Curriculum Structure for M. Tech. Programmes

(In light of NEP2020)

NCrF Level 7

For students admitted in 2023-24 onwards

Govt. College of Engineering, Amravati

(*An Autonomous Institute of Govt. of Maharashtra*)

Near Kathora Naka, Amravati, Maharashtra

PIN 444 604

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Govt. College of Engineering, Amravati

(An Autonomous Institute of Govt. of Maharashtra)

Curriculum Structure for M. Tech. (Electrical Power System)

(In light of NEP 2020)

Category wise credit distribution:

Semester	PC	PE	OE	RM	OJT / FP	ISS	RP / DI	Total
I	15	03	---	---	---	02	---	20
II	12	03	---	02	---	02	---	19
III	---	03	03	---	04	---	13	23
IV	---	---	---	---	---	---	18	18
Total	**27**	**09**	**03**	**02**	**04**	**04**	**31**	**80**

SN	Abbreviation	Meaning	Credits	Percentage
01	PC	Program Core	27	33.75
02	PE	Program Elective	09	11.25
03	OE	Open Elective	03	03.75
04	RM	Research Methodology	02	02.50
05	OJT	On-Job Training/ Internship	04	05.00
06	FP	Field Projects		
07	ISS	Independent Study & Seminar	04	05.00
08	RP	Research Project	31	38.75
09	DI	Dissertation		
		Total	80	100.00

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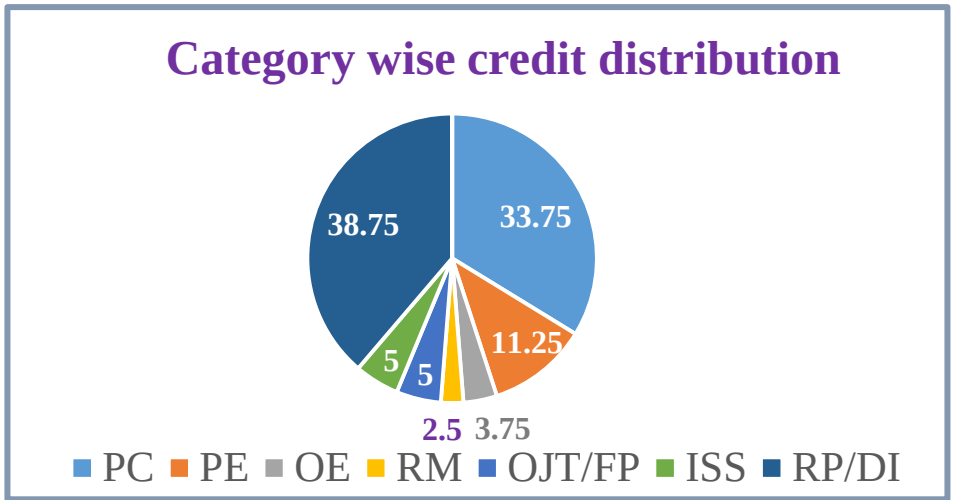

General Instructions:

1) 10% content of syllabus of each theory course of first, second and third semesters shall be completed by the students with self-study. The 10% portion of each course (for self-study) shall be declared by the concerned course-coordinator at the beginning of teaching of the course.

2) Student can complete any two theory courses of second semester, if desired, in "online" mode, offered through SWAYAM/ NPTEL. In this case –

i) Students can register and complete these online courses any time after beginning of first semester, however, the student must successfully complete and pass the course, and submit the score card/ certificate before declaration of result of second semester.

ii) In case if a student registers for a course in online mode but fails in the course the student will have to register for the course in the institute whenever it is offered. In this case, the student will have to attend the classes of the course (in order to satisfy the minimum attendance criteria), appear for all the examinations (MSE, TA, ICA, ESE, etc.) of the course, and successfully complete the course with at least D grade.

3) Student can complete the two theory courses of third semester, if desired, in "online" mode, offered through SWAYAM/ NPTEL. In this case –

i) Students can register and complete these online courses any time after beginning of first semester, however, the student must successfully complete and pass the course, and submit the score card/ certificate before declaration of result of third semester.

ii) In case if a student registers for a course in online mode but fails in the course the student will have to register for the course in the institute whenever it is offered. In this case, the student will have to attend the classes of the course (in order to satisfy the minimum attendance criteria), appear for all the examinations (MSE, TA, ICA, ESE, etc.) of the course, and successfully complete the course with at least D grade.

4) Students must complete On-the-job training/ Internship/ Field work for a duration of minimum four weeks during summer break, after completion of second semester of first year in the respective

major subject. The company/ organization for On-job training/ Internship/ Field work must be approved by the DFB.

5) Students going for industrial project or going for dissertation at some other institute (approved by DFB), during third and fourth semester, shall complete the courses Program Elective – III and Open Elective in any one of the two modes –

i) Online courses offered through SWAYAM/ NPTEL: In this case the student must complete the course and submit the score card/ certificate before commencement of fourth semester. Students can register and complete these courses any time after beginning of first semester

In case if a student registers for a course in online mode but fails in the course the student will have to register for the course in the institute whenever it is offered. In this case, the student will have to attend the classes of the course (in order to satisfy the minimum attendance criteria), appear for all the examinations (MSE, TA, ICA, ESE, etc.) of the course, and successfully complete the course with at least D grade.

ii) Self-study mode: In this case the student will have to study the course of his/her own. The student shall appear for all the college assessments/ examinations (MSE, TA and ESE) personally as per the schedule declared by the institute.

6) Maximum period for completion of M. Tech. programme:

The maximum duration for completion of the PG full time programme is eight semesters from the date of initial registration. The maximum duration of the programme includes the period of withdrawal, absence and different kinds of leaves permissible to a student but it shall exclude the period of rustication of the student from the institute and it shall also exclude the period lapsed between exit after first year (second semester) and re-entry at second year (third semester). However, genuine cases on confirmation of valid reasons may be referred to Academic Council for extending this limit by additional one year.

PG Specialization: Electrical Power System

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: To Work professionally in Electrical Power and Energy Sector.

PEO2: To Provide socially acceptable technical solutions through continuous learning and research.

PEO3: To Strengthen managerial skills, ethical principles for working in multi-disciplinary team to become successful Entrepreneur.

PROGRAM OUTCOMES (POs)

PO1: Ability to apply the enhanced knowledge in advanced technologies for modeling, analyzing and solving contemporary issues in power sector with a global perspective.

PO2: Ability to critically analyze and carry out detailed investigation on multifaceted complex Problems in area of Power Systems and envisage advanced research in thrust areas.

PO3: Ability to identify, analyze and solve real-life engineering problems in the area of Power Systems and provide strategic solutions satisfying the safety, cultural, societal and environmental aspects/ needs.

PO4: Ability for continued pursuance of research and to design, develop and propose theoretical and practical methodologies towards research and development support for the Power System infrastructure.

PO5: Ability to develop and utilize modern tools for modeling, analyzing and solving various Engineering problems related to Power Systems.

M. Tech. (Electrical Power System) Semester I

Category	Course Code	Name of the course	Teaching Scheme				Examination Scheme							Credits
							Theory				Practical		Total	
			Theory	Tut	Pract	Total	CT1	CT2	TA	ESE	ICA	ESE		
PC	EE2101	Power System Analysis	04	--	--	04	15	15	10	60	---	---	100	04
PC	EE2102	Power System Modeling	04	--	--	04	15	15	10	60	---	---	100	04
PC	EE2103	High Power Converters	04	--	--	04	15	15	10	60	---	---	100	04
PE	EE2104	Program Elective – I	03	--	--	03	15	15	10	60	---	---	100	03
PC	EE2105	Laboratory Practice – I	--	--	06	06	--	--	--	--	50	50	100	03
ISS	EE2106	Seminar – I	--	--	01	01	--	--	--	--	50	---	50	02
		Total	15	--	07	22	60	60	40	240	100	50	550	20

List of Program Electives	
EE2104: Program Elective – I	
A	Renewable Energy System
B	Smart Grids
C	Advanced Digital Signal Processing
D	EHV AC Transmission System

Note:

i) The contact hours for the students (with concerned supervisor) for Seminar – I shall be one hour per week per student, subject to maximum of four hours per week.

ii) The hours shown in the teaching scheme for Seminar I are the contact hours for the students with concerned supervisor. Each student is expected to devote at least four hours per week for Seminar I.

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M. Tech. (Electrical Power System) Semester II

Category	Course Code	Name of the course	Teaching Scheme				Examination Scheme							Credits
							Theory				Practical		Total	
			Theory	Tut	Pract	Total	CT1	CT2	TA	ESE	ICA	ESE		
PC	EE2201	Digital Protection	03	--	--	03	15	15	10	60	--	--	100	03
PC	EE2202	Power System Dynamics & Stability	03	--	--	03	15	15	10	60	--	--	100	03
PC	EE2203	HVDC and FACTS	03	--	--	03	15	15	10	60	--	--	100	03
PE	EE2204	Program Elective – II	03	--	--	03	15	15	10	60	--	--	100	03
RM	SH2201	Research Methodology	02	--	--	02	15	15	20	--	--	--	50	02
PC	EE2205	Laboratory Practice – II	--	--	06	06	--	--	--	--	50	50	100	03
ISS	EE2206	Seminar – II	--	--	01	01	--	--	--	--	50	--	50	02
OJT/ FP	EE2207	On-job training/ Internship/ Field Project	--	--	--	--	--	--	--	--	50	--	50	04
		Total	14	--	07	21	75	75	60	240	150	50	650	23

List of Program Electives	
EE2204: Program Elective – II	
A	Electric and Hybrid Vehicles
B	Restructured Power System
C	Power System Transients
D	Mathematical Methods for Power Engineering

Note:

i) The contact hours for the students (with concerned supervisor) for Seminar – II, shall be one hour per week per student, subject to maximum of four hours per week.

ii) The hours shown in the teaching scheme for Seminar II are the contact hours for the students with concerned supervisor. Each student is expected to devote at least four hours per week for Seminar – II.

iii) Individual students are required to choose a topic of their interest for Seminar II. They shall acquire state-of-the art knowledge in that area and shall define the grey area related to topic (gap analysis) so as to carry dissertation in that area. The students are required to review literature on the topic and deliver seminar.

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Exit option:

- The exit option at the end of one year of the Master's degree program will commence from AY 2024-25.
- Students who have joined a two-year Master's degree program may opt for exit at the end of the first year and he/ she shall be eligible for M. Voc. Degree (Level 6.5)
- The M. Voc. Degree may be awarded to a student provided they have earned all 43 credits of first year (first and second semester) including 04 credits of On-job training / Internship/ Field work. The On-job training / Internship/ Field work shall be completed during summer break, after completion of the second semester of the first year in the respective Major Subject.
- Even if, a student exits after third semester, the M. Voc. Degree may be awarded to him/ her provided he/ she have earned all 43 credits of first year (first and second semester) including 04 credits of On-job training / Internship/ Field work. The On-job training / Internship/ Field work shall be completed during summer break, after completion of the second semester of the first year in the respective Major Subject.
- The student must submit the report of On-job training / Internship/ Field work, in the format prescribed by the institute, as partial fulfilment of award of M. Voc. degree.
- Re-entry to complete the PG degree, after taking the exit option, will be permissible up to 05 years from the date of admission to the PG programme. Such students, shall have to surrender the M. Voc. Degree, at the time of re-entry. There shall be a gap of at least six months between exit after first year and re-entry to PG degree at third semester.

M. Tech. (Electrical Power System) Semester III

Category	Course Code	Name of the course	Teaching Scheme				Examination Scheme							Credits
							Theory				Practical		Total	
			Theory	Tut	Pract	Total	CT1	CT2	TA	ESE	ICA	ESE		
PE	EE2301	Program Elective – III	03	--	--	03	15	15	10	60	--	--	100	03
OE	SH2301	Open Elective	03	--	--	03	15	15	10	60	--	--	100	03
RP/DI	EE2302	Dissertation Stage – I	--	--	04	04	--	--	--	--	150	--	150	13
		Total	06	--	04	10	30	30	20	120	150	--	350	19

Note: The hours shown in the teaching scheme for Dissertation Stage I are the contact hours for the students with concerned supervisor. The student is expected to devote at least twenty-six hours per week for Dissertation Stage I.

List of Program Electives			List of Open Electives	
EE2301: Program Elective – III			SH2301: Open Elective	
A	Artificial Intelligence and Machine Learning		A	Industrial Safety
B	Power Quality Issues and Mitigation		B	Operations Research
C	Advanced Electric Drives		C	Project Management
D	Advanced Control System		D	Data Structures and Algorithms
E	Power Electronics Applications in Power Systems		E	Nano Technology

M. Tech. (Electrical Power System) Semester IV

Category	Course Code	Name of the course	Teaching Scheme				Examination Scheme							Credits
							Theory				Practical		Total	
			Theory	Tut	Pract	Total	CT1	CT2	TA	ESE	ICA	ESE		
RP/DI	EE2401	Dissertation Stage – II	--	--	04	04	--	--	--	--	100	200	300	18
		Total	--	--	04	04	--	--	--	--	100	200	300	18

Note:

i) Dissertation Stage – I is pre-requisite for Dissertation Stage – II

ii) The hours shown in the teaching scheme for Dissertation Stage – II are the contact hours for the students with concerned supervisor. The student is expected to devote at least thirty-six hours per week for Dissertation Stage – II.

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Comparison of existing and new programme structure:

i) On the basis of Marks and Credit:

Semester	Marks		Credits	
	Existing	**New**	**Existing**	**New**
I	610	550	17	20
II	600	650	19	23
III	300	350	16	19
IV	400	300	16	18
Total	**1910**	**1850**	**68**	**80**

ii) On the basis of semester wise number of courses:

	Number of courses									
	Semester I		Semester II		Semester III		Semester IV		Total	
	Existing	**New**	**Existing**	**New**	**Existing**	**New**	**Existing**	**New**	**Existing**	**New**
Theory	05	04	05	05	02	02	---	---	12	11
Practical	01	01	01	01	---	---	---	---	02	02
Seminar	01	01	01	01	---	---	---	---	02	02
Internship	---	---	---	01	---	---	---	---	---	01
Dissertation	---	---	---	---	01	01	01	01	02	02

iii) On the basis of course category:

Course category	Number of courses		Credits	
	Existing	**New**	**Existing**	**New**
PC	08	08	24	27
PE	03	03	09	09
OE	02	01	03	03
RM	01	01	02	02
OJT / FP	---	01	---	04
ISS	02	02	04	04
RP / DI	02	02	26	31
Total	**18**	**18**	**68**	**80**

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Equivalence Scheme

M. Tech. (Electrical Power System) (New to Old)

S. N.	Course in New Scheme			Equivalent course in Old Scheme		
	Course Code	**Course name**	**No. of Credits**	**Course Code**	**Course name**	**No. of Credits**
1	EE2101	Power System Analysis	**4**	EEP121	Power System Analysis	**3**
2	EE2102	Power System Modelling	**4**	EEP122	Power System Modelling	**3**
3	EE2103	High Power Converters	**4**	EEP123	High Power Converters	**3**
4		**Program Elective I**			**Program Elective I**	
	EE2104	A) Renewable Energy System	**3**	EEP124	A) Renewable Energy System	**3**
	EE2104	B) Smart Grids	**3**	EEP124	B) Smart Grids	**3**
	EE2104	C) Advanced Digital Signal Processing	**3**	EEP124	D) Advanced Digital Signal Processing	**3**
	EE2104	D) EHV AC Transmission System	**3**	EEP124	E) EHV AC Transmission System	**3**
5	EE2105	Laboratory Practice - I	**3**	EEP125	Laboratory Practice - I	**3**
6	EE2106	Seminar I	**2**	EEP126	Seminar I	**2**
7	EE2201	Digital Protection	**3**	EEP221	Digital Protection	**3**
8	EE2202	Power System Dynamics and Stability	**3**	EEP222	Power System Dynamics and Stability	**3**
9	EE2203	HVDC and FACTS	**3**	EEP223	HVDC and FACTS	**3**
10		**Program Elective II**			**Program Elective II**	
	EE2204	A) Electric and Hybrid Vehicles	**3**	EEP224	A) Electric and Hybrid Vehicles	**3**
	EE2204	B) Restructured Power System	**3**	EEP224	C) Restructured Power System	**3**
	EE2204	C) Power System Transients	**3**	EEP224	D) Power System Transients	**3**
	EE2204	D) Mathematical Methods for Power Engineering	**3**	EEP124C	C) Mathematical Methods for Power Engineering	**3**
11	SH2201	Research Methodology	**2**	SHP221	Research Methodology and IPR	**2**
12	EE2205	Laboratory Practice - II	**3**	EEP225	Laboratory Practice - II	**3**
13	EE2206	Seminar II	**2**	EEP226	Seminar II	**2**
14	EE2207	On-job training/ Internship/ Field Project	**4**	--	--	--
15		**Program Elective III**			**Program Elective III**	
	EE2301	A) Artificial Intelligence and Machine learning	**3**	EEP321	D) Artificial Intelligence and Machine learning	**3**
	EE2301	B) Power Quality Issues and Mitigation	**3**	EEP321	C) Power Quality Issues and Mitigation	**3**
	EE2301	C) Advanced Electric Drives	**3**	EEP321	A) Advanced Electric Drives	**3**
	EE2301	D) Advanced Control System	**3**	EEP224E	E) Advanced Control System	**3**
	EE2301	E) Power Electronics Applications in Power Systems	**3**	--	--	--
16		**Open Elective**			**Open Elective**	
	SH2301	A) Industrial Safety	**3**	SHP321	B) Industrial Safety	**3**
	SH2301	B) Operations Research	**3**	SHP321	C) Operations Research	**3**
	SH2301	C) Project Management	**3**	SHP321	H) Project Management	**3**
	SH2301	D) Data structures and Algorithms	**3**	SHP321	I) Data structures and Algorithms	**3**
	SH2301	E) Nano Technology	**3**	---	---	--
17	EE2302	Dissertation Stage I	**13**	EEP322	Dissertation Stage I	**10**
18	EE2401	Dissertation Stage II	**18**	EEP421	Dissertation Stage II	**16**

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Equivalence Scheme

M. Tech. (Electrical Power System) (Old to New)

S.N.	Course in Old Scheme			Equivalent course in New Scheme		
	Course Code	Course name	No. of Credits	Course Code	Course name	No. of Credits
1	EEP121	Power System Analysis	**3**	EE2101	Power System Analysis	**4**
2	EEP122	Power System Modelling	**3**	EE2102	Power System Modelling	**4**
3	EEP123	High Power Converters	**3**	EE2103	High Power Converters	**4**
4		**Program Elective I**			**Program Elective I**	
	EEP124	A) Renewable Energy System	**3**	EE2104	A) Renewable Energy System	**3**
	EEP124	B) Smart Grids	**3**	EE2104	B) Smart Grids	**3**
	EEP124	C) Mathematical Methods for Power Engineering	**3**	EE2204D	D) Mathematical Methods for Power Engineering	**3**
	EEP124	D) Advanced Digital Signal Processing	**3**	EE2104	C) Advanced Digital Signal Processing	**3**
	EEP124	E) EHV AC Transmission System	**3**	EE2104	D) EHV AC Transmission System	**3**
5	EEP125	Laboratory Practice - I	**3**	EE2105	Laboratory Practice - I	**3**
6	EEP126	Seminar I	**2**	EE2106	Seminar I	**2**
7	EEP221	Digital Protection	**3**	EE2201	Digital Protection	**3**
8	EEP222	Power System Dynamics and Stability	**3**	EE2202	Power System Dynamics and Stability	**3**
9	EEP223	HVDC and FACTS	**3**	EE2203	HVDC and FACTS	**3**
10		**Program Elective II**			**Program Elective II**	
	EEP224	A) Electric and Hybrid Vehicles	**3**	EE2204	A) Electric and Hybrid Vehicles	**3**
	EEP224	B) Electrical Power Distribution System		--	--	--
	EEP224	C) Restructured Power System	**3**	EE2204	B) Restructured Power System	**3**
	EEP224	D) Power System Transients	**3**	EE2204	C) Power System Transients	**3**
	EEP224	E) Advanced Control System	**3**	EE2301D	D) Advanced Control System	**3**
11	SHP221	Research Methodology and IPR	**2**	SH2201	Research Methodology	**2**
12	EEP225	Laboratory Practice - II	**3**	EE2205	Laboratory Practice - II	**3**
13	EEP226	Seminar II	**2**	EE2206	Seminar II	**2**
14	--	--	--	EE2207	On-job training/ Internship/ Field Project	**4**
15		**Program Elective III**			**Program Elective III**	
	EEP321	A) Advanced Electric Drives	**3**	EE2301	A) Advanced Electric Drives	**3**
	EEP321	B) Power Apparatus Design	**3**	--	--	--
	EEP321	C) Power Quality Issues and Mitigation	**3**	EE2301	C) Power Quality Issues and Mitigation	**3**
	EEP321	D)Artificial Intelligence and Machine learning	**3**	EE2301	B)Artificial Intelligence and Machine learning	**3**
	EEP321	E) Energy Storage System	**3**	--	--	--
	--	--	--	EE2301	E) Power Electronics Applications in Power Systems	**3**

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		Open Elective			**Open Elective**	
	SHP321	A) Business Analytics (ME)	**3**	--	--	--
	SHP321	B) Industrial Safety	**3**	SH2301	A) Industrial Safety	**3**
	SHP321	C) Operations Research	**3**	SH2301	B) Operations Research	**3**
	SHP321	D) Cost management of Engineering Projects (CE)	**3**	--	--	--
16	SHP321	E) Composite Materials (CE)	**3**	--	--	--
	SHP321	F) Waste to Energy (CE)	**3**	--	--	--
	SHP321	G) Finance Management (EE)	**3**	--	--	--
	SHP321	H) Project Management	**3**	SH2301	C) Project Management	**3**
	SHP321	I) Data structures and Algorithms	**3**	SH2301	D) Data structures and Algorithms	**3**
	--	--	--	SH2301	E) Nano Technology	**3**
17	EEP322	Dissertation Stage I	**10**	EE2302	Dissertation Stage I	**13**
18	EEP421	Dissertation Stage II	**16**	EE2401	Dissertation Stage II	**18**

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Course Code	**EE2101**							**Course category**			**PC**
Course Name	**POWER SYSTEM ANALYSIS**										
Teaching Scheme				**Examination Scheme**							**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
04	--	--	04	15	15	10	60	2 hrs 30 min	--	--	100	04

Course Objectives:

Students will be able to:

1. Study various methods of load flow and their advantages and disadvantages
2. Understand how to analyze various types off faults in power system
3. Understand power system security concepts and study the methods to rank the contingencies
4. Understand need of state estimation and study simple algorithms for state estimation
5. Study voltage instability phenomenon

Course Contents:

Load Flow: Overview of Newton-Raphson, Gauss-Siedel fast decoupled methods, convergence properties, sparsity techniques, handling Q-max violations in constant matrix, inclusion in frequency effects, AVR in load flow, handling of discrete variable in load flow.

Fault Analysis: Simultaneous faults, open conductor faults, generalized method of fault analysis.

Security Analysis: Security state diagram, contingency analysis, generator shift distribution factors, line outage distribution factor, multiple line outages, overload index ranking

Power System Equivalents: WARD REI. Equivalents

State Estimation: Sources of errors in measurement, Virtual and Pseudo, Measurement, Observability, Tracking state estimation, WSL method, bad data correction.

Voltage Stability: Voltage collapse, P-V curve, multiple power flow solution, continuation power flow, optimal multiplies load flow, voltage collapse proximity indices.

Reference Books:

1. J. J. Grainger & W. D. Stevenson, “Power System Analysis”, McGraw Hill, 2003
2. A. R. Bergen & Vijay Vittal , “Power System Analysis”, Pearson, 2000
3. L. P. Singh, “Advanced Power System Analysis and Dynamics”, New Age International, 2006
4. G. L. Kusic, “Computer aided power system analysis”, Prentice Hall India, 1986
5. A. J. Wood, “Power generation, operation and control”, John Wiley, 1994
6. P. M. Anderson, “Faulted power system analysis”, IEEE Press, 1995

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Course Outcomes:

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

EE2101.1. Calculate voltage phasors at all buses, given the data using various methods of load flow

EE2101.2. Calculate fault currents in each phase

EE2101.3. Rank various contingencies according to their severity

EE2101.4. Estimate the bus voltage phasors given various quantities viz. power flow, voltages, taps, CB status, etc.

EE2101.5. Estimate closeness to voltage collapse and calculate PV curves using continuation power flow

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
EE2101.1	2	-	-	-	1
EE2101.2	2	3	-	2	-
EE2101.3	3	2	1	1	1
EE2101.4	2	2	-	1	-
EE2101.5	3	2	1	-	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE2102	Course category	PC
Course Name	POWER SYSTEM MODELING		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
04	--	--	04	15	15	10	60	2 hrs 30 min	--	--	100	04

Course Objectives:

Students will be able to:

1. Study analysis of electromechanical machines
2. Development of mathematical models for synchronous machine
3. Modeling of induction motor

Course Contents:

Synchronous Machine Modelling:

Basic equations of a synchronous machine, Mathematical description, dq0 transformation, per unit representation, equivalent circuit for d-q axes, steady state analysis- voltage-current and flux linkage equations, Equivalent Circuits for direct and quadrature axes, Steady-state Analysis, parks transformation

Transmission line modelling:

Pi-equivalent circuit with lumped parameters or a number of cascaded pi circuits, voltage and current relationship of line.

Modelling of power system loads (Basic load modelling concepts):

Measurement based and component based load model, Static load model and dynamic load models, induction motor model

Modelling Of Excitation and Prime Mover Controllers:

Excitation System Requirements; Elements of an Excitation System; Types of Excitation System; Control and protective functions, Heffron - Phillips constants – Effects on Excitation system – Block diagram representation with exciter and AVR – Power System Stabilizer (PSS), Modelling of excitation systems, Hydraulic and Steam Turbines and governing systems

Reference Books:

1. P. C. Krause, "Analysis of Electric Machinery", McGraw Hill, New York, 1987

2. Chee Mun Ong, "Dynamic simulation of Electrical Machinery using Matlab/Simulink", Prentice Hall PTR, 1997

3. P. Vas, "Vector Control of A.C. Machines", Clarendon Press, Oxford 1990.

4. J .M. D. Murphy and F. G. Turnbull, "Power Electronic Control of AC motors", Pergamum Press, 1988.

5. W. Leonhard, "Control of Electrical Drives", Springer Verlag, 1985.

Course Outcomes:

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

EE2102.1. Analyze electromechanical devices and machines

EE2102.2. Use reference frame theory to study and analyze the behaviour of induction and synchronous machines

EE2102.3. Calculate the machine inductances for use in machine analysis

EE2102.4. Model the electrical machine from the terminal junction with transmission systems

EE2102.5. Model the power system loads

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
EE2102.1	2	-	-	-	1
EE2102.2	2	3	-	2	-
EE2102.3	3	2	1	1	1
EE2102.4	2	2	-	1	-
EE2102.5	3	2	1	-	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE2103	Course category	PC
Course Name	HIGH POWER CONVERTERS		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
04	--	--	04	15	15	10	60	2 hrs 30 min	--	--	100	04

Course Objectives:

Students will be able to:

1. Understand the requirements of high power rated converters
2. Understand the different topologies involved for these converters
3. Able to understand the design of protection circuits for these converters

Course Contents:-

Power electronic systems, An overview of PSDs, multi-pulse diode rectifier, multi-pulse, SCR rectifier.

Phase shifting transformers, multilevel voltage source inverters: two level voltage source inverter, cascaded, H bridge multilevel inverter.

Diode clamped multilevel inverters, flying capacitor multilevel inverter
PWM current source inverters, DC to DC switch mode converters

AC voltage controllers: Cyclo-converters, matrix converter, Power conditioners and UPS.
Design aspects of converters, protection of devices and circuits

Reference Books:

1. N. Mohan, T. M. Undeland and W. P. Robbins, "Power Electronics: Converter, Applications and Design", John Wiley and Sons, 1989
2. M.H. Rashid, "Power Electronics", Prentice Hall of India, 1994
3. B. K. Bose, "Power Electronics and A. C. Drives", Prentice Hall, 1986
4. Bin Wu, "High power converters and drives", IEEE press, Wiley Enter science

Course Outcomes:

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

EE2103.1. Learn the characteristics of PSDs such as SCRs, GTOs, IGBTs and use them in practical systems

EE2103.2. Acquire Knowledge of working of multi-level VSIs, DC-DC switched mode converters, cyclo- converter and PWM techniques and the ability to use them properly

EE2103.3. Acquire knowledge of power conditioners and their applications

EE2103.4. Ability to design power circuit and protection circuit of PSDs and converters

EE2103.5. Study Power conditioners and UPS

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
EE2103.1	2	-	-	-	1
EE2103.2	2	3	-	2	-
EE2103.3	3	2	1	1	1
EE2103.4	2	2	-	1	-
EE2103.5	3	2	1	-	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE2104-A								Course category			PE
Course Name	RENEWABLE ENERGY SYSTEMS											
Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2 hrs 30 min	--	--	100	03

Course Objectives:

Students will be able to:

1. To learn various renewable energy sources
2. To gain understanding of integrated operation of renewable energy sources
3. To understand Power Electronics Interface with the Grid

Course Contents:

Introduction, Distributed vs Central Station Generation, Sources of Energy such as Micro-turbines, Internal Combustion Engines.

Introduction to Solar Energy, Wind Energy, Combined Heat and Power, Hydro Energy, Tidal Energy, Wave Energy, Geothermal Energy, and Biomass and Fuel Cells.

Power Electronic Interface with the Grid

Impact of Distributed Generation on the Power System, Power Quality Disturbances

Transmission System Operation, Protection of Distributed Generators

Economics of Distributed Generation, Case Studies

Reference Books:

1. Ranjan Rakesh, Kothari D. P, Singal K. C, "Renewable Energy Sources and Emerging Technologies", 2nd Ed. Prentice Hall of India, 2011
2. Math H. Bollen, Fainan Hassan, "Integration of Distributed Generation in the Power System", July 2011, Wiley – IEEE Press
3. Loi Lei Lai, Tze Fun Chan, "Distributed Generation: Induction and Permanent Magnet Generators", October 2007, Wiley-IEEE Press.
4. Roger A. Messenger, Jerry Ventre, "Photovoltaic System Engineering", 3rd Ed, 2010
5. James F. Manwell, Jon G. McGowan, Anthony L Rogers, "Wind energy explained: Theory Design and Application", John Wiley and Sons 2nd Ed, 2010

Course Outcomes:

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

EE2104-A.1.	Understand the concept of renewable energy
EE2104-A.2.	Understand the working of distributed generation system in autonomous/grid connected modes
EE2104-A.3.	Know the Impact of Distributed Generation on Power System
EE2104-A.4.	Analyze the role of Power Electronics devices in RES
EE2104-A.5.	Discuss power quality disturbances

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
EE2104A.1	**2**	**-**	**-**	**-**	**1**
EE2104A.2	**2**	**3**	**-**	**2**	**-**
EE2104A.3	**3**	**2**	**1**	**1**	**1**
EE2104A.4	**2**	**2**	**-**	**1**	**-**
EE2104A.5	**3**	**2**	**1**	**-**	**-**

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE2104-B							Course category		PE
Course Name	SMART GRIDS									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2 hrs 30 min	--	--	100	03

Course Objectives:

Students will be able to:

1. Understand concept of smart grid and its advantages over conventional grid
2. Know smart metering techniques
3. Learn wide area measurement techniques
4. Understanding the problems associated with integration of distributed generation & its solution through smart grid.

Course Contents:

Introduction to Smart Grid, Evolution of Electric Grid, Concept of Smart Grid, Definitions Need of Smart Grid, Concept of Robust & Self Healing Grid Present development & International policies in Smart Grid

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, 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)

Concept of micro-grid, need & applications of micro-grid, formation of micro-grid, Issues of interconnection, protection & control of micro-grid. Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel-cells, micro-turbines, Captive power plants, Integration of renewable energy sources

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

Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area, Network (NAN), Wide Area Network (WAN) Bluetooth, Zig Bee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network, Basics of CLOUD Computing & Cyber Security for Smart Grid, Broadband over Power line (BPL), IP based protocols

Reference Books:

1. Ali Keyhani, "Design of smart power grid renewable energy systems", Wiley IEEE, 2011

2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press, 2009

3. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, "Smart Grid: Technology and Applications", Wiley 2012

4. Stuart Borlase, "Smart Grid: Infrastructure, Technology and solutions" CRC Press

5. A. G. Phadke, "Synchronized Phasor Measurement and their Applications", Springer

Course Outcomes:

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

EE2104-B.1. Appreciate the difference between smart grid & conventional grid

EE2104-B.2. Apply smart metering concepts to industrial and commercial installations

EE2104-B.3. Formulate solutions in the areas of smart substations, distributed generation and wide area measurements

EE2104-B.4. Come up with smart grid solutions using modern communication technologies

EE2104-B.5. Study Role of wide area measurement system in smart grid

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
EE2104B.1	2	-	-	-	1
EE2104B.2	2	3	-	2	-
EE2104B.3	3	2	1	1	1
EE2104B.4	2	2	-	1	-
EE2104B.5	3	2	1	-	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	**EE2104-C**	**Course category**	**PE**
Course Name	**ADVANCED DIGITAL SIGNAL PROCESSING**		

Teaching Scheme				**Examination Scheme**								**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2 hrs 30 min	--	--	100	03

Course Objectives:

Students will be able to:

1. Understand the difference between discrete-time and continuous-time signals
2. Understand and apply Discrete Fourier Transforms (DFT)
3. Know the filter design

Course Contents:

Discrete time signals, Linear shift invariant systems, Stability and causality, Sampling of continuous time signals, Discrete time Fourier transform- Discrete Fourier series- Discrete Fourier transform, Z transform-Properties of different transforms

Linear convolution using DFT, Computation of DFT Design of IIR digital filters from analog filters, Impulse invariance method, Bilinear transformation method

FIR filter design using window functions, Comparison of IIR and FIR digital filters Basic IIR and FIR filter realization structures, Signal flow graph representations Quantization process and errors, Coefficient quantization effects in IIR and FIR filters

A/D conversion noise- Arithmetic round-off errors, Dynamic range scaling, Overflow oscillations and zero Input limit cycles in IIR filters, Linear Signal Models

All pole, All zero and Pole-zero models, Power spectrum estimation- Spectral analysis of deterministic signals. Estimation of power spectrum of stationary random signals

Optimum linear filters, Optimum signal estimation, Mean square error estimation, Optimum FIR and IIR Filters

Reference Books :

1. Sanjit K Mitra, "Digital Signal Processing: A computer-based approach ", Tata McGraw Hill Edition1998

2. Dimitris G. Manolakis, Vinay K. Ingle and Stephen M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill international editions -2000

Course Outcomes:-

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

EE2104-C.1.	Knowledge about the time domain and frequency domain representations as well analysis of discrete time signals and systems
EE2104-C.2.	Study the design techniques for IIR and FIR filters and their realization structures.
EE2104-C.3.	Acquire knowledge about the finite word length effects in implementation of digital filters.
EE2104-C.4.	Knowledge about the various linear signal models and estimation of power spectrum of stationary random signals
EE2104-C.5.	Design of optimum FIR and IIR filters

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
EE2104C.1	**2**	**-**	**-**	**-**	**1**
EE2104C.2	**2**	**3**	**-**	**2**	**-**
EE2104C.3	**3**	**2**	**1**	**1**	**1**
EE2104C.4	**2**	**2**	**-**	**1**	**-**
EE2104C.5	**3**	**2**	**1**	**-**	**-**

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	**EE2104-D**	**Course category**	**PE**
Course Name	**EHV AC TRANSMISSION SYSTEMS**		

Teaching Scheme				**Examination Scheme**								**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2 hrs 30 min	--	--	100	03

Course Objectives:

Students will be able to:

1. Understand mechanical aspects of EHVAC transmission
2. Understand modeling and analysis of EHVAC transmission line
3. Study over voltages in EHV system

Course Contents:

Introduction: Engineering aspect and growth of EHV_ AC Transmission line trends and preliminaries, power transferability, transient stability and surge impedance loading.

Calculation of line and ground parameters: Resistance, power loss, temperature rise properties of bundled conductors, inductance and capacitance of EHV lines, positive, negative and zero sequence impedance and line parameters for modes of propagations.

Voltage gradients of conductor: Charge potential relations for multi-conductor lines, surface voltage gradients on the conductor line, distribution of voltage gradients on sub conductors of bundle. Corona in E.H.V. lines – Corona loss formulae- attenuation of traveling waves due to Corona – Audio noise due to Corona, its generation, characteristic and limits. Measurements of audio noise radio interference due to Corona – properties of radio noise – frequency spectrum of RI fields – Measurements of RI and RIV.

Theory of the Travelling and standing waves, Lighting and lighting protection, Over voltage in EHV system covered By switching operations, Power frequency voltage control and over voltage, Insulation Coordination, Design of EHV - AC lines

References Books:

1. R. D. Begamudre , “EHV AC transmission Engineering,” New Academic Science Ltd; 4th edition, 2011
2. S. Rao, “EHV -AC & HVDC transmission system enginreering”, Khanna Publication

Course Outcomes:-

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

EE2104-D.1. Know the necessity, merits and demerits of EHVAC transmission and mechanical aspects

EE2104-D.2. Evaluate the Inductance and capacitance of two conductor and multi conductor lines

EE2104-D.3. Analyze the effect of corona, electrostatic field of EHVAC lines

EE2104-D.4. Analyze the surface gradient on two conductor and bundle with more than 3 sub conductors

EE2104-D.5. Demonstrate EHV AC transmission system components, protection and insulation level for over voltages

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
EE2104D.1	2	-	-	-	1
EE2104D.2	2	3	-	2	-
EE2104D.3	3	2	1	1	1
EE2104D.4	2	2	-	1	-
EE2104D.5	3	2	1	-	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	**EE2105**						**Course category**			**PC**
Course Name	**LAB PRACTICE-I**									
Teaching Scheme				**Examination Scheme**						**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
--	--	06	06	--	--	--	--	--	50	50	100	03

Minimum two simulations / performance type experiments on each course in the current Semester should be performed. Respective Course Coordinators shall submit all details of Experiments based on concerned course to the Course Coordinator of this course at the beginning of semester.

Note:
ICA - Internal Continuous Assessment shall be based on the practical record and knowledge / skills acquired. The performance shall assess experiment wise by using continuous Assessment formats, A and B.

ESE - The End Semester Exam for practical shall be based on performance in one of Experiments and may be followed by sample questions.

Course Outcomes:

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

EE2105.1. Formulate the bus admittance matrix

EE2105.2. Determine ABCD constants of transmission line using matlab program

EE2105.3. Simulate simple power system

CO-PO-PSO Mapping:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
EE2105.1	**2**	**-**	**-**	**1**	**1**
EE2105.2	**2**	**3**	**-**	**2**	**-**
EE2105.3	**3**	**2**	**1**	**1**	**-**

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	**EE2106**							**Course category**			**PC**
Course Name	**SEMINAR-I**										
Teaching Scheme				**Examination Scheme**							**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
--	--	01	01	--	--	--	--	--	50	--	50	02

The hours shown in the teaching scheme for Seminar I are the contact hours for the students with concerned supervisor. Each student is expected to devote at least four hours per week for Seminar I.

Seminar on any technical subject other than above syllabus but related to Electrical Power System.

The students are required to review literature on the topic and deliver seminar.

A committee consisting of at least two faculty members (guide/ supervisor and one subject expert) shall be formed for evaluation. More faculty (subject experts) can be included in the committee. The committee shall assess the presentation of the seminar and award marks to the students based on merits of topic of presentation.

It is encouraged to do simulations/ experimentation related to the chosen topic and present the results at the end of the semester.

Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.

Each student shall submit two copies of a report of seminar. All sources shall be properly cited or acknowledged.

Course Outcomes:

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

EE2106.1. Perceive the idea and decide the title from literature survey

EE2106.2. Integrate information from multiple sources

EE2106.3. Prepare the effective technical document related to work carried out

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
EE2106.1	2	-	-	1	1
EE2106.2	2	3	-	-	-
EE2106.3	3	2	1	2	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Member Secretary BoS Chairperson Dean (Academics) Principal

Course Code	**EE2201**	**Course category**	**PC**
Course Name	**DIGITAL PROTECTION**		

Teaching Scheme				**Examination Scheme**								**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2 hrs30 min	--	--	100	03

Course Objectives:

Students will be able to:

1. Study of numerical relays
2. Developing mathematical approach towards protection
3. Study of algorithms for numerical protection

Course Contents:

Evolution of digital relays from electromechanical relays, Performance and operational characteristics of digital protection

Mathematical background to protection algorithms,Finite difference techniques

Interpolation formulae, Forward, backward and central difference interpolation, Numerical differentiation, Curve fitting and smoothing, Least squares method, Fourier analysis, Fourier series and Fourier transform, Walsh function analysis

Basic elements of digital protection, Signal conditioning: transducers, surge protection, analog filtering, analog multiplexers,Conversion subsystem: the sampling theorem, signal aliasing, Error, sample and hold circuits, multiplexers, analog to digital conversion, Digital filtering concepts, The digital relay as a unit consisting of hardware and software

Sinusoidal wave based algorithms, Sample and first derivative (Mann and Morrison) algorithm. Fourier and Walsh based algorithms

Fourier Algorithm: Full cycle window algorithm, fractional cycle window algorithm. Walsh function based algorithm. Least Squares based algorithms. Differential equation based algorithms. Traveling Wave based Techniques. Digital Differential Protection of Transformers. Digital Line Differential Protection. Recent Advances in Digital Protection of Power Systems.

Reference Books:

1. A. G. Phadke and J. S. Thorp, "Computer Relaying for Power Systems", Wiley/Research studies Press, 2009

2. A. T. Johns and S. K. Salman, "Digital Protection of Power Systems", IEEE Press, 1999

3. Gerhard Zeigler, "Numerical Distance Protection", Siemens Public Corporate Publishing, 2006

4. S. R. Bhide, "Digital Power System Protection" PHI Learning Pvt. Ltd. 2014

Course Outcomes:-

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

EE2201.1. Learn the importance of Digital Relays

EE2201.2. Apply Mathematical approach towards protection

EE2201.3. Develop various Protection algorithms

EE2201.4. Study advanced digital protection

EE2201.5. Apply various protection schemes

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
EE2201.1	2	-	1	1	1
EE2201.2	2	3	-	2	1
EE2201.3	3	2	3	1	-
EE2201.4	2	2	-	1	-
EE2201.5	3	2	3	-	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE2202	Course category	PC
Course Name	POWER SYSTEM DYNAMICS AND STABILITY		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2 hrs 30 min	--	--	100	03

Course Objectives:

Students will be able to:

1. Study of power system dynamics
2. Interpretation of power system dynamic phenomena
3. Study of various forms of stability

Course Contents:

Basic concepts of dynamical systems and stability

Modelling of power system components for stability studies: generators, transmission lines, excitation and prime mover controllers

Analysis of single machine and multi-machine systems, small signal angle instability (low frequency oscillations): damping and synchronizing torque analysis, Eigen value analysis, mitigation using power system stabilizers

PSS design for multi-machine systems, small signal angle instability (sub-synchronous frequency oscillations): analysis and counter-measures,

Transient instability: analysis using digital simulation and energy function method, transient stability controllers

Reference Books:

1. K. R. Padiyar, "Power System Dynamics, Stability and Control", Interline Publishers, Bangalore, 1996
2. P. Kundur, "Power System Stability and Control", McGraw Hill Inc, New York, 1995
3. P. Sauer and M. A. Pai, "Power System Dynamics and Stability", Prentice Hall, 1997.
4. E.W. Kimbark, "Power systems Stability", Vol. I and III

Course Outcomes:-

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

EE2202.1. Gain valuable insights into the phenomena of power system including obscure ones.

EE2202.2. Understand the power system stability problem.

EE2202.3. Analyze the stability problems and implement modern control strategies.

EE2202.4. Simulate small signal and large signal stability problems

EE2202.5. Study multi machine system

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
EE2202.1	2	-	1	1	1
EE2202.2	2	3	-	2	1
EE2202.3	3	2	3	1	-
EE2202.4	2	2	-	1	-
EE2202.5	3	2	3	-	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	**EE2203**						**Course category**			**PC**
Course Name	**HVDC AND FACTS**									
Teaching Scheme				**Examination Scheme**						**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2 hrs 30 min	--	--	100	03

Course Objectives:

Students will be able to:

1. Learn the active and reactive power flow control in power system
2. Understand the need for static compensators
3. Develop the different control strategies used for compensation

Course Contents:

The concept of flexible AC transmission: reactive power control in electrical power transmission lines, uncompensated transmission line, Introduction to FACTS devices and its importance in transmission Network

Introduction to basic types of FACTS controllers: Shunt Compensation: Methods of Var generation: Thyristor controlled reactor (TCR), Thyristor switched capacitor (TSC), Fixed capacitor - Thyristor controlled reactor (FC-TCR), STATCOM; Series Compensation: Thyristor Switched Series Capacitor (TSSC), Thyristor Controlled Series Capacitor (TCSC). Static Synchronous Series Compensator (SSSC), modes of operation, Voltage regulator and Phase Angle Regulator (PAR)

Multi-functional FACTS controller: The Unified Power Flow Compensator (UPFC); circuit and steady-state characteristic; effect on transmission line compensation; Interline Power Flow Controller (IPFC); circuit and steady-state characteristic

HVDC: Introduction, various possible HVDC configurations, components of HVDC system, operation of 6-pulse and 12-pulse converter, Effect of source inductance, Generation of Harmonics, Design of AC filters and DC filters, HVDC light and HVDC PLUS Series and Parallel operation of converters, Introduction to distribution FACTs devices.

Reference Books:

1. K. R. Padiyar, "HVDC Power Transmission System", Wiley Eastern Limited, New Delhi, First Edition, 1990.

2. T. J. E. Miller, "Reactive Power Control in Electrical System", John Wiley and Sons, New York, 1982

3. N. G. Hingorani, "Understanding FACTS: Concepts and Technology of FACTS Systems", IEEE Press, 2000.

4. K. R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International (P) Ltd. 2007

5. J. Arrillaga, "High Voltage Direct Current Transmission", Peter Pregnnus, London 1983.

Course Outcomes:

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

EE2203.1. Acquire knowledge about the FACTS devices

EE2203.2. Discuss Reactive Power Compensation Schemes at Transmission and Distribution level in Power Systems.

EE2203.3. Learn various Static VAR Compensation Schemes

EE2203.4. Develop analytical modeling skills needed for modeling and analysis of such Static VAR Systems.

EE2203.5. Acquire knowledge about the fundamental HVDC

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
EE2203.1	2	-	1	1	1
EE2203.2	2	3	-	2	1
EE2203.3	3	2	3	1	-
EE2203.4	2	2	-	1	-
EE2203.5	3	2	3	-	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE2204-A	Course category	PE
Course Name	ELECTRIC AND HYBRID VEHICLES		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2 hrs 30 min	--	--	100	03

Course Objectives:

Students will be able to:

1. Understand upcoming technology of hybrid system
2. Understand different aspects of drives application
3. Learn the Electric Traction

Course Contents:

History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles, Impact of modern drive-trains on energy supplies, Basics of vehicle performance, vehicle power source characterization, Transmission characteristics, Mathematical models to describe vehicle performance

Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis.

Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies Power flow control in hybrid drive-train topologies, Fuel efficiency analysis.

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Introduction Motor drives configuration and control of Permanent Magnet Motor drives Configuration and control of Switch Reluctance, Motor drives, drive system efficiency

Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics Selecting the energy storage technology Communications, supporting subsystems

Introduction to energy management and their strategies used in hybrid and electric vehicle, Classification of different energy management strategies Comparison of different energy management strategies Implementation issues of energy strategies

References Books:

1. Sira - Ramirez, R. Silva Ortigoza, "Control Design Techniques in Power Electronics Devices", Springer.

2. Siew-Chong Tan, Yuk-Ming Lai, Chi Kong Tse, "Sliding mode control of switching Power Converters"

Course Outcomes:

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

EE2204-A.1. Acquire knowledge about fundamental concept of hybrid and electric vehicles

EE2204-A.2. Design of hybrid and electric vehicles.

EE2204-A.3. Describe vehicle performance

EE2204-A.4. Differentiate electric vehicles and internal combustion engine (ICE).

EE2204-A.5. Study energy management and their strategies used in hybrid and electric vehicle

CO-PO-PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5
EE2204A.1	2	-	1	1	1
EE2204A.2	2	3	-	2	1
EE2204A.3	3	2	3	1	-
EE2204A.4	2	2	-	1	-
EE2204A.5	3	2	3	-	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	**EE2204-B**	**Course category**	**PE**
Course Name	**RESTRUCTURED POWER SYSTEM**		

Teaching Scheme				**Examination Scheme**								**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2 hrs 30 min	--	--	100	03

Course Objectives:

Students will be able to:

1. Understand what is meant by restructuring of the electricity market
2. Understand the need behind requirement for deregulation of the electricity market
3. Understand the money, power & information flow in a deregulated power system

Course Contents:

Fundamentals of restructured system, Market architecture, Load elasticity, Social welfare maximization

OPF: Role in vertically integrated systems and in restructured markets, congestion management

Optimal bidding, Risk assessment, Hedging, Transmission pricing, Tracing of power

Ancillary services, Standard market design, Distributed generation in restructured markets

Developments in India, IT applications in restructured markets

Working of restructured power systems, PJM, Recent trends in Restructuring

References Books:

1. Lorrin Philipson, H. Lee Willis, "Understanding electric utilities and de-regulation", Marcel Dekker Pub., 1998

2. Steven Stoft, "Power system economics: designing markets for electricity", John Wiley and Sons, 2002.

3. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, "Operation of restructured power systems", Kluwer Academic Pub., 2001

4. Mohammad Shahidehpour, MuwaffaqAlomoush, "Restructured electrical power systems: operation, trading and volatility", Marcel Dekker.

Course Outcomes:

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

EE2204-B.1. Describe various types of regulations in power systems.

EE2204-B.2. Identify the need of regulation and deregulation.

EE2204-B.3. Define and describe the Technical and Non-technical issues in Deregulated Power Industry.

EE2204-B.4. Identify and give examples of existing electricity markets.

EE2204-B.5. Classify different market mechanisms and summarize the role of various entities in the market.

CO-PO-PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5
EE2204B.1	**2**	**-**	**1**	**1**	**1**
EE2204B.2	**2**	**3**	**-**	**2**	**1**
EE2204B.3	**3**	**2**	**3**	**1**	**-**
EE2204B.4	**2**	**2**	**-**	**1**	**-**
EE2204B.5	**3**	**2**	**3**	**-**	**1**

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	**EE2204-C**	**Course category**	**PE**
Course Name	**POWER SYSTEM TRANSIENTS**		

Teaching Scheme				**Examination Scheme**								**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2 hrs 30 min	--	--	100	03

Course Objectives:

Students will be able to:

1. Understand and analyze transient phenomenon in power system
2. Use software for analysis of transient phenomenon
3. Know about travelling waves and lightning induced transients

Course Contents:

Sources of electrical transients, basic concepts, definitions, causes, effects, basic mathematical concepts for transient analysis

Laplace transform and differential equations, representation of transient wave shapes, modelling power apparatus for transient analysis, capacitor switching, reactor switching, magnetizing inrush and ferroresonance

Transmission lines, the wave equation, and line terminations, travelling wave attenuation and distortion, transients due to faults, electromagnetic induction, magnetic flux, and currents, transient electromagnetic phenomena

Lightning induced transients, computation of lightning events, lightning protection using shielding and surge arresters, transient voltages and grounding practices, numerical simulation of electrical transients, simulation tools, and international standards.

References Books:

1. Pritindra Chaudhari, “Electromagnetic transients in Power System”, PHI
2. J. C. Das, “Transients in Electrical Systems”, McGraw-Hill, 2010
3. A. Greenwood, “Electrical Transients in Power Systems”, Wiley-Interscience, 1991
4. L. Van der Sluis, “Transients in Power Systems”, Wiley, 2001
5. J. A. Martinez-Velasco, “Power System Transients: Parameter Determination”, CRC Press, 2009
6. L. V. Bewley, “Traveling Waves on Transmission Systems”
7. H. W. Dommell, EMTP Theory Book.

8. Alternate Transients Program Rule Book.

Course Outcomes:

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

EE2204-C.1. Define, classify, interpret and model the transient phenomena in power system.

EE2204-C.2. Simulate the transients using PSCAD, EMTP/ATP software.

EE2204-C.3. Analyze transient phenomena

EE2204-C.4. Develop the strategies to mitigate associated problems.

EE2204-C.5. Evaluate the transient process due to lightning.

CO-PO-PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5
EE2204C.1	2	-	1	1	1
EE2204C.2	2	3	-	2	1
EE2204C.3	3	2	3	1	-
EE2204C.4	2	2	-	1	-
EE2204C.5	3	2	3	-	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE2204-D	Course category	PE
Course Name	MATHEMATICAL METHODS FOR POWER ENGINEERING		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2 hrs 30 min	--	--	100	03

Course Objectives:

Students will be able to:

1. Understand the relevance of mathematical methods to solve engineering problems
2. Understand how to apply these methods for a given engineering problem

Course Contents:

Vector spaces, Linear transformations, Matrix representation of linear transformation

Eigen values and Eigen vectors of linear operator

Linear Programming Problems, Simplex Method, Duality, Non Linear Programming problems

Unconstrained Problems, Search methods, Constrained Problems

Lagrange method, Kuhn-Tucker conditions, Random Variables, Distributions

Independent Random Variables, Marginal and Conditional distributions, Elements of stochastic processes

References Books:

1. Kenneth Hoffman and Ray Kunze, "Linear Algebra", 2nd Edition, PHI, 1992

2. Erwin Kreyszig, "Introductory Functional Analysis with Applications", John Wiley & Sons, 2004

3. Irwin Miller and Marylees Miller, John E. Freund's "Mathematical Statistics", 6th Edn, PHI, 2002

4. J. Medhi, "Stochastic Processes", New Age International, New Delhi. 1994

5. A Papoulis, "Probability, Random Variables and Stochastic Processes", 3rd Edition, McGraw Hill, 2002

6. John B Thomas, "An Introduction to Applied Probability and Random Processes", John Wiley, 2000

7. Hillier F S and Liebermann G J, "Introduction to Operations Research", 7th Edition, McGraw Hill, 2001

8. Simmons D M, "Non Linear Programming for Operations Research", PHI, 1975

Course Outcomes: -

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

EE2204-D.1. Know about vector spaces, linear transformation, eigenvalues and eigenvectors of Linear operators

EE2204-D.2. Learn about linear programming problems and understanding the simple method for solving linear programming problems in various fields of science and technology

EE2204-D.3. Acquire knowledge about nonlinear programming and various techniques used for solving constrained and unconstrained nonlinear programming problems

EE2204-D.4. Understand the concept of random variables, functions of random variable and their Probability distribution

EE2204-D.5. Understand stochastic processes and their classification

CO-PO-PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5
EE2204D.1	2	-	1	1	1
EE2204D.2	2	3	-	2	1
EE2204D.3	3	2	3	1	-
EE2204D.4	2	2	-	1	-
EE2204D.5	3	2	3	-	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	SH2201	Course category	RM
Course Name	RESEARCH METHODOLOGY		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
02	--	--	02	15	15	20	--	--	--	--	50	02

Course Contents:

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

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

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

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

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

Reference Books:

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.

6. Niebel, "Product Design", McGraw Hill, 1974.

7. Asimov, "Introduction to Design", Prentice Hall, 1962.

8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.

9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Course Outcomes:

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

SH2201.1. Understand research problem formulation

SH2201.2. Analyze research related information

SH2201.3. Follow research ethics

SH2201.4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity

SH2201.5. Understand that when IPR would take such important place in growth of Individuals Nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
SH2201.1	2	-	-	-	-
SH2201.2	2	3	-	2	-
SH2201.3	3	2	1	1	-
SH2201.4	2	2	-	1	-
SH2201.5	3	2	1	-	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE2205	Course category	PC
Course Name	LABORATORY PRACTICE – II		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
--	--	06	06	15	15	--	--	--	50	50	100	03

Minimum two simulations / performance type experiments on each course in the current semester should be performed. Respective Course Coordinators shall submit all details of experiments based on concerned course to the Course Coordinator of this course at the beginning of semester.

Note:

ICA - Internal Continuous Assessment shall be based on the practical record and knowledge / skills acquired. The performance shall assess experiment wise by using continuous assessment formats, **A** and **B**.

ESE - The End Semester Exam for practical shall be based on performance in one of experiments and may be followed by sample questions.

Course Outcomes:

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

EE2205.1. Write algorithm for Mann and Morison method

EE2205.2. Write MATLAB program for power system transient stability

EE2205.3. Analyze the travelling wave phenomenon

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
EE2205.1	2	1	-	1	1
EE2205.2	2	3	-	1	1
EE2205.3	3	2	2	2	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE2206	Course category	ISS
Course Name	SEMINAR – II		

Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
--	--	01	01	--	--	--	--	50	--	50	02

The hours shown in the teaching scheme for Seminar II are the contact hours for the students with concerned supervisor. Each student is expected to devote at least four hours per week for Seminar II.

Individual students are required to choose a topic of their interest for Seminar II. They shall acquire state-of-the art knowledge in that area and shall define the grey area related to topic (gap analysis) so as to carry dissertation in that area.

The students are required to review literature on the topic and deliver seminar.

A committee consisting of at least two faculty members (guide/ supervisor and one subject expert) shall be formed for evaluation. More faculties (subject experts) can be included in the committee. The committee shall assess the presentation of the seminar and award marks to the students based on merits of topic of presentation.

It is encouraged to do simulations/ experimentation related to the chosen topic and present the results at the end of the semester.

Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.

Each student shall submit two copies of a report of seminar. All sources shall be properly cited or acknowledged.

Course Outcomes:

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

EE2206.1. Perceive the idea and decide the title from literature survey

EE2206.2. Integrate information from multiple sources.

EE2206.3. Prepare the effective technical document related to work carried out

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
EE2206.1	2	1	-	1	1
EE2206.2	2	3	-	1	1
EE2206.3	3	2	2	2	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Member Secretary BoS Chairperson Dean (Academics) Principal

Course Code	EE2207	Course category	OJT/FP
Course Name	ON-JOB TRAINING / INTERNSHIP / FIELD PROJECT		

Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
--	--	--	--	--	--	--	--	50	--	50	04

Students must complete On-the-job training/ Internship / Field work for a duration of minimum four weeks during summer break, after completion of second semester of first year in the respective major subject.

The company/ organization for On-job training/ Internship/ Field work must be approved by the DFB.

The student must submit the report of On-job training / Internship/ Field work, in the format prescribed by the institute.

Course Code	EE2301-A	Course category	PE
Course Name	ARTIFICIAL INTELIGENCE AND MACHINE LEARNING		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2 hrs 30 min	--	--	100	03

Course Objectives:

Students will be able to:

1. To understand the basic concept of AI & ML.
2. To understand strength and weakness of problem solving and search algorithms.
3. To know about basic concepts of knowledge, and reasoning, Machine Learning.
4. To optimize the different linear methods of regression and classification.
5. To interpret the different supervised classification methods of support vector machine and tree based models.

Course Contents:

Basic Definitions and terminology, Foundation and History of AI, Overview of AI problems, Evolution of AI, Applications of AI, Classification/Types of AI. Artificial Intelligence vs Machine Learning, Intelligent Agent: Types of AI Agent, Concept of Rationality, nature of environment, structure of agents, Turing Test in AI.

Search Algorithms in Artificial Intelligence: Terminologies, Properties of search Algorithms, Types of search algorithms: uninformed search and informed search, State Space search Heuristic Search Techniques: Generate-and-Test; Hill Climbing; Properties of A* algorithm

Knowledge-Based Agent in Artificial intelligence: Architecture, Approaches to designing a knowledge-based agent, knowledge representation: Techniques of knowledge representation, Propositional logic, Rules of Inference, First-Order Logic, Forward Chaining and backward chaining in AI, Reasoning in Artificial intelligence: Types of Reasoning and Probabilistic reasoning, Uncertainty.

Introduction to Machine Learning: History of ML Examples of Machine Learning Applications, Learning Types, ML Life cycle, AI & ML, dataset for ML, Data Pre-processing, Training versus Testing, Positive and Negative Class, Cross-validation.

Types of Learning: Supervised, Unsupervised and Semi-Supervised Learning. Supervised: Learning a Class from Examples, Types of supervised Machine learning Algorithms, Unsupervised: Types of Unsupervised Learning Algorithm, Dimensionality Reduction: Introduction to Dimensionality Reduction, Subset Selection, and Introduction to Principal Component Analysis.

Classification: Binary and Multiclass Classification: Assessing Classification Performance, Handling more than two classes, Multiclass Classification-One vs One, One vs Rest, Regression: Assessing performance of Regression – Error measures, Overfitting and Underfitting,

Reference Books and Websites:

1. Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall

2. J. Gabriel, Artificial Intelligence: Artificial Intelligence for Humans (Artificial Intelligence, Machine Learning), Create Space Independent Publishing Platform, First edition, 2016

3. Peter Flach: Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Cambridge University Press, Edition 2012.

4. Introduction to Artificial Intelligence & Expert Systems, Dan W Patterson, PHI. 2010.

5. Kaushik, Artificial Intelligence, Cengage Learning, 1st ed. 2011.

6. Ric, E., Knight, K and Shankar, B. 2009. Artificial Intelligence, 3rd edition, Tata McGraw Hill

7. Luger, G.F. 2008. Artificial Intelligence - Structures and Strategies for Complex Problem Solving, 6th edition, Pearson.

8. Alpaydin, E. 2010. Introduction to Machine Learning, 2nd edition, MIT

9. Ethem Alpaydin: Introduction to Machine Learning, PHI 2nd Edition-2013.

10. Nilsson Nils J, "Artificial Intelligence: A new Synthesis, Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4.

Course Outcomes:

On completion of this course student will be able to:

EE2301-A.1. Evaluate Artificial Intelligence (AI) methods and describe their foundations.

EE2301-A.2. Analyze and illustrate how search algorithms play vital role in problem solving, inference, perception, knowledge representation and learning.

EE2301-A.3. Demonstrate knowledge of reasoning and knowledge representation for solving real world problems

EE2301-A.4. Recognize the characteristics of machine learning that makes it useful to real-world problems

EE2301-A.5. Apply the different supervised learning methods of support vector machine and tree based models.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
EE2301A.1	**1**	**-**	**-**	**1**	**-**
EE2301A.2	**2**	**1**	**1**	**2**	**-**
EE2301A.3	**2**	**1**	**1**	**2**	**-**
EE2301A.4	**1**	**-**	**-**	**1**	**-**
EE2301A.5	**1**	**-**	**-**	**-**	**2**

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE2301-B	Course category	PE
Course Name	POWER QUALITY ISSUES AND MITIGATION		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2 hrs 30 min	--	--	100	03

Course Objectives:

Students will be able to:

1. Understand the different power quality issues to be addressed
2. Understand the recommended practices by various standard bodies like IEEE, IEC, etc. on voltage& frequency, harmonics
3. Understand STATIC VAR Compensators

Introduction-power quality-voltage quality-overview of power quality phenomena, classification of power quality issues-power quality measures and standards-THD-TIF-DIN-C, message weights-flicker factor transient phenomena-occurrence of power quality problems, power acceptability curves-IEEE guides, standards and recommended practices.

Harmonics-individual and total harmonic distortion, RMS value of a harmonic waveform, Triplex harmonics-important harmonic introducing devices-SMPS, Three phase power converters, arcing devices saturable devices-harmonic distortion of fluorescent lamps-effect of power system harmonics on power system equipment and loads.

Modeling of networks and components under non-sinusoidal conditions transmission and distribution systems, Shunt capacitors-transformers-electric machines-ground, systems loads that cause power quality problems, power quality problems created by drives and its impact on drive

Power factor improvement- Passive Compensation, Passive Filtering , Harmonic Resonance Impedance Scan Analysis- Active Power Factor Corrected Single Phase Front End, Control Methods for Single Phase APFC, Three Phase APFC and Control Techniques, PFC, Based on Bilateral Single Phase and Three Phase Converter

Static VAR compensators-SVC and STATCOM Active Harmonic Filtering-Shunt Injection, Filter for single phase, three-phase three-wire and three-phase four- wire systems d-q domain control of three phase shunt active filters uninterruptible power supplies constant voltage transformers, series active power filtering techniques for harmonic cancellation and isolation.

Dynamic Voltage Restorers for sag , swell and flicker problems. Grounding and wiring introduction, NEC grounding requirements-reasons for grounding, typical grounding and wiring problems solutions to grounding and wiring problems

Reference Books:

1. G. T. Heydt, "Electric power quality", McGraw-Hill Professional, 2007

2. Math H. Bollen, "Understanding Power Quality Problems", IEEE Press, 2000

3. J. Arrillaga, "Power System Quality Assessment", John Wiley, 2000

4. J. Arrillaga, B. C. Smith, N. R. Watson & A. R. Wood," Power system Harmonic Analysis", Wiley, 1997

Course Outcomes:

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

EE2301-B.1	Acquire knowledge about the harmonics, harmonic introducing devices and effect of harmonics on system equipment and loads
EE2301-B.2	Develop analytical modeling skills needed for modeling and analysis of harmonics in networks and components
EE2301-B.3	Introduce the student to active power factor correction based on static VAR compensators and its control techniques
EE2301-B.4	Introduce the student to series and shunt active power filtering techniques for harmonics
EE2301-B.5	Understand the importance of grounding and wiring, problems thereof, solution to grounding and wiring problems.

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
EE2301B.1	**2**	**-**	**-**	**-**	**-**
EE2301B.2	**2**	**2**	**1**	**2**	**2**
EE2301B.3	**2**	**2**	**1**	**2**	**2**
EE2301B.4	**2**	**2**	**1**	**2**	**2**
EE2301B.5	**2**	**-**	**-**	**3**	**2**

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE2301-C	Course category	PE
Course Name	ADVANCED ELECTRIC DRIVES		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2 hrs 30 min	--	--	100	03

Course Objectives:

Students will be able to:

1. Understand the operation of power electronic converters and their control strategies.
2. Understand the vector control strategies for ac motor drives
3. Understand the implementation of the control strategies using digital signal processors.

Course Contents:

Power Converters for AC drives
PWM control of inverter, selected harmonic elimination, space vector modulation, current control of VSI, three level inverter, Different topologies, SVM for 3 level inverter, Diode rectifier with boost chopper, PWM converter as line side rectifier, current fed inverters with self-commutated devices. Control of CSI, H bridge as a 4-Q drive.

Induction motor drives
Different transformations and reference frame theory, modeling of induction machines, voltage fed inverter control-v/f control, vector control, direct torque and flux control (DTC).

Synchronous motor drives
Modeling of synchronous machines, open loop v/f control, vector control, direct torque control, CSI fed synchronous motor drives.

Permanent magnet motor drives
Introduction to various PM motors, BLDC and PMSM drive configuration, comparison, Block diagrams, Speed and torque control in BLDC and PMSM.

Switched reluctance motor drives
Evolution of switched reluctance motors, various topologies for SRM drives, comparison, Closed loop speed and torque control of SRM.

DSP based motion control

Use of DSPs in motion control, various DSPs available, realization of some basic blocks in DSP for implementation of DSP based motion control.

References Books:

1. B. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education, Asia, 2003.
2. P. C. Krause, O. Wasynczuk and S. D. Sudhoff, "Analysis of Electric Machinery and Drive Systems", John Wiley & Sons, 2013.
3. H. A. Taliyat and S. G. Campbell, "DSP based Electromechanical Motion Control", CRC press, 2003.
4. R. Krishnan, "Permanent Magnet Synchronous and Brushless DC motor Drives", CRC Press, 2009.

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Course Outcomes:

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

EE2301-C.1	Explain operation of power electronic converters and their control strategies
EE2301-C.2	Describe vector control strategies for induction and synchronous motor drives
EE2301-C.3	Present operation and control of permanent magnet motor drive
EE2301-C.4	Present operation and control of switched reluctance motor drive
EE2301-C.5	Understand the implementation of the control strategies using digital signal processors

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
EE2301C.1	3	2	-	2	3
EE2301C.2	3	2	-	3	2
EE2301C.3	3	3	3	2	2
EE2301C.4	3	2	-	3	2
EE2301C.5	3	3	-	2	2

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE2301-D	Course category	PE
Course Name	ADVANCED CONTROL SYSTEM		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2 hrs 30 min	--	--	100	03

Course Objectives:

Students will be able to:

1. Analyze and design linear dynamic system
2. Analyze nonlinear systems
3. Analyze digital control system

Course Content:

Review of Linear Algebra: Vector space, linear combination, linear independence, bases of a vector space, representation of any vector on different basis, matrix representation of a linear operator, change of basis, rank, nullity, range space and null space of a matrix, Eigen value and Eigen vector of a matrix, similarity transform, Diagonalization.

Linear System analysis in state space: Controllability, Observability and Stability, Luapunov stability analysis of SISO and MIMO linear systems, Minimal realizations and co-prime fractions.

Control Design: State feedback controller by pole placement and design of observer for linear systems, Design of PI/PID controller.

Optimal Control: Formulation of optimal control problem, linear quadratic regulator (LQR).

Non-linear Systems: Introduction to nonlinear systems, phase plane and describing function methods for analysis of linear systems and linearization,

Digital Control System: Discrete time systems, discretization, sampling, aliasing, choice of sampling frequency, ZOH equivalent.

References Books:

1. Chi-Tsong Chen, "Linear System Theory and Design", Oxford University Press
2. John S. Bay, "Linear System Theory"
3. Thomas Kailath, "Linear System", Prentice Hall, 1990
4. Gillette "Computer Oriented Operation Research", McGraw Hill Publications
5. K. Hoffman and R. Kunze, "Linear Algebra", Prentice-Hall (India), 1986
6. G.H. Golub and C. F. Van Loan, "Matrix Computations", North Oxford Academic, 1983

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7. H. K. Khalil, "Nonlinear Systems", Prentice Hall, 2001.

8. K. Ogata, "Discrete Time Control Systems", Prentice Hall, 1995

Course Outcomes:

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

EE2301-D.1 Analyze linear control system using vector spaces.

EE2301-D.2 Design linear control system using state space to achieve desired system performance

EE2301-D.3 Design Linear quadratic regulator to achieve desired system performance

EE2301-D.4 Analyze non- linear systems

EE2301-D.5 Obtain discrete representation of LTI systems

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
EE2301D.1	3	3	-	2	3
EE2301D.2	3	3	-	3	2
EE2301D.3	3	3	3	2	3
EE2301D.4	3	3	-	3	2
EE2301D.5	3	3	-	3	2

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	SH2301-A	Course category	OE
Course Name	INDUSTRIAL SAFETY		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2 hrs 30 min	--	--	100	03

Course Objectives:
To make the students aware and understand:

1. Importance of Industrial safety
2. Fundamental of maintenance engineering
3. Prevention of wear and corrosion
4. Fault tracing
5. Periodic and preventive maintenance

Course Content:

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc. Safety color codes. Fire prevention and firefighting, equipment and methods.

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: i. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Reference Books:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, McGraw Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall, London.

Course Code	SH2301-B	Course category	OE
Course Name	OPERATIONS RESEARCH		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2 hrs 30 min	--	--	100	03

Course Contents:

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models – Geometric Programming.

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References Books:

1. H. A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J. C. Pant, Introduction to Optimization: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Course Outcomes:

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

SH2301-B.1. Apply the dynamic programming to solve problems of discrete and continuous variables.
SH2301-B.2. Apply the concept of non-linear programming
SH2301-B.3. Carry out sensitivity analysis.
SH2301-B.4 Model the real world problem and simulate it

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Course Code	SH2301-C	Course category	OE
Course Name	**PROJECT MANAGEMENT**		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2 hrs 30 min	--	--	100	03

Course Content:

Introduction: Human Factors and Systems, Information Input and Processing, Visual Displays of Dynamic Information, Human Output and Control: Physical Work and Manual Materials Handling, Motor Skills, Human Control of Systems, Hand Tools and Devices.

Definition of Ergonomics and its significance in designing workplace layout and detailed motion plan of work, Man-Machine Symbiosis, Human Factors in design & manufacturing, Viz. pressure of the environment, temperature, humidity etc., Principles of motion economy, anthropometric condition, stability criterion etc. Biodynamic analysis for design of products & its concept of learning by man and machine;

Measurement of Learning Index and training for each job and each man, Product design – various aspects including ergonomic design and reliability based design.

Dynamic consideration in design of product using vibration stability in biomechanisms. Safety in manufacturing. Considerations of human stress, Allowable limit of stress, stress adjustment.

Estimation of human error and human reliability, combining various forms of human error by random number simulation, Human Error, Accidents and safety, Human Factors and the Automobile, Human Factors in Systems Design.

Dynamic consideration in project operations, leadership, requirement, communication process, motivating a diverse workflow, facilitating team decisions, resolving interpersonal conflicts, managing different people, strengthening team accountability

Reference Books:

1. Sanders, M. M. & Mc Cormick, E. J., Human Factors in Engineering & Design, McGraw Hill, 7th ed. (1993)

2. S. K. Basu, K. C. Sahu and Rajiv B, Industrial Organization and Management, PHI New Delhi, Nov 2012

Course Code	SH2301-D	Course category	OE
Course Name	DATA STRUCTURE AND ALGORITHM		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2 hrs 30 min	--	--	100	03

Course Objectives:

1. Write neat code by selecting appropriate data structure and demonstrate a working solution for a given Problem.
2. Think of all possible inputs to an application and handle all possible errors properly.
3. Analyze "Clearly different possible solutions to a program and select the most efficient one.
4. Write an application requiring an effort to fat least l000 lines of code to demonstrate a good working solution.
5. Demonstrate the ability to write reusable code and abstract data types in C, using object-based way of thinking

Course Contents:

Introduction:
Data, Data types. Object, data structure and abstract data types (ADT). Characteristics of an algorithm' Analyzing programs Frequency count Time and space complexity. Big 'O' and Ω notation. Best, average and worst cases. Dangling pointers and garbage memory. Arrays, Files and Searching: Searching: linear and binary search algorithm. Hashing: hashing functions, chaining, overflow handling with and without chaining, open addressing: linear. Quadratic Teaching Scheme: Examination Scheme: probing. Files handling: text and binary files, use of various libraries for handling files.

Stacks and Queues:
Stack and queue. as ADT. Operations on stack and queue. Implementations using arrays and dynamic memory allocation. Application of stack for expression evaluation, expression conversion. Recursion and stacks. Problems like maze and knight's tour.

Lists:
List as ADT. Concept of linked organization of data against linked list. Singly linked list, doubly linked list, circular linked list. Representation & manipulations of polynomials/ sets using linked lists. Dynamic memory management. Representation of sparse matrix. Addition and transpose of sparse matrix.

Trees and Graphs:
Basic terminology. Binary trees and its representation. Binary tree traversals (recursive and non-recusive) and various operations. Insertion and deletion of nodes in binary search tree. Representation of graphs using adjacency matrix, adjacency list. Implementation of algorithms for traversals; implementing Kruskal's. Prim's algorithms. Single source shortest paths using Djkstra's algorithm. Applications of graphs and trees

Time Complexity Analysis, Algorithm Design:
Verification of programs, invariants, assertions, proof of termination. Best, Average and Worst case analysis of binary search, quick sort, merge sort, insertion sort, hashing techniques, sparse matrix algorithms. Designing data structures for specific applications

Reference Books:

1. E. Horowitz, S. Sahni, S. Anderson-freed, "Fundamentals of Data Structures in C", Second Edition, University Press, ISBN 978-81-7371-605-8
2. B. Kernighan, D. Futchie, "The C Programming Language", Prentice Hall of India, Second Edition, ISBN 8 1 -203-0596-5
3. Y. Langsam, M. Augenstin and A. Tarmenbaum, "Data Structues using C", Pearson Education Asia, First Edition, 2002, ISBN 978-81-317-0229-1
4. Ellis Horowitz, S. Sahni, D. Mehta "Fundamentals of Data Structures in C++", Galgotia Book Source, New Delhi 1995 ISBN 16782928
5. Jean-Paul Tremblay, Paul. G. Soresan, "An inhoduction to data structures with Applications",Tata Mc-Graw Hill Intemational Editions, 2nd edition 1984, ISBN-007-462471-7

Course Code	SH2301-E	Course category	OE
Course Name	NANO TECHNOLOGY		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2 hrs 30 min	--	--	100	03

Course Objectives:

Students will be able to:

1. Understand the history, background and nature of nanoscience and nanotechnology as well as the quantum and nanosized scale effect on materials.
2. Acquire theoretical understanding of different types of materials and their application in nanotechnology.
3. Understand the physics behind the unusual properties of nanomaterials and its applications.
4. Learn the method of synthesis & characterization of graphene and graphene oxide.
5. Develop a strong background if he/she chooses to pursue research in Nanoscience and Nanotechnology as a career.

Course Contents:

Basics and scale of Nanotechnology:

Scientific revolutions –Time and length scale in structures – Definition of a nano system – Dimensionality and size dependent phenomena – Surface to volume ratio -Fraction of surface atoms – Surface energy and surface stress- surface defects-Properties at nanoscale (optical, mechanical, electronic, and magnetic).

Different classes of Nanomaterials:

Classification based on dimensionality-Quantum Dots, Wells and Wires, preparation of quantum nanostructures, size effects, conduction electrons and dimensionality, Fermi gas and density of states, potential wells, partial confinement, properties dependent on density of states, exitons, single electron tunnelling.

Material Synthesis Method:

Nanostructures of one dimension: Crystalline growth, Template based synthesis. Nanostructures of two dimensions: Fundamentals of thin film growth, physical vapour deposition, chemical vapour deposition, atomic layer deposition, self-assembly, Langmuir-Blodgett films, Sol-Gel films, electrochemical deposition.

Nanostructures of three dimensions:

Nanocomposites, Severe plastic deformation process: Fric-tion stir processing (FSP) and equi-channel angular pressi.

Material Characterization Methods:

UV visible microscopy; scanning electron microscopy (SEM); transmission electron microscopy/diffraction (TEM); x-ray diffraction (XRD); neutron diffraction; scanning probe microscopy.

Advance Nanomaterials:

Graphene; brief history of graphene, structure of graphene, Types of graphene, synthesis methods of graphene and graphene oxide, applications of graphene

Textbooks:

1. Introduction to Nanotechnology by C. P. Poole Jr. and F. J. Oweus, Wiley Interscience
2. Nano-Technology by Gregory Timp (Editor), AIP Press, Springer.
3. Pradeep T., "A Textbook of Nanoscience and Nanotechnology", Tata McGraw Hill Education Pvt. Ltd.

Reference Books and Website Links:

1. Hari Singh Nalwa, "Nanostructured Materials and Nanotechnology", Academic Press
2. Graphene: Synthesis and applications, edited by Wonbong Choi and Jo-won Lee.
3. Semiconductor Nanostructures and Nanodevices, Vol 1-5-A. A. Balandin, K. L.Wang.
4. Springer Handbook of Nanotechnology: Bharat Bhushan
5. Nanofabrication towards biomedical application: Techniques, tools, Application and impact: Ed. Challa S., S. R. Kumar, J. H. Carola
6. A. S. Edelstein and R. C. Cammarata, "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Pub., 1998.
7. G. Cao, Nanostructures & Nanomaterials: Synthesis, Properties & Applications, Imperial College Press, 2004.
8. G.A. Ozin and A.C. Arsenault, "Nano chemistry: A chemical approach to nanomaterials", Royal Society of Chemistry, 2005.
9. Joel I. Gersten, "The Physics and Chemistry of Materials", Wiley, 2001.
10. K.W. Kolasinski, "Surface Science: Foundations of Catalysis and Nanoscience", Wiley, 2002.
11. Physical Chemistry – Atkins Peter, Paula Julio.
12. Nanotechnology in Biology and Medicine: Methods, Devices, and Applications.

Course Outcomes:

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

SH2301-E.1. To learn basic material science with special, emphasize on nanomaterials.

SH2301-E.2. Correlate physical behavior of materials at the nanoscale with quantum mechanics

SH2301-E.3 Understand the physical, chemical and biological methods for synthesis of nanoparticles**.**

SH2301-E.4 Understand the various characterization techniques of nano materials.

SH2301-E.5 Apply the knowledge gained to suggest different applications of nanoscience and technology.

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
EE2101.1	**3**	**-**	**-**	**-**	**-**
EE2101.2	**2**	**3**	**3**	**2**	**-**
EE2101.3	**3**	**-**	**-**	**-**	**3**
EE2101.4	**3**	**-**	**2**	**-**	**-**
EE2101.5	**3**	**-**	**-**	**3**	**3**

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE2302	Course category	RP/DI
Course Name	DISSERTATION STAGE - I		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
--	--	04	04	--	--	--	--	--	150	--	150	13

Course Objectives:

To make the students competent for:

1. Carrying out literature survey based on latest technological advancements
2. Selecting a topic for dissertation based on literature survey
3. Development of a system to carry out analysis/experimental investigation for the selected area/problem.

Course Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have:

1. Relevance to social needs of society
2. Relevance to value addition to existing facilities in the institute
3. Relevance to industry need
4. Problems of national importance
5. Research and development in various domain

Student shall complete dissertation work in III, & IV semesters individually. In III semester, student shall complete Literature survey and decide the dissertation topic. He/She shall complete conceptual study and design part of dissertation topic and submit the progress report in proper format. Student has to deliver a seminar on the selected topic (covering 25% or more work). It is to be evaluated internally by three member's panel of examiners headed by the HoD wherein guide should be one of the members of the panel. Last date of submission of report shall be two weeks before the end of semester.

Course Outcomes:

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

EE2302.1 Carry out analysis/experimental investigation for the selected area/problem and derive conclusions based on results of investigations carried out

EE2302.2 Select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design

EE2302.3 Write dissertation report

EE2302.4 Prepare and deliver presentation

EE2302.5 Present the work in International/ National conference or reputed journals.

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
EE2401.1	**3**	**-**	**-**	**2**	**-**
EE2401.2	**3**	**-**	**-**	**-**	**-**
EE2401.3	**-**	**2**	**-**	**-**	**3**
EE2401.4	**-**	**-**	**-**	**2**	**-**
EE2401.5	**2**	**-**	**2**	**-**	**-**

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE2401	Course category	RP/DI
Course Name	DISSERTATION STAGE - II		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
--	--	04	04	--	--	--	--	--	100	200	300	18

Course Objectives:

To make the students competent for:

1. Make the students competent to carry out analysis/ experimental investigation for the selected area/problem and derive conclusions based on results of investigations carried out.
2. Make the students competent to write dissertation report.
3. Make the students competent to prepare and deliver presentation.

Course Contents:

Syllabus Dissertation (Phase II):

1. Student shall complete dissertation work in IV semester, and submit a progress report in proper format.

2. Dissertation (Phase-II): Internal assessment of dissertation (complete work) is to be carried out by three members panel of examiners headed by HOD wherein guide should be one of the members of the panel, for 100 marks. The external assessment of dissertation work is to be carried out by panel of examiners consisting of internal (guide) and external examiner for 200 marks.

Candidate shall present the entire work on Dissertation, followed by viva-voce. Last date of submission of dissertation will be the end of the semester. Please see Appendix-C of Rules & Regulation for further information.

***Note:** Dissertation Phase-I (EE2302) & Seminar as prerequisite for (EE2401) Dissertation Phase-II

In case of unsatisfactory performance, committee may recommend for extension or repeating the work

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Course Outcomes:

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

EE2401.1 Synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem.

EE2401.2 Select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design

EE2401.3 Develop a system to carry out analysis/experimental investigation for the selected area/problem

EE2401.4 Present the findings of their technical solution in a written report

EE2401.5 Present the work in International/ National conference or reputed journals

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5
EE2401.1	3	-	-	2	-
EE2401.2	3	-	-	-	-
EE2401.3	-	2	-	-	3
EE2401.4	-	-	-	2	-
EE2401.5	2	-	2	-	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated