electronics Simulation Laboratory		0	0	4	2
7	2042211111	Power Converters Laboratory		0	0	4	2
8	2000211130	Audit course-1		2	0	0	0

I year-II Semester							
S.No.	**Course Code**	**Courses**		**L**	**T**	**P**	**Credits**
1	2042211200	Switched Mode Power Conversion		3	0	0	3
2	2042211201	Power Electronic Control of Electrical Drives		3	0	0	3
3	2042211250	**Program Elective - III**	Control & Integration of Renewable Energy Systems	3	0	0	3
	2042211251		Electric Vehicle Design and Development				
	2042211252		Special Electrical Machines				
4	2042211253	**Program Elective - IV**	Advanced Digital Signal Processing	3	0	0	3
	2042211254		Applications of Power Converters				
	2042211255		Microcontrollers				

5	2042211210	Electric Drives Simulation Laboratory	0	0	4	2
6	2042211211	Electric Drives Laboratory	0	0	4	2
7	2000211230	Audit course-2	2	0	0	0
8	2042211270	Mini Project with Seminar	0	0	4	2
Total credits						**18**

II Year – I semester							
S. No	**Course code**	**Courses**		**L**	**T**	**P**	**Credits**
1	2042212150	**Program Elective-5**	1. Distributed Generation and Micro Grids	3	1*	0	3
	2042212151		2. Smart Grid Technologies				
	2042212152		3. Modeling & Simulation of PowerElectronic Systems				
2	2042212160	**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	2042212170	**Dissertation-I/ Industrial Project #**		0	0	20	10
Total Credits							**16**

Students going for Industrial project / Thesis will complete these courses through MOOCs

II Year – II semester						
S. No	**Course code**	**Courses**	**L**	**T**	**P**	**Credits**
1	2042212270	**Dissertation-II**	0	0	32	16

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

Course Code	**Course Title**
2042212161	Renewable Energy Systems
2042212162	Introduction to Electric vehicles
2042212163	Programmable Logic Controller

M.Tech

I Year – I Semester

(Detailed Syllabus)

Subject Code	Electrical Machines Modeling and Analysis	L	T	P	C
2042211100		3	0	0	3

Pre-requisite:

Electrical machines & Special machines.

Course Educational Objectives:

- To know the concepts of generalized theory of electrical machines.
- To represent the DC and AC machines as Basic Two Pole machine.
- To model the electrical machines with voltage, current, torque and speed equations.
- To investigate the steady state and transient behavior of the electrical machines.
- To understand the dynamic behavior of the AC machines.

UNIT– 1:

Basic concepts of Modeling

Basic two-pole machine representation of Commutator machines, representations of 3-phase synchronous machine with and without damper bars and 3-phase induction machine, Kron‟s primitive Machine voltage, current and torque equations.

UNIT– 2:

DC Machine Modeling

Mathematical model of separately excited D.C motor – Steady state analysis-transient State analysis-sudden application of inertia load-transfer function of separately excited D.C motor- Mathematical model of Series motor, Shunt motor-Linearization techniques for small perturbations.

UNIT– 3:

Reference frame theory & Modeling of single phase Induction Machines

Linear transformation-Phase transformation - three phase to two phase transformation (abc to αβ0) and vice-versa, transformation to rotating reference frame, (αβ0 to dqo) and vice versa -Power equivalence-Mathematical modeling of single phase induction machines.

UNIT– 4:

Modeling of three phase Induction Machine

Generalized model in arbitrary reference frame-Derivation of commonly used induction machine models-Synchronously rotating reference frame model, Stator reference frame model-Rotor reference frame model--power equation, electromagnetic torque equation, state space model in induction motor with flux linkages

as variables

UNIT– 5:

Modeling of Synchronous Machine

Synchronous machine inductances –derivation of voltage equations in the rotor‟s dq0 reference frame electromagnetic torque-current in terms of flux linkages-three phase synchronous motor. State space models with flux linkages as variables.

Course Outcomes:

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

- Understand the behavior of DC motors and also model the different Dc motors.
- Apply the knowledge of reference frame theory for AC machines to model the induction and Synchronous machines.
- Evaluate the steady state and transient behaviour of induction and synchronous machines to Propose the suitability of drives for different industrial applications.
- Analyze the characteristics of different types of DC motors and 2-Phase induction machines using voltage and torque equations to differentiate the behaviour and to propose their applications in real world.

Text Books

1. Analysis of Electric Machinery and Drive Systems, 3rd Edition-Wiley-IEEE Press- Paul Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven Pekarek, Junr 2013.
2. Electric Motor Drives - Modeling, Analysis& control -R.Krishnan- Pearson Publications.

Reference Books:

1. Generalized theory of Electrical Machines -Fifth edition, Khanna Publishers P. S. Bimbhra, 2185.
2. Dynamic simulation of Electric machinery using MATLAB / Simulink –CheeMunOng- Prentice Hall, 2003.
3. Magneto electric devices transducers, transformers and machines-G. R. Slemon- Wiley in New York, London, 2166.

Subject Code	ANALYSIS OF POWER ELECTRONIC CONVERTERS	L	T	P	C
2042211101		3	0	0	3

Pre-Requisite:

Power Electronics.

Course Educational Objectives:

- To understand the control principle of ac to ac conversion with suitable power semi - conductor devices.
- To have the knowledge of ac to dc conversion and different ac to dc converter topologies.
- To understand the effect of operation of controlled rectifiers on p.f. and improvement of p.f. with PFC converters
- To acquire the knowledge on dc-ac converters and to know the different control techniques of dc-ac converters.
- To know multilevel inverter configuration to improve the quality of the inverter output voltage.

Overview of Switching Devices:

Power MOSFET, IGBT, GTO, GaN devices-static and dynamic characteristics, gate drive circuits for switching devices.

UNIT– II:

AC-DC converters:

Single phase fully controlled converters with RL load– Evaluation of input power factor and harmonic factor- Continuous and Discontinuous load current, Power factor improvements, Extinction angle control, symmetrical angle control, PWM control. Three Phase AC-DC Converters, fully controlled converters feeding RL load with continuous and discontinuous load current, Evaluation of input power factor and harmonic factor-three phase dual converters.

UNIT– III:

Power Factor Correction Converters:

Single-phase single stage boost power factor corrected rectifier, power circuit principle of operation, and steady state- analysis, three phase boost PFC converter

UNIT– IV:

PWM Inverters:

of operation-Voltage control of single phase inverters - sinusoidal PWM – modified PWM – phase displacement Control – Trapezoidal, staircase, stepped, harmonic injection and delta modulation. Voltage Control of Three-Phase Inverters- Sinusoidal PWM- 60^0PWM- Third Harmonic PWM- Space Vector Modulation- Comparison of PWM Techniques- Three phase current source inverters- Variable dc link inverter.

UNIT– V:

Multi level inverters: Introduction, Multilevel Concept, Types of Multilevel Inverters- Diode-Clamped Multilevel Inverter, Principle of Operation, Features of Diode-Clamped Inverter, Improved Diode-Clamped Inverter- Flying-Capacitors Multilevel Inverter- Principle of Operation, Features of Flying-Capacitors Inverter- Cascaded Multilevel Inverter- Principle of Operation- Features of Cascaded Inverter- Switching Device Currents-DC-Link Capacitor Voltage Balancing- Features of Multilevel Inverters- Comparisons of Multilevel Converters.

Text Books

1. Power Electronics: Converters, Applications, and Design- Ned Mohan, Tore M. Undeland, William P. Robbins, John Wiley& Sons, 2nd Edition, 2003.
2. Power Electronics-Md.H.Rashid –Pearson Education Third Edition- First IndianReprint-2008.

Course Outcomes:

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

- Examine the operation of phase controlled converters and AC voltage converters.
- Determine the requirements of power factor correction in converter circuits.
- Analyze the operation of 3-phase inverters with and without PWM techniques.
- Describe principles of operation and features of multilevel inverters.

Reference Books:

1. Power ElectronicsDaniel W. Hart - McGraw-Hill, 2011.
2. Elements of Power Electronics – Philip T. Krein, Oxford University press, 2014.
3. Converter Circuits – William Shepherd & Li Zhang-Yes Dee CRC Press, 2004.

Subject Code	MODERN CONTROL THEORY (ELECTIVE-I)	L	T	P	C
2042211150		3	0	0	3

Pre-requisite:

Control Systems, differential equations.

Course Educational Objectives:

- To facilitate the evolution of state variable approach for the analysis of control systems.
- To examine the importance of controllability and observability in modern control engineering.
- To enable students to analyze various types of nonlinearities & construction of trajectories using describing functions and phase plane analysis.
- To study the analysis of stability and instability of continuous time invariant system.

UNIT– 1

State Variable Analysis

The concept of state – State Equations for Dynamic systems– Solution of Linear Time Invariant Continuous-Time State Equations, State transition matrix and it‟s properties. Controllability and Observability of state model in Jordan Canonical form - Controllability and Observability Canonical forms of State model.

UNIT– 2

Design using state variable technique

Design of state feedback controller through pole placement technique-Necessary and sufficient condition-Ackermann‟s formula. Concept of observer-Design of full order state observer-reduced order observer.

UNIT– 3

Non Linear Systems

Classification of Nonlinearities- common physical nonlinearities– Characteristics of nonlinear systems - Singular Points –Linearization of nonlinear systems– Describing function – describing function analysis ofnonlinear systems- Stability analysis of Nonlinear systems through describing functions.

UNIT– 4

Stability Analysis

Stability in the sense of Lyapunov, Lyapunov‟s stability and Lyapunov‟s instability theorems – Stability Analysis of Linear Continuous time invariant systems by Lyapunov method – Generation of Lyapunov

functions – Variable gradient method – Krasooviski‟s method.

UNIT– 5

Introduction to Optimal Control

Minimization of functional of single function – Constrained minimization – Minimum principle – Control variable inequality constraints – Control and state variable inequality constraints – Euler Lagrangine equation.

Typical optimal control performance measures-optimal control based on Quadratic performance measures- Quadratic optimal regulator systems- State regulator problems –Output regulator problems, tracking problems; Riccati equation-Infinite time regulator problem-Reduce matrix Riccati equation-determination of optimal feedback gain matrix.

Course Outcomes:

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

- Understand the state variable approach's which are suitable for higher order systems.
- Analyze the concepts of controllability and observability.
- Examine the stability and instability problems in continuous time invariant systems, various non-linearities using phase plane analysis and descriptive functions and.
- Solve the optimal control problems for any continuous time invariant systems.

Text Books:

1. Modern Control Engineering – by K. Ogata, Prentice Hall of India, 3rd edition, 2198.
2. Automatic Control Systems by B.C. Kuo, Prentice Hall Publication.

Reference Books:

1. Modern Control System Theory – by M. Gopal, New Age International Publishers, 2nd edition,2196
2. Control Systems Engineering by I.J. Nagarath and M.Gopal, New Age International (P) Ltd.
3. Digital Control and State Variable Methods – by M. Gopal, Tata McGraw–Hill Companies, 1997.
4. Systems and Control by Stainslaw H. Zak , Oxford Press, 2003.
5. Optimal control theory: an Introduction by Donald E.Kirk by Dover publications.
6. Modern control systems, Richard C. Dorf and Robert H. Bishop, 11th Edition, Pearson Edu, India, 2009

Subject Code	Hybrid Electric Vehicles (ELECTIVE-I)	L	T	P	C
2042211151		3	0	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 vehicles and their control.

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 its constituents.

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 battery charging.

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 electric vehicles.
- Familiar with different motors used for hybrid electric vehicles.
- Understand the power converters used in hybrid electric vehicles
- Know different batteries and other energy storage systems.

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”, Elsevier 2008
2. Mi Chris, Masrur A., and Gao D.W., “ Hybrid Electric Vehicle: Principles and Applications with Practical Perspectives” 2215.

Subject Code	PROGRAMMABLE LOGIC CONTROLLERS & APPLICATIONS (ELECTIVE-I)	L	T	P	C
2042211152		3	0	0	3

Pre-requisite:

Knowledge on relay logic and digital electronics.

Course Educational Objectives:

- To have knowledge on PLC.
- To acquire the knowledge on programming of PLC.
- To understand different PLC registers and their description.
- To have knowledge on data handling functions of PLC.
- To know how to handle analog signal and converting of A/D in PLC.

UNIT– I:

PLCBasic :

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

UNIT– II:

PLC Programming:

Input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill press operation. Digital logic gates, programming in the Boolean algebra system, conversion examples. Ladder diagrams for process control: Ladder diagrams and sequence listings, ladder diagram construction and flow chart for spray process system.

UNIT– III:

PLC Registers:

Characteristics of Registers, module addressing, holding registers, input registers, output registers. PLC Functions: Timer functions and Industrial applications, counters, counter function industrial applications, Arithmetic functions, Number comparison functions, number conversion functions.

UNIT– IV:

Data Handling functions:

SKIP, Master control Relay, Jump, Move, FIFO, FAL, ONS, CLR and Sweep functions and

their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controlling oftwo axis and three axis Robots with PLC, Matrix functions.

UNIT– V:

Analog PLC operation:
Analog modules and systems, Analog signal processing, multi bit data processing, analog output application examples, PID principles, position indicator with PID control, PID modules, PID tuning, PID functions.

Text Books:

1. Programmable Logic Controllers – Principle and Applications by John W. Webb and Ronald A. Reiss, Fifth Edition, PHI
2. Programmable Logic Controllers – Programming Method and Applications by JR. Hackworth and F.D Hackworth Jr. – Pearson, 2004.

Course Outcomes: After completion of this course the students will be able to:

- Understand the PLCs and their I/O modules.
- Develop control algorithms to PLC using ladder logic etc.
- Manage PLC registers for effective utilization in different applications and also Handle data functions & control of two axis, their axis robots with PLC.
- Design PID controller with PLC.

Reference Books:

1. Introduction to Programmable Logic Controllers- Gary Dunning-Cengage Learning. Programmable Logic Controllers –W.Bolton-Elsevier publisher.

Subject Code	ARTIFICIAL INTELLIGENCE TECHNIQUES (ELECTIVE-II)	L	T	P	C
2042211153		3	0	0	3

Pre –requisite:

Fundamentals of Neural networks and Fuzzy Logic

Course Educational Objectives:

- To have knowledge on concept of neural network.
- To know different types of neural networks and training algorithms.
- To understand the concept of genetic algorithm and its application in optimization.
- To have the knowledge on fuzzy logic and design of fuzzy logic controllers.
- To know the applications of AI Techniques in electrical engineering.

UNIT– I:

Introduction

Artificial Neural Networks (ANN) – definition and fundamental concepts – Biological neural networks – Artificial neuron – activation functions – setting of weights – typical architectures – biases and thresholds – learning/training laws and algorithms. Perceptron – architectures, ADALINE and MADLINE – linear separability- XOR function

.

UNIT– II:

ANN Paradigms

ADALINE – feed forward networks – Back Propagation algorithm- number of hidden layers – gradient decent algorithm – Radial Basis Function (RBF) network. Kohonen‟sself organizing map (SOM), Learning Vector Quantization (LVQ) and its types – Functional Link Networks (FLN) – Bidirectional Associative Memory (BAM) – Hopfield Neural Network

UNIT– III:

Classical and Fuzzy Sets

Introduction to classical sets- properties, Operations and relations; Fuzzy sets, Membership, Operations, Properties, Fuzzy relations, Cardinalities, Membership functions.

UNIT– IV:

Fuzzy Logic Controller (FLC)

Fuzzy logic system components: Fuzzification, Inference engine (development of rule base and decision making system), Defuzzification to crisp sets- Defuzzification methods.

UNIT– V:

Application of AI Techniques

Speed control of DC motors using fuzzy logic –load flow studies using back propagation algorithm, single area and two area load frequency control using fuzzy logic.

Course Outcomes:

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

- Understand the concept of genetic algorithm and its application in optimization.
- Differentiate between Algorithmic based methods and knowledge based methods.
- Use appropriate AI framework for solving of power system problems.
- Design the fuzzy logic controllers for power engineering applications.

Text Books:

1. Introduction to Artificial Neural Systems - Jacek M. Zuarda, Jaico Publishing House, 2197.
2. Fuzzy logic with Fuzzy Applications – T.J Ross – McGraw Hill Inc, 2197.

Reference Books:

1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by S.Rajasekaran andG.A.VijayalakshmiPai – PHI Publication.
2. Modern power Electronics and AC Drives – B.K.Bose -Prentice Hall, 2002
3. Genetic Algorithms- David E Goldberg. Pearson publications.
4. Introduction to Neural Networks using MATLAB 6.0 by S N Sivanandam, SSumathi, S N Deepa TMGH
5. Introduction to Fuzzy Logic using MATLAB by S N Sivanandam, SSumathi,S N Deepa Springer, 2007.

Subject Code	RENEWABLE ENERGYTECHNOLOGIES (ELECTIVE-II)	L	T	P	C
2042211154		3	0	0	3

Pre requisite:

UG power Electronics.

Course Educational Objectives:

- To learn technical challenges in renewable energy.
- To learn basics of wind energy conversion & PV power generation.
- To analyze the of fuel cell system.

UNIT– I:

Introduction: Renewable Sources of Energy; Distributed Generation; Renewable Energy Economics - Calculation of Electricity Generation Costs; Demand-Side Management Options; Supply-Side Management Options; Control of renewable energy based power Systems

UNIT– 2

Induction Generators: Principles of Operation; Representation of Steady-State Operation; Power and Losses Generated - Self-Excited Induction Generator; Magnetizing Curves and Self-Excitation - Mathematical Description of the Self-Excitation Process; Interconnected and Stand-alone operation - Speed and Voltage Control.

UNIT– 3

Wind Power Plants: Site Selection; Evaluation of Wind Intensity; Topography; Purpose of the Energy Generation- General Classification of Wind Turbines; Rotor Turbines; Multiple-Blade Turbines; Drag Turbines; Lifting Turbines - Generators and Speed Control Used in Wind Power Energy; Analysis of Small wind energy conversion system.

UNIT– 4

Photovoltaic Power Plants: Solar Energy; Generation of Electricity by Photovoltaic Effect; Dependence of a PV Cell on Temperature and irradiance input-output Characteristics - Equivalent Models and Parameters for Photovoltaic Panels; MPPT schemes: P&O,INC, effect of partial shaded condition. Applications of Photovoltaic Solar Energy-Economical Analysis of Solar Energy

UNIT– 5

Fuel Cells: The Fuel Cell; Low- and High-Temperature Fuel Cells; Commercial and Manufacturing Issues - Constructional Features of Proton Exchange-Membrane Fuel Cells; Reformers;

Electrolyzer Systems; Advantages and Disadvantages of Fuel Cells - Fuel Cell Equivalent Circuit; Practical Determination of the Equivalent Model Parameters; Aspects of Hydrogen for storage.

Course Outcomes:

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

- Understand various general aspects of renewable energy systems.
- Analyze and design induction generator for power generation from wind.
- Design MPPT controller for solar power utilization.
- Utilize fuel cell systems for power generation.

Text Books:

1. Felix A. Farret, M. Godoy Simo` es, Integration of Alternative Sources of Energy, John Wiley & Sons, 2006.
2. Remus Teodorescu, Marco Liserre, Pedro Rodríguez, Grid Converters for Photovoltaic and Wind Power Systems, John Wiley & Sons, 2011.

Reference Books:

1. Gilbert M. Masters, Renewable and Efficient Electric Power Systems, John Wiley & Sons, 2004

Subject Code	POWER ELECTRONIC APPLICATIONS TO RENEWABLE ENERGY (ELECTIVE-II)	L	T	P	C
2042211155		3	0	0	3

Pre-requisite:

knowledge on power electronics and renewable energy engineering

Course Educational Objectives:

- To learn various schemes of power electronic applications.
- To learn the operation and analysis of different power converters.
- To learn the control of renewable systems with power electronic devices.

UNIT – 1

Introduction to renewable sources:
World energy scenario, Wind, solar, hydro, geothermal, availability and power extraction. Introduction to solar, wind, hydro, geothermal, tidal energy.

UNIT – 2

Electrical Machines for Renewable Energy Conversion: Review of reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.

UNIT – 3

DC-DC converters for solar PV: buck/boost/buck-boost /flyback /forward/cuk, bidirectional converters, Interleaved and multi-input converters.

UNIT – 4

Grid connected Inverters: 1ph, 3ph inverters with & w/o x'mer, Heric, H6, Multilevel Neutral point clamp, Modular multilevel, CSI; Control schemes: unipolar, bipolar, PLL and synchronization, power balancing / bypass, Parallel power processing; Grid connection issues: leakage current, Islanding, harmonics, active/reactive power feeding, unbalance.

UNIT – 5

Synchronous generator with back to back controlled/ uncontrolled converter: Doubly fed induction generator with rotor side converter topologies; permanent magnet based generators. Battery: Types, charging discharging. Introduction to AC and DC microgrids.

Course Outcomes:

1. Explain about various non conventional energy sources
2. Describe different machines used in renewable energy systems and also the control of synchronous generator with converters
3. Analyse different DC-DC converters
4. Explain control schemes for grid connected inverters

Text Books:

1. Sudipta Chakraborty, Marcelo G. Simes, and William E. Kramer. Power Electronics for Renewable and Distributed Energy Systems: A Sourcebook of Topologies, Control and Integration. Springer Science & Business, 2013.
2. Nicola Femia, Giovanni Petrone, Giovanni Spagnuolo, Massimo Vitelli, Power Electronics and control for maximum Energy Harvesting in Photovoltaic Systems, CRC Press, 2013.
3. Chetan Singh Solanki, Solar Photovoltaics: fundamentals, Technologies and Applications, Prentice Hall of India, 2011.
4. Rashid .M. H "Power Electronics Hand book", Academic press, 2001.
5. Rai. G.D, "Non conventional energy sources", Khanna publishes, 1993.

Subject Code	RESEARCH METHODOLOGY AND IPR	L	T	P	C
2000211100		2	0	0	2

UNIT-I:

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT-II:

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT-III:

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT-IV:

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT-V:

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students""

2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"

4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd,2007.

5. Mayall, "Industrial Design", McGraw Hill, 1992.

Subject Code	POWER ELECTRONICS SIMULATION LABORATORY	L	T	P	C
2042211110		0	0	4	2

Course Educational Objectives:

To analyze the operation of DC-DC converters, AC-DC converters and DC-AC converters by simulation.

Any 10 of the following experiments are to be conducted**.**

List of Experiments:

1. Simulation of Buck converter using small signal model.
2. Simulation of Boost converter using small signal model.
3. Simulation of single phase half bridge inverter.
4. Simulation of single-phase full bridge inverter using Uni-polar & Bi-polar PWM techniques.
5. Simulation of three phase inverter using sine-triangle PWM.
6. Simulation of three phase inverter using space vector PWM.
7. Simulation of three level three phase NPC inverter.
8. Study of neutral point voltage floating in NPC three level inverter
9. Simulation of 3-level flying capacitor inverter & evaluation of capacitor voltage balanced methods.
10. Simulation of single phase AC voltage regulator.
11. Simulation of three phase AC voltage regulator.
12. Comparison of harmonic profile of two level& three level inverter (FFT analysis).
13. Simulation of 5-level inverter using carrier based PWM methods.
14. Simulation of three phase full converter with RL & RLE loads.
15. Simulation of three-phase dual converter.

COURSE OUTCOMES: After completion of this course the students will be able to:

- Examine power semiconductor device properties via simulation.
- Analyze and implementing the speed controlling techniques for AC machines in simulation.
- Explain the operation of various power electronic converters in simulation.
- Implement the PWM techniques in simulation.

Subject Code	POWER CONVERTERS LABORATORY	L	T	P	C
2042211111		0	0	4	2

Course Educational Objectives:

To study and understand the different converters and inverters for single and three phase loads.

Any 10 of the following experiments are to be conducted.

List of experiments

1. Study of DC-DC non-isolated converters such as Buck & Boost converter.
2. Study of DC-DC Buck-Boost and Cuk converters.
3. Study of 1-ϕ dual converter.
4. Determination of input p.f. and harmonic factor for 1-ϕsemi- converter and 1-ϕ full-converter (Inductive load)
5. Study of p.f. improvement in 1-ϕ full-converter with symmetric and extinction angle control.
6. Study of 1-ϕ square wave and sinusoidal PWM inverter.
7. Study of 3-ϕ inverter with $120^o$and 180^omode of operation.
8. Study of 3-ϕ sinusoidal PWM inverter.
9. Study of 3-level NPC inverter.
10. Study of 5-level cascaded H-bridge inverter.
11. Determination of input p.f. and harmonic factor for 3-ϕ full converter (Inductive load).
12. Determination of input p.f. and harmonic factor for 3-ϕ semi converter (Inductive load).
13. Study the characteristics of IGBT, MOSFET & GTO‟s.
14. Design of gate drive circuits for IGBT & MOSFET‟s.

Course Outcomes: Students are able to

- Determine the power factor and harmonic factor for various converters.
- Design of gate drive circuits for IGBT & MOSFET‟s.
- Explain the operation of various power electronic inverters.
- Implement the converter and inverters in real time applications.

Subject Code	AUDIT COURSE-1	L	T	P	C
2000211130		2	0	0	0

M.Tech

I Year – II Semester

(Detailed Syllabus)

Subject Code	SWITCHED MODE POWER CONVERSION	L	T	P	C
2042211200		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-DC converters.
- To understand the basic operation of resonant converters.
- To understand the control operation of isolated DC-DC converters.
- To understand the control schemes of DC-DC converters and designing of magnetic components.
- To understand the modeling and control design of switch mode conversion based on linearization.
- To understand how to analyze the switch mode converters using small-signal analysis.

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-ideal components.

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 mode converters.
- Design of non-isolated and isolated switch mode converters.
- Understand the operation and control of resonant converters.
- Create the switch mode converters based on linearized models.

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, Wiley publications
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
2042211201		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 SRM drives.

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 BLDC motor.

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 drive systems.
- Design controllers and converters for induction motor, PMSM and BLDC drives.
- Select and implement proper control techniques for induction motor and PMSM for specific applications.
- Analyze the control techniques and converters for SRM drives.

Text Books:

1. Bose B. K., "Power Electronics and Variable Frequency Drives', IEEE Press, Standard Publisher Distributors. 2001.
2. Krishnan R., "Electric Motor Drives – Modeling, Analysis and Control", Prentice Hall of India Private Limited.

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
2042211250		4+1	0	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 conversion technologies.
- To understand the basics of real & reactive power control with renewable generators.
- To learn the principles of standalone and grid connected systems.

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 storage devices
- Recognize, model and simulate different renewable energy sources
- Analyze, model and simulate basic control strategies required for grid connection
- Implement a complete system for standalone/grid connected system

Text books:

1. Ali Keyhani Mohammad Marwali and Min Dai, "Integration and Control of Renewable Energy in Electric Power System" John Wiley publishing company
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", Wiley 2011.

Subject Code	ELECTRIC VEHICLE DESIGN AND DEVELOPMENT (ELECTIVE -III)	L	T	P	C
2042211251		4+1		0	3

Course Overview: Study the different architectures of HEV, Modeling and Simulation of the Elective vehicles

Course Objectives: 1. Understand the Different Architectures of HEV's

2. Understand the power flow HEV Systems

3. Design the Chassis for EV

4. Design the Different EV' Systems

UNIT-I

Basic Architecture of Hybrid Drive Trains and Analysis of Series Drive Train Hybrid Electric Vehicles (HEV): The gasoline ICE and battery, Diesel ICE and battery, Battery and Fuel Cell , Battery and flywheel . Energy use in conventional vehicles, Energy saving potential of hybrid drive trains: Various HEV configurations and their operation modes: Series configuration, Parallel configuration, Series-parallel configuration

UNIT-II

Power Flow in HEVs Part-I: Power Flow Control: Optimal ICE operating point, Optimal ICE operating line, Safe battery voltage. Power Flow Control in Series Hybrid: Mode 1, normal driving or acceleration, Mode 2, light load, Mode 3, braking or deceleration, Mode 4, vehicle at stop. Power Flow Control in Parallel Hybrid: Mode 1, start up, Mode 2, normal driving, Mode 3, braking or deceleration, Mode 4, light load.

UNIT-III

Power Flow in HEVs Part-II: Power Flow Control in Series-Parallel Hybrid: Mode 1: At startup, Mode 2: During full throttle acceleration, Mode 3: During normal driving, Mode 4: During normal braking or deceleration, Mode 5: To charge the battery during driving, Mode 6: When the vehicle is at standstill.

UNIT-IV

Design of Electric Motors and Chassis for EV's: Introduction to Modeling of motors, Modeling of PMMC motor, Modeling BLDC Motor, Modeling of SRM Motors, Numericals. EV Chassis requirement, Chassis Layout, Chassis strength, Rigidity, Crush Resistance, Design Stability, suspension for EV, Example of Chassis used for battery and Hybrid Electric Vehicle and Fuel Cell Electric Vehicle ,Soft ware used to design the Chassis of the EV .

UNIT-V

Modeling and Simulation of EV : Introduction to EV modeling, Tractive affects Modeling, Acceleration Performance parameters, Modeling of EV Scooter , Modeling of Small Car, Modeling of EV range: Range modeling of the Battery –EV, , Constant Velocity Range, Range Modeling of Fuel Cell, Range Modeling of the Hybrid EV , Simulation of EV using Matlab.

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

1. Understand the different Architecture of HEV.
2. Analysis of PowerFlow controlin Series and Parallel HEV Drive.

3. Design of Chassis and selection of Motor.

4. Design of Electric Vehicle of HEV systems

Text Books:

1. "Modern Electric, Hybrid Electric and Fuel Cell Vehicles" , Fundamentals, Theory and Design, M. Ehsani, CRC Press, 2005
2. " Electric Vehicles " , I. Husain CRC Press, 2003 2nd ed.
3. " Vehicle Propulsion Systems: Introduction to Modeling and Optimization ", L. Guzzella and A. Sciarretta Springer, 2007 fifth edition

Reference Books:

1. " Automotive Transmissions: Fundamentals, Selection, Design and Application" , G. Lechner and H. Naunheimer Springer, 2199 Third edition

Subject Code	SPECIAL ELECTRICALMACHINES SYSTEMS (ELECTIVE-III)	L	T	P	C
2042211252		4+1	0	0	3

Prerequisites: Concepts of Electrical machines.

Course Educational Objectives:

- To know the concepts of special types of electrical machines.
- To understand the different control schemes for PMSM.
- To learn about the different sensor used in brushless DC motors.
- To draw the characteristics of servo motors, tacho meters and SRM.
- To understand the concepts of linear induction motor.

UNIT I: Stepper Motors

Constructional features, Principle of operation, Modes of excitation torque production in Variable Reluctance (VR) stepping motor, Dynamic characteristics, Drive systems and circuit for open loop control, closed loop control of stepping motor.

UNIT II: Permanent Magnet Synchronous Motors (PMSM) and Switched Reluctance Motors (SRM)

PMSM: Power electronic controllers, Torque speed characteristics, Self control, Vector control, Current control

SRM: Constructional features, Principle of operation. Torque equation, Characteristics, Control Techniques, Drive concept.

UNIT III: Permanent Magnet Brushless DC Motors

Concept of electronic commutation, Hall sensors, Optical sensors, back emf detection, Multiphase Brushless motor, Square wave permanent magnet brushless motor drives, Torque and emf equation, Torque-speed characteristics, Speed control by microcontroller.

UNIT IV: Servomotors and AC Tachometers

Servomotor – Types – Constructional features – Principle of Operation – Characteristics - Control – Microprocessor based applications.

AC Tachometers: Permanent magnet ac tachometer, AC induction tachometer, Schematic diagrams, Operating principle.

UNIT V: Linear Motors

Linear Motors: Linear Induction Motor (LIM) Classification – Construction – Principle of operation – Concept of Current sheet –Goodness factor – DC Linear Motor (DCLM) types – Circuit equation – DCLM control-applications.

Course Outcomes:

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

- Apply the knowledge of sensors used in PMSM which can be used for controllers and synchronous machines.
- Analyze the characteristics of different types of PM type brushless DC motors and the different controllers used in electrical machines to propose the suitability of drives for different industrial applications.
- Classify the types of DC linear motors and apply the knowledge of controllers to propose their application in real world.
- Evaluate the steady state and transient behavior linear induction motors.

References Books:

1. Miller, T.J.E. "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1989.
2. Kenjo, T, "Stepping Motors and their Microprocessor control", Clarendon Press, Oxford, 1989.
3. Naser A and Boldea I, "Linear Electric Motors: Theory, Design and Practical Application", Prentice Hall Inc., New Jersey,1987
4. Special Electrical Machines-K.Venkataratnam- University press
5. Floyd E Saner,"Servo Motor Applications", Pittman USA, 1993.
6. Kenjo, T and Naganori, S "Permanent Magnet and brushless DC motors", Clarendon Press, Oxford, 1989.
7. Generalized Theory of Electrical Machines – P.S.Bimbra-Khanna publications-5th edition-1995

Subject Code	ADVANCED DIGITAL SIGNAL PROCESSING (ELECTIVE-IV)	L	T	P	C
2042211253		4+1	0	0	3

Pre-requisite: Signals & Systems

Course Educational Objectives:

- To understand the various digital filter structures
- To design the FIR and IIR Filters
- To know the importance of FFT algorithm for computation of Discrete Fourier Transform
- To analyze the finite word length effects on various filters
- To learn the concepts of power spectrum estimation of periodic and non-periodic signals

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

- Design digital filters with different techniques and also describe structure of digital filters.
- Understand the implementation aspects of signal processing algorithms.
- Know the effect of finite word length in signal processing.
- Analyze different power spectrum estimation techniques.

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- 9th reprint

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 and Design-Auntonian-TMH.

Subject Code	APPLICATIONS OF POWER CONVERTERS (ELECTIVE-IV)	L	T	P	C
2042211254		4+1	0	0	3

Pre-requisites: Analysis of Power Electronic Converters

Course Educational Objectives:

- To understand the inverters for induction heating applications
- To understand the power converters for different industrial applications
- To understand modeling of high voltage power supplies using the power converters for radar and space applications
- To understand modeling of low voltage and high current power supplies using the power converters for microprocessors and computer loads
- To understand the applications of DC-DC converters

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 application requirements.
- Identify suitable power converter from the available configurations.
- Develop improved power converters for any stringent application requirements.
- Improvise the existing control techniques to suit the application. Design of Bi-directional converters for charge/discharge applications

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. Current literature

Subject Code	MICROCONTROLLERS (ELECTIVE-IV)	L	T	P	C
2042211255		4+1	0	0	3

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

Course Educational Objectives:

- To learn about microcontrollers architecture.
- To learn about DSP architecture and assembly programming for DSP processors.
- To learn about basics of FPGA controllers.

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, Software Tools.

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- case study.

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

- Understand about DSP architecture and assembly programming for DSP processors.
- Design the interfacing circuits for input and output to PIC micro controllers and DSP processors.
- Create ALP for DSP processing devices.
- Design PWM controller for power electronic circuits using FPGA.

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, Thomson publishers,2005.
2. Microprocessor and Microcontrollers by Prof C.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
2042211210		--	0	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 chopper converter.
3. Simulation of induction motor modes using d-q model.
4. Simulate the speed control of induction motor by using V/f control.
5. Simulate the BLDC motor and observe the speed transients.
6. Simulate speed control of induction motor by using vector control.
7. Compare the transient performance of induction motor controlled by v/f control & vector control methods.
8. Simulate PMSM motor by using d-q model.
9. Simulate the multi-level inverter fed induction motor drive.
10. Simulate the re-generative braking of inverter fed induction motor.
11. Study of PWM controlled inverter fed PMSM drive.
12. Evaluation of switching frequency effect on electric drive

Course Outcomes: The student can able to

- Implement the PWM techniques in simulation for various machines.
- Analyze the performance of different electrical machines and drives.
- Examine and simulation the various types of machines.
- Evaluation the effect of switching frequency on electric drives.

Subject Code	ELECTRIC DRIVES LABORATORY	L	T	P	C
2042211211		--	0	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 full converter.
2. Study of chopper controlled separately excited DC drive.
3. Study of armature controlled separately excited DC drive with 3-ϕ full converter
4. Study of dynamic braking of DC drives.
5. Study of regenerative braking of DC drive.
6. Study of performance characteristics of a 3-ϕ induction motor using V/f control.
7. Vector control based speed control of induction motor.
8. Study of direct torque control of induction motor.
9. Speed control of PMSM drive with 3-ϕ inverter.
10. Speed control of BLDC drive with 3-ϕ inverter.
11. Speed control of switched reluctance motor drive.

Course Outcome: The student can able to

- Understand the performance of DC & AC drives.
- Analyze the performance of DC drives and AC drives.
- Examine the Speed control of PMSM drive, BLDC drive and induction motor drive.
- Explain the dynamic braking and regenerative braking of DC drive.

Subject code	AUDIT COURSE-2	L	T	P	C
2000211230		3	0	0	0

Subject Code	MINI PROJECT WITH SEMINAR	L	T	P	C
2042211270		--		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- I semester
(Detailed Syllabus)

Course Code	DISTRIBUTED GENERATION AND MICRO GRIDS (PROGRAM ELECTIVE - V)	L	T	P	C
2042212150		3	1	0	3

Course Overview:

To impart knowledge about distributed generation technologies, their interconnection in grid, to understand relevance of power electronics in DG, to understand concept of microgrid.

Course Objectives:

The objective of the course is

- To understand distributed generation concepts and interconnection issues of DGs
- To understand operation of various types of DG systems
- To study power electronics application to DG systems
- To study and understand operation and control of Microgrids
- To understand reliability and market issues of microgrids

UNIT –I

INTERCONNECTION ISSUES AND STANDARDS OF DGs: Concept of distributed generations (DG) or distributed energy resources (DERs), topologies, selection of source, dependence on storage facilities, regulatory standards/ framework, standards for interconnecting DGs to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Grid code and Islanding & non-islanding system

UNIT –II

OPERATIONAL FEATURES OF GRID CONNECTED DG SYTEMS: Grid interconnection issues for grid connected operation of various types of DG systems. Constraints on operational parameters: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Reliability, stability and power quality issues involved in grid connected operation of various DGs.

UNIT –III

POWER ELECTRONICS AND DG SYSTEMS: Relevance of power electronics in DG applications, Power quality requirements and source switching using SCR based static switches, Distribution system loading, line drop model, series voltage regulators and on line tap changers, power converter topologies, model and specifications for DG applications, issues filter designs, harmonic reduction, Control of DG inverters, phase locked loops, current control and DC voltage control for standalone and grid parallel operations. Protection of converters, power quality implication

UNIT –IV

OPERATION, CONTROL AND MODELLING OF MICROGRID: Concept and definition of microgrid, review of sources of microgrids, typical structure and configuration of a microgrid, microgrid implementation in Indian and international scenario, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids, communication infrastructure, modes of operation and control of microgrid: grid connected and islanded mode operation, anti-islanding schemes. Control techniques for voltage, frequency, active and reactive power control of microgrid system

UNIT –V

INTRODUCTION TO RELIABILITY AND MARKET ISSUES OF MICROGRID: Power quality issue, THD reduction techniques, protection and stability analysis of microgrid, regulatory standards, introduction to microgrid reliability. Features of microgrid economy and market. LVDC Microgrid.

Course Outcomes:

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

- To explain topologies and interconnection issues of DGs
- To explain features of grid connected DG systems
- To design power converter topologies for DG applications
- To implement the control of MG and understand market issues of Microgrid

Text Books:

1. Renewable Energy- Power for a sustainable future, third edition, Edited by Godfrey Boyle,Oxford University Press, 2013.
2. AmirnaserYezdani, and Reza Iravani, "Voltage Source Converters in Power Systems:Modeling, Control and Applications", IEEE John Wiley Publications, 2009.
3. DorinNeacsu, "Power Switching Converters: Medium and High Power", CRC Press, Taylor& Francis, 2006. New Delhi.
4. Microgrids: Architectures and Control, Nikos Hatziargyriou (Editor), ISBN: 978-1-118-72068-4, 340 pages, December 2013, Wiley-IEEE Press
5. Microgrids and Active Distribution Networks, S. Chowdhury, S.P. Chowdhury and P.Crossley, The Institution of Engineering and Technology, London, U.K, 2009.

Course Code	SMART GRID TECHNOLOGIES (PROGRAM ELECTIVE–V)	L	T	P	C
2042212151		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 in hybrid electric vehicles etc.
- 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 Smart Grid.

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:

- Explain about the micro grids and distributed generation systems.
- Develop concepts of smart grid technologies in hybrid electrical vehicles etc.
- Understand smart substations, feeder automation, GIS, smart grids, smart grid policies and developments in smart grids.
- Analyze the effect of power quality in smart grid and to understand latest developments in 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 Blackwell21
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
2042212152		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 simulation software.
- Choose the required numerical solver to be used for analysis.
- Debug the convergence problems occurring during simulation.
- Investigate different switching function technique and their properties of the switching function

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
2042212161		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.

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

- Gain knowledge on different renewable energy sources and storage devices
- Recognize, model and simulate different renewable energy sources
- Analyze, model and simulate basic control strategies required for grid connection
- Implement a complete system for standalone/grid connected system

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	INTRODUCTION TO ELECTRIC VEHICLES (OPEN ELECTIVE)	L	T	P	C
2042212162		3	1	0	3

Course Overview: This course deals with the fundamental concepts, principles, analysis and design of electric vehicles. It also discusses various aspects of electric and hybrid electric drive trains, their configuration, types of electric machines, etc.

Course Objectives:

The objective of the course is to understand general aspects of Electric and Hybrid Electric Vehicles.

- To understand the fundamentals of electric vehicles
- To understand the concept of vehicle fundamentals and hybrid electric vehicles
- To understand operation of different motors used for electric vehicles
- To understand the Indian and global scenario of electric vehicles

UNIT-I

Introduction to Vehicles: History, Components of ICE vehicle and Electric Vehicle, General Layout of EV, EV classification Comparison with Internal combustion Engine: Technology, Advantages & Disadvantages of EV, Overview of Tesla car.

UNIT-II

Hybrid Electric Vehicles: History, Components of Hybrid Electric Vehicle, General Layout of Hybrid EV, Comparison with Electric Vehicles, Advantages & Disadvantages of Hybrid EV, Overview of Toyota prius.

UNIT-III

Vehicle Fundamentals: Vehicle resistance, Types: Rolling Resistance, grading resistance, Aerodynamic drag vehicle performance, Calculating the Acceleration Force, maximum speed, Finding the Total Tractive Effort, Torque Required on The Drive Wheel, Transmission: Differential, clutch &gear box, Braking performance.

UNIT-IV

Motors for Electric Vehicles: Different motors used in electric vehicle, Principle and working of DC motor,DC motor speed control and braking methods for EVs, Induction motor speed control and braking methods for EVs, BLDC motor speed control and braking methods for EVs, Permeant Magnet motor speed control and braking methods for EVs.

UNIT-V

Indian and Global Scenario: Technology Scenario, Market Scenario, Policies and Regulations, Payback and commercial model, Payback and commercial model, Polices in India

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

1. Explain thefundamentals of electric vehicles.
2. Discuss the concept of vehicle fundamentals and hybrid electric vehicles.
3. Explain the operation of different motors used for electric vehicles.
4. Discuss the Indian and world electric vehiclescenarios

Text Books:

1. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2003.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design', CRC Press, 2004.

3. James Larminie, John Lowry, “Electric Vehicle Technology Explained”, Wiley, 2003.
4. NPTEL Web Course Material on ‘Hybrid and Electric Vehicles”.

Reference Books:

1. Gianfranco, “Electric and Hybrid Vehicles: Power Sources, Models, Sustainability, Infrastructure and The Market”, Pistoia Consultant, Rome, Italy, 2010.
2. Chris MI, M. Abul and David Wenzhong Gao, “Hybrid Electrical Vehicle Principles and Application with Practical Perspectives”, John Wiley & Sons Ltd., 2011.
3. John M. Miller, “Propulsion System for Hybrid Vehicle”, 2nd Edn.
4. Jack Erjavec and Jeff Arias, “Hybrid, Electric and Fuel Cell Vehicles”, Cengage Learning, 2012.
5. SerefSoylu “Electric Vehicles - The Benefits and Barriers”,InTechPublishers, Croatia, 2011.
6. Jack Erjavec and Jeff Arias, “Alternative Fuel Technology – Electric, Hybrid and Fuel Cell Vehicles”, Cengage Learning Pvt. Ltd., New Delhi, 2007
7. Seth Leitman, “Build Your Own Electric Vehicle”, McGraw hill, New York, USA 2013.

Course Code	PROGRAMMABLE LOGIC CONTROLLER (OPEN ELECTIVE)	L	T	P	C
2042212163		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.

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 – PID controller.

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.
- Manage PLCregistersforeffectiveutilizationindifferentapplications.
- Design HardwareconfigurationanddeveloplogicfordifferentIndustrialApplications.

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

AUDIT 1 and 2: SOFT SKILLS

Course objectives:

Students will be able to:

Understand that how to improve your writing skills and level of readability
Learn about what to write in each section

Understand the skills needed when writing a Title Ensure the good quality of paper at very first- time submission

Syllabus

Units	CONTENTS	Hours
1	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	4
2	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	4
3	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	4
4	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	4
5	skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	4
6	useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	4

Suggested Studies:

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

UDIT 1 and 2: DISASTER MANAGEMENT

Course Objectives: -Students will be able to:

learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.

critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

Syllabus

Units	CONTENTS	Hours
1	**Introduction** Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.	4
2	**Repercussions Of Disasters And Hazards**: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man- made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.	4
3	**Disaster Prone Areas In India** Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics	4
4	**Disaster Preparedness And Management** Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.	4
5	**Risk Assessment** Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People"s Participation In Risk Assessment. Strategies for Survival.	4
6	**Disaster Mitigation** Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.	4

Suggested Readings:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies ""New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

AUDIT 1 and 2: POLLUTION CONTROL, MONITORING AND MANAGEMENT

Course Objectives: students will be able to

1. Learn the effects of Air Pollution and different control methods.
2. Learn the effects of water Pollution and different control methods.
3. Learn the effects of soil Pollution and different control methods.

Syllabus

Unit	Content	Hours
1	**Air Pollution-I** Effects of Air Pollution on: (a) Physical properties of the Atmosphere (b) Economic materials and structures (c) Indoor Air quality and (d) Vegetation and Human health.	4
2	**Air Pollution-II** Control methods for: (a) Particulates (b) Oxides of Sulfur (c) Oxides of Nitrogen and (d) Hydrocarbons. Air quality standards, Monitoring and management of Air Pollution.	4
3	**Water Pollution** Water quality monitoring, River pollution-A case study of River Ganges, Effects of water pollutants on Human health, Ground water pollution, Effect of wastewater on environment, Water pollution control, water and wastewater treatment. Marine oil pollution and its impacts.	4
4	**Soil Pollution** Soil Pollution-Sources and Effects, Soil erosion-Control methods, Soil Acidification, Monitoring and Control of Soil Pollution, Municipal Solid waste and Hazardous wastes, Problems associated with MSW and Hazardous wastes, Analysis and Management. Hazardous wastes rules, 1989.	4
5	**Monitoring and Management** Environmental monitoring-Purpose of monitoring, Types of monitoring, Monitoring and Management of Noise pollution, Thermal pollution, Radio active pollution.	4

Course Output

Students will be able to

1. Understand the the effects of air, water and soil pollutions.
2. Prevent the pollution control using the different control methods.
3. Explain the environmental monitoring-purpose of monitoring, types of monitoring.
4. Monitor and Manage the Noise pollution, Thermal pollution, Radio active pollution.

Books for References:

1. Air Pollution, Arthur C. Stern, Vol. I-IV, Academic Press, INC. New York.
2. Principles of water quality control, T. H. Y. Tebbutt, Pergmon Press, New York.
3. Air Pollution, H. C. Perkins, Mc Graw Hill series, New Delhi.
4. The Nature and Properties of Soil, Brady.
5. Analysis of water and wastewater, APHA publication

AUDIT 1 and 2: VALUE EDUCATION

Course Objectives

Students will be able to

1.Understand value of education and self- development
2.Imbibe good values in students
3. Let the should know about the importance of character

Syllabus

Unit	Content	Hours
1	• Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. • Moral and non- moral valuation. Standards and principles. • Value judgements	4
2	• Importance of cultivation of values. • Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. • Honesty, Humanity. Power of faith, National Unity. • Patriotism.Love for nature ,Discipline	6
3	• Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. • Punctuality, Love and Kindness. • Avoid fault Thinking. • Free from anger, Dignity of labour. • Universal brotherhood and religious tolerance. • True friendship. • Happiness Vs suffering, love for truth. • Aware of self-destructive habits. • Association and Cooperation. • Doing best for saving nature	6
4	• Character and Competence –Holy books vs Blind faith. • Self-management and Good health. • Science of reincarnation. • Equality, Nonviolence ,Humility, Role of Women. • All religions and same message. • Mind your Mind, Self-control. • Honesty, Studying effectively	6

Suggested reading

1 Chakroborty, S.K. ″Values and Ethics for organizations Theory and practice″, Oxford University Press, New Delhi

Course outcomes

Students will be able to 1.Knowledge of self-development
2.Learn the importance of Human values 3.Developing the overall personality

AUDIT 1 and 2: CONSTITUTION OF INDIA

Course Objectives:

Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals" constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Syllabus

Units	Content	Hours
1	•**History of Making of the Indian Constitution:** History Drafting Committee, (Composition & Working)	4
2	•**Philosophy of the Indian Constitution:** Preamble Salient Features	4
3	**Contours of Constitutional Rights & Duties:** Fundamental Rights Right to Equality Right to Freedom Right against Exploitation Right to Freedom of Religion Cultural and Educational Rights Right to Constitutional Remedies Directive Principles of State Policy Fundamental Duties.	4

4	**Organs of Governance:** Parliament Composition Qualifications and Disqualifications Powers and Functions Executive President Governor Council of Ministers Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions	4
5	**Local Administration:** District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CE of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy	O
6	**Election Commission:** Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.	4

Suggested reading

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes:

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

AUDIT 1 and 2: ISSUES AND PROBLEMS OF WOMEN IN INDIA

Course Objectives:

Students will be able to:

1. study the different isuuess related to gender diffrence and problems of women in india.
2. Identify the issues of the rights of sexual minorities and transgender - Article 377 and beyond.
3. Explain the Concept of engendering - Strategic Gender Needs - Practical Gender Needs.

Syllabus

Units	Content	Hours
1	**Gender Division Of Labour** Concept of work – productive and reproductive - Invisibility of Women's work factors affecting and promoting women's entry into the market - Women in organized and unorganized sector - Feminization of poverty	3
2	**Reproductive Health** Socio-economic determinants of Women's Health, Menarche - Menstruation and Menstrual hygiene – menopause - Ailments related to pregnancy - Anemia and nutritional deficiency - Causes for Female Infanticide Premarital Sexuality – Abortion - issues and Gender Dimensions of Infertility - Contraception Prospects for improvement in reproductive health.	4
3	**Women In Situations Of Conflict** Religious fundamentalism - communalism and oppressed women in the Indian context Women and militant movements - Restrictions on rights of women - Code of conduct ant nation of honor and honor killings from religious and caste perspectives - Women in peace movement.	4
4	**Issues Related To Third Gender** Issues of the rights of sexual minorities and transgender - Article 377 and beyond	2
5	**Engendering Social – Economic – Cultural - And Political Contexts** Concept of engendering - Strategic Gender Needs - Practical Gender Needs – Gender Budgeting– Gender Auditing – Gender sensitive approaches to development.	3

Course Outcomes:

Students will be able to:

1. Understand the rights of sexual minorities and transgender -about Article 377.
2. Explain the concept of engendering - Strategic Gender Needs - Practical Gender Needs – Gender Budgeting– Gender Auditing – Gender sensitive approaches to development.
3. Discuss the different isuuess related to gender diffrence and problems of women in india.

Reference:

1. Bharathi Ray, (Ed)., Women of India: Colonial and post colonial periods of History of Sciences and Philosphy in India Civilization, Vol, IX part 3, Sage, New Delhi, 2005.
2. Kamal K.Misra, Janet Huber Lowry, (Ed)., recent Studies on Indian Women, Rawat Pub. Jaipur, 2007.
3. Malini Bhattacharya (Ed).m, Women and Globalization, Tulika Books in Association of School of Women‟s Studies, Jadapur University, New Delhi, 2005.
4. Thomas Sebastian, Globalization and Uneven Development – Neocolononialism, Multi National Corporations, Space and Society, Rawat Publishers, Jaipur

AUDIT 1 and 2: HUMAN VALUES & PROFESSIONAL ETHICS

Course Objectives

1. To create an awareness on Engineering Ethics and Human Values.
2. To instill Moral and Social Values and Loyalty.
3. To appreciate the rights of Others

Syllabus

Unit	Content	Hours
1	**Human Values** Morals, Values and Ethics-Integrity-Work Ethic-Service learning – Civic Virtue – Respect for others – Living Peacefully – Caring – Sharing – Honesty - Courage- Co Operation – Commitment – Empathy –Self Confidence Character – Spirituality.	4
2	**Engineering Ethics** Senses of „Engineering Ethics- Variety of moral issued types of inquiry – Moral dilemmas –Moral autonomy –Kohlberg‟s theory- Gilligan‟s theory- Consensus and controversy – Modelsof professional roles- Theories about right action- Self interest - Customs and religion –Uses of Ethical theories – Valuing time –Co operation – Commitment.	8
3	**Engineering As Social Experimentation** Engineering As Social Experimentation – Framing the problem – Determining the facts – Codes of Ethics – Clarifying Concepts – Application issues – Common Ground - General Principles – Utilitarian thinking respect for persons.	8
4	**Engineers Responsibility For Safety And Risk** Safety and risk – Assessment of safety and risk – Risk benefit analysis and reducing risk- Safety and the Engineer- Designing for the safety- Intellectual Property rights(IPR).	
5	**Global Issues** Globalization – Cross culture issues- Environmental Ethics – Computer Ethics – Computers as the instrument of Unethical behavior – Computers as the object of Unethical acts – Autonomous Computers- Computer codes of Ethics – Weapons Development - Ethics and Research – Analyzing Ethical Problems in research – Intellectual property Rights(IPR).	

Course Outcomes: Students will be able to:

1. Identify and analyze an ethical issue in the subject matter under investigation or in a relevant field.
2. Articulate what makes a particular course of action ethically defensible.
3. Assess their own ethical values and the social context of problems.
4. Demonstrate knowledge of ethical values in non-classroom activities, such as service learning, internships, and field work.
5. Integrate, synthesize, and apply knowledge of ethical dilemmas and resolutions in academic settings, including focused and interdisciplinary research.

Reference Books:

1. Engineering Ethics includes Human Values" by M.Govindarajan, S.Natarajan and V.S.SenthilKumar-PHI Learning Pvt. Ltd-2009.

2. "Engineering Ethics" by Harris, Pritchard and Rabins, CENGAGE Learning, India Edition, 2009.

3. "Ethics in Engineering" by Mike W. Martin and Roland Schinzinger – Tata McGraw-Hill– 2003.

4. "Professional Ethics and Morals" by Prof.A.R.Aryasri, Dharanikota Suyodhana - Maruthi Publications.

5. "Professional Ethics and Human Values" by A.Alavudeen, R.Kalil Rahman and M.Jayakumaran- Laxmi Publications.

6. "Professional Ethics and Human Values" by Prof.D.R.Kiran.

7. "Indian Culture, Values and Professional Ethics" by PSR Murthy-BS Publication

AUDIT 1 and 2: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS Course

Objectives

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

Syllabus

Unit	Content	Hours
1	Neetisatakam-Holistic development of personality • Verses- 19,20,21,22 (wisdom) • Verses- 29,31,32 (pride & heroism) • Verses- 26,28,63,65 (virtue) • Verses- 52,53,59 (dont‟s) • Verses- 71,73,75,78 (do‟s)	8
2	• Approach to day to day work and duties. • Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48, • Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35, • Chapter 18-Verses 45, 46, 48.	8
3	• Statements of basic knowledge. • Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 • Chapter 12 -Verses 13, 14, 15, 16,17, 18 • Personality of Role model. Shrimad Bhagwad Geeta: Chapter2- Verses 17, Chapter 3-Verses 36,37,42, • Chapter 4-Verses 18, 38,39 • Chapter18 – Verses 37,38,63	8

Suggested reading

1. ″Srimad Bhagavad Gita″ by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari‟s Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes

Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity Study of Neetishatakam will help in developing versatile personality of students

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.**