ACADEMIC REGULATIONS (R18PG)

COURSE STRUCTURE AND DETAILED SYLLABUS

For

M.Tech.- Regular Two Year Post Graduate Degree Programe

(Effective from 2018-19)

MASTER OF TECHNOLOGY
IN
POWER SYSTEMS

KANDULA SRINIVASA REDDY MEMORIAL COLLEGE OF ENGINEERING

(UGC-Autonomous)

Kadapa 516003, A.P

(Approved by AICTE, Affiliated to JNTUA, Ananthapuramu, Accredited by NAAC)

(An ISO 14001:2004 & 9001: 2015 Certified Institution)

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VISION AND MISSION OF THE INSTITUTE

VISION

To evolve as centre of repute for providing quality academic programs amalgamated with creative learning and research excellence to produce graduates with leadership qualities, ethical and human values to serve the nation.

MISSION

M-1: To provide high quality education with enriched curriculum blended with impactful teaching-learning practices.

M-2: To promote research, entrepreneurship and innovation through industry collaborations.

M-3: To produce highly competent professional leaders for contributing to Socio-economic development of region and the nation.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION

To emerge as a department of excellence in the domain of Electrical and Electronics Engineering producing globally competent engineers with research acumen having moral and social values.

MISSION

M-1: To offer education with skill-based curriculum through innovative pedagogy, enabling the students to engage in lifelong learning.

M-2: To establish industry interactions for creating research-oriented culture to invoke the desire among the students for pursuing successful career.

M-3: To maintain sustainable environment of learning in which students acquire knowledge and imbibed with social and ethical values.

PROGRAM EDUCATIONAL OBJECTIVES

Program Educational Objectives of the Electrical and Electronics Engineering provides the following wide aspects in connection with the Vision and Mission of the department.

PEO1: To pursue higher studies or be employed in Electrical and Electronics Engineering or relevant disciplines.

PE02: To analyze real life problems and design Electrical and Electronics Engineering systems with appropriate solutions that are technically sound, economically feasible and socially acceptable.

PEO3: To exhibit professionalism, ethical attitude, communication skills, team work in their profession and adapt to current trends by engaging in lifelong learning.

PROGRAM OUTCOMES

PO1 - Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 - Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 - Design/Development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 - Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 - Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6 - The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 - Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 - Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

PO9 - Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 - Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 - Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 - Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES

PSO1: Able to apply the knowledge of Science, Mathematics; Electrical and Electronics Engineering fundamentals to solve complex problems in Electrical Machines, Control Systems, Power Systems and Power Electronics.

PSO2: Able to analyze the performance of Electrical Machines, Power Systems and

Control Systems.

PSO3: Able to apply the knowledge of ethical and management principles required to

work on a team as well as to lead a team.

KSRM College of Engineering, Kadapa-516003, AP

Regulations, Curriculum and Syllabus for M. Tech

KSRM College of Engineering, Kadapa-516003, AP

Regulations for PG Programs in Engineering (R18 PG)

1.0 Nomenclature

1.1 *Academic Term*: Extent of time during which academic instructions are initiated and completed

1.2 *Academic Year*: Academic Term of, approximately, one year duration that usually starts in June/July and ends in April/May next

1.3 *Semester*: Either of two Academic Terms that make up an Academic Year

1.4 *Major*: A specific field of study

1.5 *Minor*: An area outside of, or complementary to, a Major

1.6 *Subject*: An area of knowledge that is studied as part of a Course

1.7 *Core*: A subject that is mandatory for a Major course of study

1.8 *Elective*: A subject that is selected for study to suit one's individual needs

1.9 *Audit Subject*: A subject that is studied to meet certain requirements but has no credits assigned to it

1.10 *Humanities*: Subjects that describe and interpret human achievements, problems and historical changes at individual and societal levels covering the disciplines of literature, history, and philosophy

1.11 *Social Sciences*: Subjects that describe the mental and behavioural activities of individuals, groups, organizations, institutions, and nations covering the disciplines of anthropology, economics, linguistics, political science, and psychology

1.12 *Exam*: A test to measure one's progress, knowledge, or ability in a subject

1.13 *Credit*: A numerical weight given to a subject

1.14 *Grade*: A numerical or alphabetic designation measuring the level of achievement in an exam

1.15 *Attendance*: Physical presence of oneself in a classroom/laboratory for purpose of a scheduled academic instruction

1.16 *Course*: A series of subjects that constitute a Major field of study

1.17 *Branch*: Same as Course

1.18 *Program*: Same as Course

1.19 *Specialization*: Same as branch

1.20 *Degree*: An academic title conferred to honour distinguished achievement

2.0 Short Title and Application

2.1 These rules and regulations may be called as R18 PG and come into force from Academic Year 2018-19 and exist until superseded by new regulations

2.2 These rules and regulations are applicable to all post graduate courses in engineering and technology leading to Master's Degree in Technology (M. Tech)

2.3 The Specializations offered, at present, are:

2.3.1 Geotechnical Engineering

2.3.2 Power Systems

2.3.3 CAD & CAM

2.3.4 Digital Electronics and Communication Systems

2.3.5 Computer Science and Engineering

2.4 The Institute may offer new Specializations in future to which these rules and regulations will be applicable

3.0 Suspension and Amendment of Rules

3.1 Academic Council has the authority to suspend a rule temporarily

3.2 Academic Council has the authority to amend a rule

3.3 For affirmative action on any suspension or amendment of a rule, an affirmative vote of three-fifths of the members present and voting shall be required in Academic Council

4.0 Requirements for Admission

4.1 At present, admissions into first semester of various Specializations are governed by Government and the Affiliating University. The eligibility criteria and procedure for admission are prescribed by Government and Affiliating University

4.2 A student is not allowed change of Specialization after admission

4.3 A student must fulfil medical standards required for admission

4.4 The selected students are admitted into first semester after payment of the prescribed fees

5.0 Structure of the M. Tech course

5.1 *Duration*: The duration of M. Tech degree course is four semesters

5.2 *Working Days*: Calendar for any semester shall be announced at least four weeks before its commencement. Minimum number of working days is 90 per semester

5.3 *Curriculum*: Each Specialization shall have core, elective and audit subjects. The curriculum for each Specialization shall be approved by its corresponding Board of Studies and then by the Academic Council

5.4 *Credits*: All subjects that are assessed for marks have credits assigned to them. The credits assigned to subjects shall be given in curriculum. The total number of credits for entire course is 68 for all Specializations. The distribution of total credits semester-wise is given in Table 1

Table 1 Semester-wise Total Credits

Semester	Total Credits
First Semester	18
Second Semester	18
Third Semester	16
Fourth Semester	16
Total for entire course	**68**

5.5 The curriculum and syllabus is given in Annexure-1 and Annexure-2 respectively

5.6 Responsibility and Advising: It is the responsibility of the student to understand and know the regulations and requirements to earn the degree. Each student admitted in to the degree programs is assigned to a Faculty Advisor who assists the student in designing an effective program of study. Students should consult their Faculty Advisors for selection of electives and for general advice on academic program

6.0 Registration and Enrolment

6.1 Prior to opening of each semester, every student shall register for all the credit-bearing and audit subjects listed in curriculum of the term. Excepting first semester, the registration for a semester shall be done during a specified week after end examinations of previous semester. In first semester, the registration shall be done within six working days from date of opening. Recommendation of Faculty Advisor is needed for registration

6.2 Late registration will be permitted with a fine, decided from time to time, up to six working days from the last date specified for registration

6.3 A student will be eligible for registration for a semester if she or he i) is promoted to that semester, ii) has cleared all fees to the Institute, library and hostel of previous term, and iii) is not disqualified for registration by a disciplinary action of the Institute

6.4 A student will be enrolled and allowed to attend the classes on successful registration and payment of necessary fees to Institution, library, and hostel

6.5 Registration and enrolment will be controlled by the Office of the Controller of Examinations

7.0 Assessment Procedure – Internal Tests and End Examinations

7.1 Performance of students in all subjects is assessed continuously through internal assessment tests and an End examination

7.2 Allocation of internal assessment and End examination marks

7.2.1 For theory subjects, the allocation is 40 marks for internal assessment and 60 marks for End examination totalling 100 marks

7.2.2 For laboratory/project work subjects, the allocation is 50 marks for internal assessment and 50 marks for End examination totalling 100 marks

7.2.3 For mini-project/mini-project with seminar total 100 marks are allocated for internal assessment. There shall be no end examination for this mini-project

7.2.4 For all audit subjects the allocation is 40 marks for internal assessment and no allocation for End examination

7.3 Internal Assessment Examinations

7.3.1 Internal assessment means performance evaluation of students by faculty members who teach the subjects

7.3.2 For theory subjects, including audit subjects, the internal assessment shall be done by midterm tests. For each subject, two midterm tests will be conducted for 40 marks each and the internal assessment mark is the better of two marks. If any student abstains for any midterm test, she or he will be awarded zero marks for that midterm test.

7.3.3 For laboratory/practical subjects, the internal assessment will be based on regular laboratory work over full term. The assessment will be done by the faculty concerned. The students shall be informed sufficiently early of the procedure to be followed for internal assessment

7.3.4 For subjects like seminar, project-work, industrial training, and comprehensive viva-voce, the internal assessment will be done by a concerned Department Committee consisting of two senior faculty members and faculty guide of concerned student. The assessment procedure will be informed sufficiently early to the students

7.4 End examinations

7.4.1 End examinations shall be conducted after completion of coursework in each term

7.4.2 The question papers for theory subjects shall be set by faculty members outside of the Institute. The external faculty members for question paper setting will be selected by the Principal

7.4.3 Evaluation of answer scripts shall be done by faculty members from outside of the Institute selected by the Principal

7.4.4 For laboratory subjects, end examination shall be conducted by a committee consisting of two internal examiners. One examiner shall be recommended by Head of Department of concerned Major, and the other examiner shall be appointed by the Principal

7.4.5 For project work viva-voce, End examination shall be conducted by a committee consisting of one internal examiner, one external examiner, and the concerned guide of the student. Internal examiner shall be appointed by Head of Department of concerned Major, and the external examiner shall be appointed by the Principal

7.4.6 If a student abstains from End examination of any subject, for any reason, she or he shall be awarded zero marks in that subject

7.4.7 There is no end examination for audit subjects.

8.0 Method of Assigning Letter Grades and Grade Points

8.1 For all credit-bearing subjects, performance of a student in a subject is indicated by a letter grade that corresponds to absolute marks earned in that subject. Each letter grade is assigned a numeric Grade Point that is used to compute Grade Point Average on a scale of 0 to 10

8.2 Performance of a student in both internal assessment and End examination will be considered for awarding grades for credit bearing subjects. Total marks earned in a subject is the sum of marks obtained in internal and End examinations in that subject

8.3 Pass grade A+ to D- is assigned to a subject based on total marks earned in that subject provided that a student earns at least i) 35% of marks in End examination marks and ii) 40% of marks in internal and End examination marks put together; otherwise fail grade F will be assigned to that subject

8.4 Grade I will be assigned to a subject if a disciplinary action is pending and is not resolved before publication of results. Office of Controller of Examinations shall resolve the pending disciplinary action within six working days from the date of publication of results and change the grade to any of A+ to D- or F

8.5 Grade X will be assigned to a subject if a student abstains for End examination of that subject

8.6 The absolute marks and corresponding letter grade and grade points are given in Table2

Table 2 Letter Grades and Grade Points

Absolute Marks	Letter Grade	Grade Points	Remark
95-100	A+	10.0	Pass
90-94	A	9.5	Pass
85-89	A-	9.0	Pass
80-84	B+	8.5	Pass
75-79	B	8.0	Pass
70-74	B-	7.5	Pass
65-69	C+	7.0	Pass
60-64	C	6.5	Pass
55-59	C-	6.0	Pass
50-54	D+	5.5	Pass
0-49	F	0.0	Fail
-	I	0.0	Result Withheld
-	X	0.0	Absent for End Exam

8.7 *SGPA*: Semester Grade Point Average indicates the performance of a student in all credit-bearing subjects of a term. SGPA is calculated as the weighted average

of Grade Points of all subjects of the term with corresponding credits of subjects as weights. Audit subjects are not considered for SGPA calculation

8.8 *CGPA*: Cumulative Grade Point Average indicates the performance of a student in all terms up to and including the current term under consideration. CGPA is calculated as the weighted average of SGPAs with total credits in each term as the weights

8.9 *Grade Card*: All students shall be issued Grade Cards after the publication of results of a term. Grade Card is a statement of performance of a student in a term. It contains information about each registered subject: type of subject, allocated credits, and letter grade earned. SGPA and CGPA will also be indicated

9.0 Requirements for Completing Subjects

9.1 A student shall complete all credit-bearing and audit subjects successfully to be eligible for award of degree

9.2 *Credit-bearing subjects*: A student is considered to have completed a credit-bearing subject successfully and earned credits if she or he obtains a pass grade from A+ to D- in that subject. If a student receives fail grade F or X in any subject, she or he must register for supplementary End examination for that subject as and when opportunity arises and improve grade to pass grade

9.3 *Audit subjects*: A student is considered to have successfully completed an audit subject if she or he earns at least 40% of marks in internal assessment marks. A student may request for makeup tests to satisfy this requirement by paying requisite fee

10.0 Requirements for taking End Examinations

10.1 A student is eligible to take regular End Examinations of current semester if she or he full fills the attendance requirement

10.2 A student shall be promoted from current term to succeeding term on satisfying the attendance requirement

10.3 A student shall complete all credit-bearing and audit subjects successfully before taking End examination for project viva-voce

10.4 Attendance Requirement

10.4.1 Attendance of students shall be recorded for credit-bearing and audit subjects as per the workload indicated in curriculum

10.4.2 Total class-periods conducted shall be reckoned from beginning to end of a term as published in academic calendar

10.4.3 Aggregate Percentage of Attendance is calculated using total number of class-periods attended as numerator and total number of class-periods conducted for the concerned subject as the denominator

10.4.4 A minimum aggregate attendance of 75% is required for promotion to succeeding term

10.4.5 A student can appeal to Academic Council for condoning deficiency in aggregate attendance if she or he gets 65% or more aggregate attendance presenting a valid reason for deficiency. Such a student will be granted

promotion if Academic Council pardons the deficiency. Academic Council has the right to reject the appeal if it is not satisfied with the performance of the student or the reason cited for deficiency of the attendance

10.4.6 A student earning less than 65% aggregate attendance will be denied promotion. A student who is not promoted on basis of attendance shall be removed from the rolls and shall register for the same term when opportunity arises. The current term record of the student is cancelled automatically

10.5 A student can forego promotion and opt to repeat the current term on written request. Recommendation of the concerned Faculty Advisor is required for cancellation of promotion. This option shall be exercised before the commencement of the End examinations of the current term

11.0 Revaluation of End Examination Scripts

11.1 Revaluation of End Examination scripts is allowed for theory subjects only by paying requisite fee

11.2 A Procedure for Revaluation: The script will be revaluated by an examiner appointed by the Principal. The maximum of revaluation and regular end examination marks will be awarded for that subject

11.3 A student can apply for revaluation in a subject only once

12.0 Supplementary End Examinations

12.1 Students are eligible to take Supplementary examinations in subjects with fail grade F or X only

12.2 Supplementary examinations for even semester subjects will be conducted with regular examinations of odd semester subjects and vice versa

12.3 A student will be allowed to improve grade in any theory subject provided she or he has completed coursework of all terms but before award of provisional/final degree

13.0 Requirements for Award of M. Tech degree

13.1 Time Limit for completion of requirements for award of degree is four calendar years from the date of admission. A student who could not complete all the requirements in this time limit shall forego admission and will be removed from the rolls of the Institute

13.2 A student shall be eligible for award of degree provided she or he has:

13.2.1 Registered and successfully completed all required credit-bearing and audit subjects with a total of 68 credits

13.2.2 Secured a CGPA of 4.5 or more

13.2.3 Cleared all dues to the Institute, library and hostel

13.2.4 No disciplinary action is pending against her or him

13.2.5 Satisfied any other stipulation of the affiliating University

13.3 Award of Class: Each student will be given class in degree based on CGPA as given in Table 3

Table 3 Class of Degree

Class of Degree	Range of CGPA
Second Class	>= 5.5 but <6.5
First Class	>= 6.5 but <7.5
First Class with Distinction	>= 7.5

13.4 Consolidated Grade Card and Degree will issued under the seal of affiliating University.

14.0 Transitory Regulations

14.1 A student who initially joins the Institute in a previous Regulation and has to rejoin in an academic-term of the present Regulations, due to any reason, shall be bound by the rules of the current Regulations. Board of Studies of the concerned Major will specify, extra or otherwise, academic coursework to be undertaken by such students who rejoin the current Regulations

COURSE STRUCTURE

M.Tech. (Power Systems)-R18 Course Structure

Annexure-1 Curriculum

I-SEMESTER

S. No.	C/PE/A	Course Code	Course Name	L	T	P	IM	EM	CR
1	C 1	1852101	Power System Analysis	3	0	0	40	60	3
2	C 2	1852102	Power System Dynamics - I	3	0	0	40	60	3
3	PE1	1852103	Renewable Energy System	3	0	0	40	60	3
		1852104	Smart grids	3	0	0	40	60	3
		1852105	Wind and Solar Systems	3	0	0	40	60	3
4	PE 2	1852106	Electrical Power Distribution System	3	0	0	40	60	3
		1852107	Mathematical Methods for Power Engineering	3	0	0	40	60	3
		1852108	Electric and Hybrid Vehicles	3	0	0	40	60	3
5	---	1800109	Research Methodology and IPR	2	0	0	40	60	2
6	Lab 1	1852110	Power System Lab - I	0	0	3	50	50	2
7	Lab 2	1852111	Power System Simulation Lab-I	0	0	3	50	50	2
8	A 1	---	Audit Course I	2	0	0	40	-	0
			Total	**14**	**0**	**8**	**350**	**400**	**18**

*** C - Course * PE - Professional Elective * A - Audit Course**

II SEMESTER

S. No.	C/PE/A	Course Code	Course Name	L	T	P	IM	EM	CR
1	C 3	1852201	Digital Protection of Power System	3	0	0	40	60	3
2	C 4	1852202	Power System Dynamics - II	3	0	0	40	60	3
3	PE 3	1852203	Restructured Power Systems	3	0	0	40	60	3
		1852204	Energy Auditing and Management	3	0	0	40	60	3
		1852205	Power Apparatus Design	3	0	0	40	60	3
4	PE 4	1852206	SCADA System and Applications	3	0	0	40	60	3
		1852207	Power Quality	3	0	0	40	60	3
		1852208	AI Techniques	3	0	0	40	60	3
5	C 5	1852209	Mini Project	0	0	4	100	-	2
6	Lab 3	1852210	Power System Lab -II	0	0	4	50	50	2
7	Lab 4	1852211	Power Systems Simulation Lab -II	0	0	4	50	50	2
8	A II	--	Audit Course II	2	0	0	40	-	-
			Total	**12**	**0**	**12**	**410**	**340**	**18**

III SEMESTER

S. No.	C/PE/A	Course Code	Course Name	L	T	P	IM	EM	CR
1	PE 5	1852301	Power System Transients	3	0	0	40	60	3
		1852302	Industrial Load Modeling and Control	3	0	0	40	60	3
		1852303	Dynamics Of Linear Systems	3	0	0	40	60	3
2	OE	1871304	Business Analytics	3	0	0	40	60	3
		1871305	Industrial Safety	3	0	0	40	60	3
		1871306	Operations Research	3	0	0	40	60	3
		1871307	Cost Management of Engineering Projects	3	0	0	40	60	3
		1871308	Composite Materials	3	0	0	40	60	3
		1871309	Waste to Energy	3	0	0	40	60	3
3	Major Project	1852310	Phase - I Dissertation	0	0	20	100	-	10
			Total	**6**	**0**	**20**	**180**	**120**	**16**

IV SEMESTER

S. No.	Course	Course Code	Course Name	L	T	P	IM	EM	CR
1	Major Project	1852401	Phase - II Dissertation	0	0	32	50	50	16
		Total		**0**	**0**	**32**	**50**	**50**	**16**

Audit course I & II

S. No.	Course Code	Course Name
1	1870A01	English for Research Paper Writing
2	1870A02	Disaster Management
3	1870A03	Sanskrit for Technical Knowledge
4	1870A04	Value Education
5	1870A05	Constitution of India
6	1870A06	Pedagogy Studies
7	1870A07	Stress Management by Yoga
8	1870A08	Personality Development through Life Enlightenment Skills

M.TECH.-
I- SEMESTER SYLLABUS

Course Title	POWER SYSTEM ANALYSIS					M.Tech PS I Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1852101	CORE-1	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 2 Hours					End Exam Duration: 3Hrs			

Course Objectives:

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

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Able to calculate voltage phasors at all buses, given the data using various methods of load flow and fault currents in each phase
CO 2	Rank various contingencies according to their severity
CO 3	Estimate the bus voltage phasors given various quantities viz. power flow, voltages, taps, CB status etc
CO 4	Estimate closeness to voltage collapse and calculate PV curves using continuation power flow

UNIT-I

Load flow: Overview of Newton-Raphson, Gauss-Seidel, Fast-decoupled methods, convergence properties, sparsity techniques. Control of Voltage profile: Control by generators- Control by VAR generators – control by transformers. Load flow under power electronic control: AC-DC load flow – Converter model – Solution technique – Sequential method.

UNIT-II

Fault Analysis: Symmetrical-internal voltages of loaded machines under fault conditions- Short circuit of a synchronous machine – symmetrical components- sequence networks of synchronous machine, transmission line, transformer – unsymmetrical faults -open conductor faults.

UNIT-III

Security Analysis: Factors affecting power system security- contingency analysis – over view of security analysis – Linear sensitivity factors: Generation shift factors, line outage distribution factors – AC power flow methods – Contingency selection.

UNIT-IV

State Estimation: Introduction to State Estimation, Least Squares Estimation and Weighted Least Squares Estimation, State Estimation in AC Network, Orthogonal Decomposition, Detection and Identification of Bad measurements, Network Observability and Pseudo – measurements.

UNIT-V

Voltage Stability: Basic concepts related to voltage stability- definition - classification – voltage collapse – P-V & Q-V curve – voltage stability analysis: – prevention of voltage collapse.

Text Books:

1. J.J. Grainger & W.D.Stevenson, "Power System Analysis", McGraw Hill, 2003.
2. A.J. Wood, "Power Generation, Operation and Control", John Wiley, 1994.
3. I.J. Nagrath, D.P. Kothari, "Modern Power System Analysis", TMH Publications.

Course Title	POWER SYSTEM DYNAMICS - I				M.Tech PS I Sem		
Course Code	Category	Hours/Week		Credits	Maximum Marks		
1852102	CORE-2	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 2 Hours					End Exam Duration: 3Hrs		

Course Objectives:

- Students will be able to: Study of system dynamics and its physical interpretation, Development of mathematical models for synchronous machine, Modeling of induction motor.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the modelling of synchronous machine in detail.
CO 2	Carry out simulation studies of power system dynamics using MATLAB-SIMULINK.
CO 3	Carry out stability analysis with and without power system stabilizer.
CO 4	Understand the load modelling in power system.

UNIT-I

Modeling of Synchronous Machine: Synchronous machine – Park's Transformation-analysis of steady state performance, per - unit quantities-Equivalent circuit of synchronous machine.

UNIT-II

Steady State Analysis: Voltage, Current and Flux Linkage relationships, Steady state equivalent circuit, Formulation of State Space Model.

UNIT-III

Sub-Transient and transient inductance and Time Constants, Synchronous Machines Simplified model.

UNIT-IV

Excitation System: Effects of Excitation system, PSS-Block Diagram, System State matrices (Type Systems).

UNIT-V

Modeling of Induction Motors: Basic Equations, d-q Transformations, Steady State Characteristics, Equivalent Circuits, Effect of rotor resistance, Modelling of Prime Movers.

Text Books:

1. P.M. Anderson & A.A. Fouad, "Power System Control and Stability", IEEE Press.
2. Power system Stability and Control, P. Kundur, TMH.
3. Power system Analysis and Design, William D Stevenson, John J Grainger, TMH.

Reference Books:

1. Power Systems Dynamics and Stability, M.A.Pai- PHI Publications.
2. Power system dynamics, K.R. PADIYAR - B.S. Publications.

Course Title	RENEWABLE ENERGY SYSTEMS				M.Tech PS I Sem		
Course Code	Category	Hours/Week		Credits	Maximum Marks		
1852103	PE-1	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 2 Hours					End Exam Duration: 3Hrs		

Course Objectives:

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

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Knowledge about renewable energy.
CO 2	Understand the working of distributed generation system in autonomous/grid connected modes.
CO 3	Know the Impact of Distributed Generation on Power System.

UNIT - I

Introduction, Distributed Vs Central Station Generation, Various non - Conventional energy sources, availability, classification merits and demerits.

UNIT - II

Introduction to solar Energy Theory of Solar Cells, Solar cell materials, Solar Cell array, solar radiation, Flat Plate Collectors, Focussing Plate Collectors, Solar Thermal Power Plants.

UNIT - III

Introduction to wind energy, wind power and its Sources, Site Selection, criterion, Classification of rotors, wind characteristics, Performance and limitations of energy conversion Systems.

UNIT - IV

Resources of geothermal energy, Thermo dynamics of geothermal energy conversion electrical conversion, non - electrical Conversion, environmental considerations.

UNIT - V

Tidal and wave energy - Principle of working, Performance and limitations. Biomass energy-Availability of biomass and its Conversion Theory.

Fuel Cells-Working Principle, types of Fuel Cells, Performance and limitations.

Text Books:

1. RanjanRakesh, 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", July2011, 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 Title	SMART GRID					M.Tech PS I Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1852104	PE-1	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 2 Hours					End Exam Duration: 3Hrs			

Course Objectives:

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

Course Outcomes: On successful completion of this course, the students will be able to	
CO 1	Understand the difference between smart grid & conventional grid.
CO 2	Apply smart metering concepts to industrial and commercial installations.
CO 3	Formulate solutions in the areas of smart sub-stations, distributed generation and wide area measurements.
CO 4	Come up with smart grid solutions using modern communication technologies.

UNIT - I

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.

UNIT - II

Introduction to Smart Meters, Real Time Pricing, 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.

UNIT - III

Geographic Information System (GIS)-Intelligent Electronic Devices(IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Wide Area Measurement System(WAMS)-Phase Measurement Unit(PMU).

UNIT - IV

Concept of micro-grid, need & applications of micro-grid, formation of micro-grid, Issues of inter-connection, protection & control of micro-grid.-Thin film solar cells, Variable speed wind generators, fuel-cells, micro-turbines.

UNIT - V

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

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. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, "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 Title	WIND AND SOLAR SYSTEMS					M.Tech PS I Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1852105	PE-1	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 2 Hours					End Exam Duration: 3Hrs			

Course Objectives:

- To get exposure to wind and solar systems
- To understand the factors involved in installation and commissioning of a Solar or Wind plant.
- Learning the dynamics involved when interconnected with power system grid

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the importance of energy growth of the power generation from the renewable energy sources and participate in solving these problems.
CO 2	Gain the knowledge of the physics of wind power and solar power generation and all associated issues so as to solve practical problems.
CO 3	Gain the knowledge of physics of solar power generation and the associated issues.
CO 4	Identify, formulate and solve the problems of energy crises using wind and solar energy.

UNIT-I

Historical development and current status: Introduction – historical background – current status of wind power worldwide – status of wind turbine technology.

Characteristics of wind power generation – basic integration issues: consumer requirements – requirements from wind farm operators – the integration issues.

UNIT – II

Generators and Power Electronics for wind turbines: generator concepts – power electronic concepts – power electronic solutions in wind farms.

Power quality standards of wind turbines: Power Quality characteristics of wind turbines – Impact on voltage quality.

Technical regulations for inter connections: overview of technical regulations – comparison of technical regulations.

UNIT- III

Isolated systems with wind power: isolated power systems – overview of wind – diesel power systems – wind power impact on power quality.

Reactive power capability and voltage control: Relevance and design paradigm – Reactive power capability of a wind turbine – model based design of voltage control systems for wind power plants.

Economic aspects: introduction – costs for network connection and network upgrading – System operation costs in a deregulated market.

UNIT – IV

Impacts of wind power on power system stability: Power system stability and security – rotor angle stability – voltage stability – frequency stability – dynamic behavior of wind power plants.

Solar energy: merits, demerits – thermal applications.

UNIT- V

Concentrating collectors - devices for thermal collection & storages – Thermal energy storage: sensible heat storage, latent heat storage, Thermo chemical storage - solar pond: principle of working – description.

Text Books:

1. Wind power in Power Systems by Thomas Ackerman, John Willy & Sons ltd.
2. Solar Energy by K. Sukhatme & S.P. Sukhatme, TMH, 2nd Edition.

Course Title	ELECTRICAL POWER DISTRIBUTION SYSTEM				M.Tech PS I Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
1852106	PE-2	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 2 Hours					End Exam Duration: 3Hrs			

Course Objectives:

- Learning about power distribution system
- Learning of SCADA System
- Understanding Distribution Automation

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Gain knowledge in power distribution systems.
CO 2	Study of Distribution automation and its applications.
CO 3	Learn SCADA system.
CO 4	Apply AI Techniques to DA.

UNIT-I

Electricity Forecasting: Power loads – connected loads – short term load forecasting - long term load forecasting – distribution of power- Distributed energy supply system – technological forecasting.

UNIT-II

Distribution Automation: need for distribution automation – characteristics of distribution system – distribution automation- feeder automation – communication requirements for DA-Remote Terminal Unit.

UNIT- III

SCADA System: Introduction- block diagram –components of SCADA – functions of SCADA – SCADA applied to DA – Advantages of DA through SCADA – Requirements and feasibility – DA Integration Mechanisms – Communication protocols in SCADA systems.

UNIT-IV

Remote Metering: Background for Automatic Meter Reading(AMR) for utility – Components of AMR systems – communication methods used for meter reading – AMR system – services and functions - Planning for AMR implementation -Optimal Switching Device placement in Radial distribution system – sectionalizing switches.

UNIT –V

AI Techniques Applied to DA: Introduction – general techniques description – genetic algorithm and its implementation – steps followed in simple Genetic algorithm – Application of GA to DA. Energy Management – Need Based Energy Management- Demand Side management -Urban and Rural Distribution Systems: Urban Distribution – Rural distribution systems.

Text Books:

1. A.S. Pabla, “Electric Power Distribution”, Tata McGraw Hill Publishing Co. Ltd, Fourth Edition.
2. M.K. Khedkar, G.M. Dhole, “A Text Book of Electrical Power Distribution Automation”, University Science Press, New Delhi.
3. Anthony J Panseni, “Electrical Distribution Engineering”, CRC Press.

Course Title	MATHEMATICAL METHODS FOR POWER ENGINEERING				M.Tech PS I Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
1852107	PE-2	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 2 Hours					End Exam Duration: 3Hrs			

Course Objectives:

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

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Knowledge about vector spaces, linear transformation, eigen values and eigenvectors of linear operators.
CO 2	To learn about linear programming problems and understanding the simple method for solving linear programming problems in various fields of science and technology.
CO 3	Acquire knowledge about nonlinear programming and various techniques used for solving constrained and unconstrained nonlinear programming problems.
CO 4	Understanding the concept of random variables, functions of random variable and their probability distribution.
CO 5	Understand stochastic processes and their classification.

UNIT-I

Vector spaces, Linear transformations, Matrix representation of linear transformation, Eigen values and Eigen vectors of linear operator.

UNIT- II

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

UNIT -III

Unconstrained Problems, Search methods, Constrained Problems.

UNIT-IV

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

UNIT- V

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

Reference Books:

1. Kenneth Hoffman and Ray Kunze, "Linear Algebra", 2nd Edition, PHI, 1992.
2. Hillier F S and Liebermann G J, "Introduction to Operations Research", 8th Edition, McGraw Hill, 2009.
3. A Papoulis, S. Unnikrishna pillai, "Probability, Random Variables and Stochastic Processes", 4rd Edition, McGraw Hill., 2002.
4. S.S. Rao, Engineering Optimization Theory and Practice ' Third Enlarges Edition, New age international publishers, 2013.
5. Irwin Miller and Marylees Miller, John E. Freund's "Mathematical Statistics", 6th Edn, PHI, 2002.
6. J. Medhi, "Stochastic Processes", New Age International, New Delhi., 1994.

Course Title	ELECTRIC AND HYBRID VEHICLES				M.Tech PS I Sem		
Course Code	Category	Hours/Week		Credits	Maximum Marks		
1852108	PE-2	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 2 Hours					End Exam Duration: 3Hrs			

Course Objectives:

- To understand upcoming technology of hybrid system.
- To understand different aspects of drives application.
- Learning the electric Traction.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Acquire knowledge about fundamental concepts, principles of hybrid and electric vehicles.
CO 2	Analyse and design of hybrid and electric vehicles.
CO 3	To learn electric drive in vehicles / traction.

UNIT - I

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.

UNIT - II

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

UNIT - III

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

UNIT - IV

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

UNIT - V

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.

Reference 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 Title	RESEARCH METHODOLOGY AND IPR				M.Tech PS I Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1800109		L	T	P	C	Continuous Internal Assessment	End Exams	Total
		2	0	0	2	40	60	100
Mid Exam Duration: 2 Hours					End Exam Duration: 3Hrs			

Course Objectives:

- To provide a perspective on research to the scholars so as to broaden their conceptions of what research involves.
- To impart knowledge on techniques related to research such as problem formulation, literature survey, information retrieval, use of statistical techniques, writing of research reports and evaluation To expose the scholars ethics in research and Intellectual Property Rights

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand research problem formulation.
CO 2	Analyse research related information.
CO 3	Follow research ethics.
CO 4	Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
CO 5	Understanding 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 6	Understand that IPR protection provides an incentive to inventors for further research work.
CO 7	and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT-I

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

UNIT-II

Effective literature studies approaches, Plagiarism and Research ethics.

UNIT-III

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

UNIT-IV

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

UNIT-V

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.

Text 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".

Reference Books:

1. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd,2007.
2. Mayall, "Industrial Design", McGraw Hill, 1992.
3. Niebel, "Product Design", McGraw Hill, 1974.
4. Asimov, "Introduction to Design", Prentice Hall, 1962.
5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
6. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

Course Title	POWER SYSTEMS LAB - I					M.Tech PS I Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1852110	LAB-1	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		0	0	4	2	50	50	100
Mid Exam Duration: 2 Hours					End Exam Duration: 3Hrs			
Course Objectives: •								
Course Outcomes: On successful completion of this course, the students will be able to								
CO 1								
CO 2								

Any Eight of the following experiments has to be carried out

1. Sequence impedances of synchronous machine
1. Single line to ground fault.
2. Line to line fault
3. Double line to ground fault.
4. Symmetrical fault.
5. Sequence impedances of three phase transformer.
6. Power angle characteristics of salient pole synchronous machine.
7. Ferranti effect and ABCD parameters of 220kV transmission line.
8. Transient & sub-transient reactance's of synchronous machine.
9. Three-phase semi converter.

<table>
<tr><td colspan="2">Course Title</td><td colspan="5">POWER SYSTEMS SIMULATION LAB - I</td><td colspan="3">M.Tech PS I Sem</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">1852111</td><td rowspan="2">LAB-2</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>2</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 2 Hours</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
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<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8"></td></tr>
<tr><td>CO 2</td><td colspan="8"></td></tr>
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Any Eight of the following experiments has to be carried out

1. Formation of Y-bus
2. Formation of Z-bus
3. Load flow analysis by Gauss-Seidel Method
4. Load flow analysis by Newton-Raphson Method
5. Load flow analysis by Fast-decoupled Method
6. Small signal stability of Single machine connected to Infinite bus system
7. Transient stability of Multi Machine System
8. Simulation of Static VAR Compensator
9. Short circuit studies
10. Harmonic analysis & tuned filter design to mitigate harmonics.

M.TECH.-
II- SEMESTER SYLLABUS

Course Title	DIGITAL PROTECTION OF POWER SYSTEM				M.Tech PS II Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1852201	CORE-3	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 2 Hours					End Exam Duration: 3Hrs			

Course Objectives:

- Study of numerical relays
- Developing mathematical approach towards protection
- Study of algorithms for numerical protection

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Learn the importance of Digital Relays.
CO 2	Apply Mathematical approach towards protection.
CO 3	Learn to develop various Protection algorithms.

UNIT - I

Introduction: Evolution of Digital Relays from Electromechanical Relays, Performance and Operational Characteristics of Digital Protection.

UNIT - II

Mathematical Background to Protection Algorithms: Finite Difference Techniques, Interpolation Formulas: 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.

UNIT - III

Basic Elements Of Digital Protection: Signal Conditioning: transducers, Surge Protection, Analog Filtering, Analog Multiplexers, Conversion Subsystem 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.

UNIT - IV

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.

UNIT - V

Travelling 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 Publicis Corporate Publishing, 2006.
4. S.R.Bhide "Digital Power System Protection" PHI Learning Pvt.Ltd.2014.

Course Title	POWER SYSTEM DYNAMICS-II				M.Tech PS II Sem		
Course Code	Category	Hours/Week		Credits	Maximum Marks		
1852202	CORE-4	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 2 Hours					End Exam Duration: 3Hrs			

Course Objectives:

- Study of power system dynamics
- Interpretation of power system dynamic phenomena
- Study of various forms of stability

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Gain valuable insights into the phenomena of power system including obscure ones.
CO 2	Understand the power system stability problem.
CO 3	Analyze the stability problems and implement modern control strategies. Simulate small signal and large signal stability problems.

UNIT-I

Basic Concepts and Definitions: Concept of State, Eigen values, Eigen Vectors, Representation of State space. Small signal stability of single machine connected to infinite bus system.

UNIT-II

Effect of Damper,Flux Linkage Variation and Effect of AVR on Synchronizing and Damping Torque Components, Block diagram.

UNIT-III

Large Signal Rotor Angle Stability, Mitigation Using Power System Stabilizer, Multi-Machine Stability.

UNIT-IV

Dynamic Analysis of Voltage Stability- Modeling requirements, Static and Dynamic analysis, Voltage Collapse.

UNIT-V

Frequency Stability: Automatic Generation Control Models-Primary Speed Control and Supplementary Control, Implementation of AGC, Functional Block Diagram.

Text Books:

1. P.M. Anderson and A.A. Fouad, "Power System Control And Stability", IEEE Press.
2. Power System Stability and Control, P.Kundur, TMH.
3. Power System Analysis and Design, William D Stevenson, John J Grainger, TMH.
4. Power Systems Dynamics and Stability, M.A.Pai- PHI Publications.

Course Title	RESTRUCTURED POWER SYSTEMS					M.Tech PS II Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1852203	PE-3	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 2 Hours					End Exam Duration: 3Hrs			

Course Objectives:

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

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand various types of regulations in power systems.
CO 2	Identify the need of regulation and deregulation.
CO 3	Define and describe the Technical and Non-technical issues in Deregulated Power Industry.
CO 4	Identify and give examples of existing electricity markets.
CO 5	Classify different market mechanisms and summarize the role of various entities in the market.

UNIT-I

Deregulation of Electric Utilities: Introduction – Traditional central utility model, reform motivations, separation of ownership and operation, competition and direct access in the electricity market, independent system operator (ISO), retail electric providers, different experiences.

UNIT-II

Competitive Wholesale Electricity Markets & Transmission Open Access: Introduction, ISO, wholesale electricity market characteristics, market model, challenges, trading arrangements, the pool and bilateral trades, multi lateral trades.

UNIT-III

Transmission Cost Allocation Methods: Introduction - Postage Stamp Rate Method - Contract Path Method - MW-Mile Method – Unused Transmission Capacity Method - MVA-Mile method – Comparison of cost allocation methods.

UNIT-IV

Market Power & Ancillary Services Management: Introduction - Different types of market Power – Mitigation of Market Power – Examples - Introduction – Reactive Power as an Ancillary Service – a Review – Synchronous Generators as Ancillary Service Providers.

UNIT-V

Available Transfer Capability (ATC) : Transfer Capability Issues – ATC – TTC – TRM – CBM Calculations – Calculation of ATC based on power flow - Introduction – Electricity Price Volatility Electricity Price Indexes – Challenges to Electricity Pricing – Construction of Forward Price Curves – Short-time Price Forecasting.

Text Books:

1. Power System Restructuring and Deregulation, Loi Lei Lai, John Wiley & Sons Ltd., England, 2001.
2. Operation of Restructured Power System, Kankar Bhattacharya, Math H.J. Boller and Jaap E. Daalder Kulwer Academic Publishers, 2001.
3. Restructured Electrical Power Systems, Mohammad Shahidehpour and Muwaffaq alomoush, Marcel Dekker, Inc., 2001.

Course Title	ENERGY AUDITING AND MANAGEMENT					M.Tech PS II Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1852204	PE-3	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 2 Hours					End Exam Duration: 3Hrs			

Course Objectives:

- To understand the need for energy auditing.
- Understanding of various loads involved based on power consumption for auditing to know about different audit instruments used in practice.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Acquire the background required for engineers to meet the role of energy managers and to acquire the skills and techniques required to implement energy management.
CO 2	Identify and quantify the energy intensive business activities in an organization.
CO 3	Able to perform basic energy audit in an organization.

UNIT - I

System approach and End use approach to efficient use of Electricity-Electricity tariff types-Energy auditing: Types and objectives - audit instruments-ECO assessment and Economic methods-Specific energy analysis-Minimum energy paths-consumption models-Case study.

UNIT - II

Electric motors-Energy efficient controls and starting efficiency-Motor Efficiency and Load-Load Matching and selection of motors-Variable speed drives; Pumps and Fans-Efficient Control strategies - Optimal selection and sizing-Transformer Loading/Efficiency analysis-Reactive Power management-Capacitor-Sizing-Degree of Compensation-Capacitor-losses-Location-Placement-Maintenance,-Case-study.

UNIT - III

Peak Demand controls- Methodologies-Types of Industrial loads-Optimal Load scheduling-case study-Lighting- Energy efficient light sources-Energy conservation in Lighting Schemes-Electronic ballast-Power quality issues-Luminaries, case study.

UNIT - IV

Cogeneration-Types and Schemes-Optimal operation of cogeneration plants-case study-Electric loads of Air conditioning &Refrigeration-Energy conservation measures- Cool storage-Types-Optimal operation case study.

UNIT - V

Electric water heating-Geysers-Solar Water Heaters-Power Consumption in Compressors-Energy conservation measures-Electrolytic Process-Computer Controls- software-EMS.

Reference Books:

1. Anthony J. Pansini, Kenneth D. Smalling, .Guide to Electric Load Management., Pennwell Pub; (1998).
2. Howard E. Jordan, .Energy-Efficient Electric Motors and Their Applications., Plenum Pub Corp; 2ndedition (1994).
3. Giovanni Petrecca, Industrial Energy Management: Principles and Applications., The Kluwerinternational series -207,1999.
4. Handbook on Energy Audit and Environment Management, Y P Abbi and Shashank Jain, TERI, 2006.
5. Handbook of Energy Audits Albert Thumann, William J. Younger, Terry Niehus, 2009.

Course Title	POWER APPARATUS DESIGN					M.Tech PS II Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1852205	PE-3	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 2 Hours					End Exam Duration: 3Hrs			

Course Objectives:

- Study the modelling analysis of rotating machine.
- Learning electromagnetic energy conversion
- To know about rating of machines.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	To give a systematic approach for modeling and analysis of all rotating machines under both transient and steady state conditions with the dimensions and material used.
CO 2	Ability to model and design all types of rotation machines including special machines.

UNIT-I

The Design problem – Introduction, design specifications, limitations in design, Modern trends in design of electrical machines.

Thermal state in electrical Machines – Salient features of heating curves – cooling of rotating machines – Methods of cooling - cooling system - Induced & forced ventilation, Radial and Axial Ventilation - Cooling of turbo alternators: Hydrogen cooling, Direct cooling, Air cooled. - Types of Duties and Ratings.

UNIT - II

Design of transformers – Types of transformer – core construction, output equation, principle of design of core, windings, yoke main dimensions (H & W) for single phase: core type, shell type. 3-phase – core type transformers estimation of no load current of transformer.

Temperature rise of transformer- Design of tank with tubes.

UNIT-III

General concepts of rotating machines – Output equation of dc machines, ac machines, separation of D & L, choice of specific loadings.

Design of D.C machines – Choice of no. of poles, selection of no. of armature slots, choice of winding, estimation of conductor cross section of armature, design of field systems: tentative design of field winding of dc machines.

UNIT-IV

Design of 3-phase induction motor – Separation of D & L, Choice of Ampere conductors and B_{av}.

Stator design – Selection of no of stator slots, turns per phase, design of conductor cross section.

Rotor design - Selection of no of rotor slots, principles of design of squirrel cage rotor, design of slip ring rotor.

Relation between D&L for best power factor – Methods of improving Starting Torque - Losses & Efficiency.

UNIT-V

Design of synchronous machines – Separation of D & L, choice of Ampere conductors & B_{av} - Short Circuit Ratio (SCR) and its significance.

Armature design – choice of no. of stator (Armature) slots, turns/phase, conductor cross section for both salient pole and cylindrical pole machines.

Introduction to computer aided design – different approaches.

Reference Books:

1. Sawhney. A. K., "A course in Electrical Machine Design", Dhanpat Rai & Co.
2. Clayton. A. E. & NN Hancock, "The performance and design of Direct Current machines", CBS publishers & Distributors.

Course Title	SCADA SYSTEM AND APPLICATIONS				M.Tech PS II Sem			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1852206	PE-4	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 2 Hours					End Exam Duration: 3Hrs			

Course Objectives:

- To understand what is SCADA and its functions.
- To know various communication used in SCADA.
- To get an insight into its application.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the basic tasks of Supervisory Control Systems (SCADA) as well as their typical applications.
CO 2	Acquire knowledge about SCADA architecture, various advantages and disadvantages of each system.
CO 3	Gain knowledge about single unified standard architecture IEC 61850.
CO 4	Learn about SCADA system components: remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server.
CO 5	Learn and understand about SCADA applications in transmission and distribution sector, industries etc.

UNIT - I

Introduction to SCADA-Data acquisition systems-Evolution of SCADA-Communication technologies.

UNIT - II

Monitoring and supervisory functions-SCADA applications in Utility Automation-Industries SCADA.

UNIT - III

SCADA System Components-Schemes- Remote Terminal Unit (RTU)-Intelligent Electronic Devices (IED)-Programmable Logic Controller (PLC)-Communication Network, SCADA Server, SCADA/HMI Systems.

UNIT - IV

SCADA Architecture-Various SCADA architectures, advantages and disadvantages of each System-Single unified standard architecture -IEC 61850.

UNIT - V

SCADA Communication-various industrial communication technologies-wired and wireless methods and fiber optics-SCADA Applications: Utility applications.

Reference Books:

1. Stuart A. Boyer: "SCADA-Supervisory Control and Data Acquisition", Instrument Society of America Publications, USA, 2004.
2. Gordon Clarke, Deon Reynders: "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes Publications, Oxford, UK, 2004.
3. William T. Shaw, "Cyber security for SCADA systems", Penn Well Books, 2006.
4. David Bailey, Edwin Wright, "Practical SCADA for industry", Newnes, 2003.
5. Michael Wiebe, "A guide to utility automation: AMR, SCADA, and IT systems for electric power", Penn Well 1999.

Course Title	POWER QUALITY					M.Tech PS II Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1852207	PE-4	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 2 Hours					End Exam Duration: 3Hrs			

Course Objectives:

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

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Acquire knowledge about the harmonics, harmonic introducing devices and effect of harmonics on system equipment and loads.
CO 2	Develop analytical modeling skills needed for modeling and analysis of harmonics in networks and components.
CO 3	Understand active power factor correction based on static VAR compensators and its control techniques.
CO 4	Analyze series and shunt active power filtering techniques for harmonics

UNIT - I

Introduction-power quality-voltage quality-overview of power quality Phenomena-classification of power quality issues-power quality measures and standards-flicker factor transient phenomena-occurrence of power quality problems.

UNIT - II

Harmonics-individual and total harmonic distortion-RMS value of a harmonic waveform-Triplex harmonics-important of 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.

UNIT - III

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.

UNIT - IV

Power factor improvement- Passive Compensation-Passive Filtering, Harmonic Resonance-Active Power Factor Correction- 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.

UNIT - V

Dynamic Voltage Restorers for sag , swell and flicker problems.

Grounding and wiring introduction-grounding requirements-reasons for grounding

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 Title	AI TECHNIQUES					M.Tech PS II Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1852208	PE-4	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 2 Hours					End Exam Duration: 3Hrs			

Course Objectives:

- Understanding fuzzy logic, ANN
- Understanding GA & EP

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Learn the concepts of biological foundations of artificial neural networks.
CO 2	Learn Feedback networks and radial basis function networks and fuzzy logics.
CO 3	Identifications of fuzzy and neural network.
CO 4	Acquire the knowledge of GA

UNIT-I

Artificial Neural Networks: Basics of ANN - Comparison between Artificial and Biological Neural Networks – Basic Building Blocks of ANN – Artificial Neural Network Terminologies – McCulloch Pitts Neuron Model – Learning Rules, Perceptron Networks – Back Propagation Neural Networks – Associative Memories Radial Basis Function Networks.

UNIT-II

Fuzzy Logic: Classical Sets – Fuzzy Sets – Fuzzy Properties and Operations – Fuzzy Logic System – Fuzzification –Defuzzification – Membership Functions- Knowledge Representation and Inference Mechanism – Fuzzy Rule base – Fuzzy Logic Controller Design.

UNIT-III

Fuzzy Neural Network- System Identification using Fuzzy and Neural Network.

UNIT-IV

Genetic algorithm- Reproduction cross over, mutation- Introduction to evolutionary program.

UNIT-V

Neural Network Applications to Electrical Load Forecasting, Control systems, Fuzzy Logic Implementation for Induction Motor Control. Automatic Voltage Regulator-GA Applications.

Text Books:

1. J M Zurada , "An Introduction to ANN",Jaico Publishing House.
2. Simon Haykins, "Neural Networks", Prentice Hall.
3. Timothy Ross, "Fuzzy Logic with Engg.Applications", McGraw. Hill.
4. Driankov, Dimitra, "An Introduction to Fuzzy Control", Narosa Publication.
5. Golding, "Genetic Algorithms", Addison-Wesley Publishing Com.

Reference Books:

1. Introduction to Fuzzy Logic using MATLAB by S. N. Sivanandam, S. Sumathi and S. N. Deepa, Springer International Edition, 2013.
2. Intelligent System – Modeling, Optimization & Control by Yung C. Shin and Chengying Xu, CRC Press, 2009.
3. Introduction to Neural Networks using MATLAB by S. N. Sivanandam, S. Sumathi and S. N. Deepa, Tata McGraw Hill Edition, 2006.
4. Fuzzy Logic with Engineering Applications by Timothy J. Ross, WILEY India Edition, 3rd Edition, 2012.

Course Title	MINI PROJECT WITH SEMINAR					M.Tech PS II Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1852209	CORE-5	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		0	0	4	2	100	--	100
Internal Assessment								

Course Objectives:

- Acquire practical knowledge within the chosen area of technology for project development
- Identify, analyze, formulate and handle programming projects with a comprehensive and systematic approach
- Contribute as an individual or in a team in development of technical projects.
- Develop effective communication skills for presentation of project related activities

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Students will get an opportunity to work in actual industrial environment if they opt for internship.
CO 2	In case of mini project, they will solve a live problem using software / analytical / computational tools.
CO 3	Students will learn to write technical reports.
CO 4	Students will develop skills to present and defend their work in front of technically qualified audience.

Students can take up small problems in the field of design engineering as mini project. It can be related to solution to an engineering problem, verification and analysis of experimental data available, conducting experiments on various engineering subjects, material characterization, studying a software tool for the solution of an engineering problem etc.

Course Title	POWER SYSTEMS LAB - II					M.Tech PS II Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1852210	LAB-3	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		0	0	0	4	50	50	100
					End Exam Duration: 3Hrs			
Course Objectives: •								
Course Outcomes: On successful completion of this course, the students will be able to								
CO 1								
CO 2								
CO 3								
CO 4								

Any Eight of the following experiments has to be carried out.

1. Characteristics of over current relay.
2. Characteristics of Directional Over Current Relay
3. Testing of Relay
4. Characteristics of differential current relay.
5. Over voltage/under voltage relay.
6. Negative sequence relay.
7. Voltage & Current control of 220kV transmission line.
8. Study of rooftop solar system.
9. Field visit to wind generation system.
10. Study of Bio-mass generation plant.

Course Title	POWER SYSTEMS SIMULATION LAB - II				M.Tech PS II Sem		
Course Code	Category	Hours/Week		Credits	Maximum Marks		
1852211	LAB-4	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		0	0	0	4	50	50	100
					End Exam Duration: 3Hrs			
Course Objectives: •								
Course Outcomes: On successful completion of this course, the students will be able to								
CO 1								
CO 2								
CO 3								
CO 4								

Any Eight of the following experiments has to be carried out.

1. Single Area Load Frequency Control with and without PI controller.
2. Two area load frequency control system.
3. Simulation of swing equation.
4. Simulation of AVR system.
5. Simulation of Excitation system stabilizer.
6. Simulation of FACTS controllers.
7. Simulation of Power Quality problems.
8. Three -phase fully controlled rectifiers.
9. Three- phase inverter with PWM controller.
10. Buck & Boost converters for power system applications.

M.TECH.-
III- SEMESTER SYLLABUS

Course Title	POWER SYSTEM TRANSIENTS				M.Tech PS III Sem			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1852301	PE-5	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 2 Hours					End Exam Duration: 3Hrs			

Course Objectives:

- Learn the reasons for occurrence of transients in a power system.
- Understand the change in parameters like voltage & frequency during transients.
- To know about the lightning phenomenon and its effect on power system.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Gain knowledge of various transients that could occur in power system and their mathematical formulation.
CO 2	Ability to design various protective devices in power system for protecting equipment and personnel.
CO 3	Coordinating the insulation of various equipment's in power system.
CO 4	Modeling the power system for transient analysis.

UNIT-I

Simple switching transients: Circuit closing transients, recovery transients initiated by removal of short circuit, double frequency transient damping, resistance switching, load switching.

Abnormal switching transients: Normal & abnormal switching transients, current suppression, capacitance switching, transformer magnetizing in rush current.

UNIT-II

Modelling of power apparatus of their transient conditions: Transformer model for switching on open circuit , Internal model for transformer, Modelling of transformer for transfer of surges, modeling of generators, modeling of motors, modeling of overhead transmission lines and cables

UNIT-III

Lighting, physical phenomena of lighting, interaction between lighting and power system, Influence of tower footing resistance and earth resistance.

Insulation co-ordination, strength of insulation, Hierarchy of insulation co-ordination, test voltage waveforms and transient ratings, approaches to insulation co-ordination.

UNIT-IV

Travelling waves on transmission line: circuits with distributed parameters - Wave equation - Reflection & refraction - behaviour of travelling waves at the line terminations- lattice diagrams - Attenuation & distortion - Multi conductor system and velocity wave.

UNIT-V

Protection of system against Transient over voltages: Protection of transmission line against lighting, lighting shielding of substations, lighting arresters, surge arresters, surge capacitors and reactors, Surge protection of rotating machines.

Text Books:

1. Allan Greenwood, "Electrical transients in Power System", Wiley & Sons Inc. New York, 1991.

Course Title	INDUSTRIAL LOAD MODELING AND CONTROL					M.Tech PS III Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1852302	PE-5	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 2 Hours					End Exam Duration: 3Hrs			

Course Objectives:

- Understand the energy demand scenario.
- Understand the modeling of load and its ease to study load demand industrially.
- Analyze Electricity pricing models.
- Study Reactive power management in Industries.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Gain knowledge about load control techniques in industries and its application.
CO 2	Learn different types of industrial processes and optimize the process using tools like LINDO and LINGO.
CO 3	Apply load management to reduce demand of electricity during peak time.
CO 4	Apply different energy saving opportunities in industries.

UNIT - I

Electric Energy Scenario-Demand Side Management- Industrial Load Management, Load Curves-Load Shaping Objectives, Methodologies-Barriers

Classification of Industrial Loads, Continuous and Batch processes -Load Modelling.

UNIT - II

Electricity pricing – Dynamic and spot pricing -Models, Direct load control- Interruptible load control, Bottom - up approach- scheduling- Formulation of load Models, Optimization and control algorithms - Case studies.

UNIT - III

Reactive power management in industries-Controls-power quality impacts Application of filters Energy saving in industries.

UNIT - IV

Cooling and heating loads, load profiling, Modelling- Cool storage, Types-Control strategies, optimal operation, and Problem formulation- Case studies.

UNIT - V

Operating and control strategies, Power Pooling- Operation models, Peak load saving, Constraints Problem formulation- Case study, Integrated Load management for Industries.

Reference Books:

1. C.O. Bjork "Industrial Load Management - Theory, Practice and simulations", Elsevier, the Netherlands, 1989.
2. C.W. Gellings and S.N. Talukdar, Load management concepts. IEEE Press, New York, 1986, pp. 3-28.
3. Y. Manichaikul and F.C. Schweppe ," Physically based Industrial load", IEEE Trans. on PAS, April 1981.
4. H. G. Stoll, "Least cost Electricity Utility Planning", Wiley Inter science Publication, USA, 1989.
5. I.J. Nagarath and D.P. Kothari, .Modern Power System Engineering., Tata McGraw Hill publishers, NewDelhi, 1995.
6. IEEE Bronze Book- "Recommended Practice for Energy Conservation and cost effective planning in Industrial facilities", IEEE Inc, USA.

Course Title	DYNAMICS OF LINEAR SYSTEMS					M.Tech PS III Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1852303	PE-5	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 2 Hours					End Exam Duration: 3Hrs			

Course Objectives:

- To understand the linear system and its functions.
- To understand the stability analysis of linear systems and implement the same in MATLAB.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Learn linear system modelling, analysis and design so as to obtain the ability to apply the same to engineering problems in a global perspective.
CO 2	Gain knowledge on carrying out detailed stability analysis of both linear and nonlinear systems.
CO 3	Design observers and controllers for linear systems.
CO 4	Analyse and design pole placement method using MATLAB.

UNIT- I

Introduction Concept of State, State Variables and State Model, State model for Linear Continuous Time Systems, transfer function and transfer function matrix, MATLAB programs.

UNIT- II

Solving the time invariant state equation methods-exponential Laplace for homogeneous and non- homogeneous state equations

UNIT- III

Controllability, complete controllability of continuous time systems observability complete observability of continuous time systems principle of duality.

UNIT- IV

The introduction to the design pole placement method, problems in MATLAB. State observers, full order- minimum order.

UNIT-V

Lyapunov stability analysis, introduction, Lyapunov stability criterion, direct method of lyapunov and the linear systems.

Text Books:

1. Thomas Kailath, "Linear Systems", Prentice Hall Inc., Englewood Cliffs, N.J. 1980.
2. K. Ogata, "State Space Analysis of Control Systems", Prentice Hall Inc., Englewood Cliffs, N.J., 1965.
3. K. Ogata, "Modern Control Engineering, (second edition)", Prentice Hall Inc., Englewood Cliffs, N.J., 1990.
4. M. Gopal, "Digital Control and State Variable Methods", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.
5. C.T. Chen, "Linear System Theory and Design", New York: Holt Rinehart and Winston, 1984.
6. R.C. Dorf, and R. T. "Bishop, Modern Control Systems", Addison Wesley Longman Inc., 1999.

OPEN ELECTIVES

1. Business Analytics
2. Industrial Safety
3. Operations Research
4. Cost Management of Engineering Projects
5. Composite Materials
6. Waste to Energy

Course Title	BUSINESS ANALYTICS (Open Elective)					M.Tech PS III Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1871304	OEC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 2 Hours					End Exam Duration: 3Hrs			

Course Objectives:

- Understand the role of business analytics within an organization.
- Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
- To become familiar with processes needed to develop, report, and analyze business data. Use decision-making tools/Operations research techniques.
- Mange business process using analytical and management tools.
- Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Students will demonstrate knowledge of data analytics.
CO 2	Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
CO 3	Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
CO 4	Students will demonstrate the ability to translate data into clear, actionable insights.

UNIT I

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modeling, sampling and estimation methods overview.

UNIT II

Trendiness and Regression Analysis: Modeling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

UNIT III

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.
Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT IV

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT V

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making. Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

Text Books:

1. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, "Business analytics Principles, Concepts, and Applications", Pearson FT Press.

2. James Evans, "Business Analytics", persons Education.

3. Essentials of Business Analytics: An Introduction to the Methodology and its Applications, Bhimsankarm Pochiraju, Sridhar Seshadri, Springer.

Reference Books:

1. Business Analytics: Data Analysis and Decision Making, S. Christian Albright, Wayne L. Winstone, 6th Edition, Cengage Learning.

2. An Introduction to Business Analytics, Ger Koole, MG Books.

Course Title	INDUSTRIAL SAFETY (Open Elective)				M.Tech PS III Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1871305	OEC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 2 Hours					End Exam Duration: 3Hrs			

Course Objectives:

- To Know about Industrial Safety Program, Fundamentals of Maintenance Engineering to understand Wear and Corrosion and their preventions.
- To Analyze Fault tracking, Periodic and preventive Maintenance.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Analyze the Industrial Safety, Drinking water layouts, fire prevention, etc
CO 2	Understand the Wear and Corrosion and their Preventions.
CO 3	Analyze faults in machine tools and their general causes.
CO 4	Understand Periodic and preventive maintenance

UNIT I

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.

UNIT II

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.

UNIT III

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.

UNIT IV

Fault tracing: Fault tracing-concept and importance, decision treeconcept, 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, Electrical motors, Types of faults in machine tools and their general causes.

UNIT V

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.

Text Books:

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

Reference Books:

1. D.A. Crowl and J.F. Louvar, Chemical Process Safety: Fundamentals with Applications, Prentice Hall, 2011.
2. Fawcett H.H and W.S. Wood, Safety and Accident Prevention in Chemical Operations, 2nd Edition, John Wiley and Sons inc.

Course Title	OPERATIONS RESEARCH (Open Elective)				M.Tech PS III Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1871306	OEC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 2 Hours					End Exam Duration: 3Hrs			

Course Objectives:

- To Apply various optimization Techniques for Decision Making.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Students should able to apply the dynamic programming to solve problems of discreet and continuous variables
CO 2	Students should able to apply the concept of non-linear programming
CO 3	Students should able to carry out sensitivity analysis
CO 4	Student should able to model the real world problem and simulate it

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

UNIT V

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

Text Books:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
4. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010.

Reference Books:

1. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008.
2. Panner selvam, Operations Research: Prentice Hall of India 2010
3. Operations Research: Principles and Applications, G. Srinivasan, PHI.

Course Title	COST MANAGEMENT OF ENGINEERING PROJECTS (Open Elective)				M.Tech PS III Sem			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1871307	OEC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 2 Hours					End Exam Duration: 3Hrs			

Course Objectives:

- Understand the concepts of Project management for planning to execution of Projects.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand project characteristics and various stages of project.
CO 2	Analyze the learning and understanding techniques for project planning, scheduling and execution control.

UNIT I

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT II

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non- technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

UNIT III

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector.

UNIT IV

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis.

UNIT V

Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Text Books:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting

Reference Books:

1. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
2. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co.
3. The Engineer's Cost Handbook, Richard E. Westney, P.E, CRC Press.

Course Title	COMPOSITE MATERIALS (Open Elective)				M.Tech PS III Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1871308	OEC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 2 Hours					End Exam Duration: 3Hrs			

Course Objectives:

- Train student on Composite materials-definition, Advantages and classification.
- Equip students with knowledge on composite strengthening addition of components and their production rules.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Identify and understand the behavior of composite materials
CO 2	Apply the choices made for using certain type of composites in certain applications with reference to composite properties.
CO 3	Analyze the manufacturing of metal matrix composites and polymer matrix composites.

UNIT I

Introduction: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II

Reinforcements: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT III

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT IV

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT V

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Text Books:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

Reference Books:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Course Title	WASTE TO ENERGY (Open Elective)				M.Tech PS III Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1871309	OEC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 2 Hours					End Exam Duration: 3Hrs			

Course Objectives:

- To Create awareness in students of energy conservation.
- To Identify use of different types of Bio waste energy resources.
- To Understand different types of Bio waste energy conservations.
- To detect different waste conservation into different forms of energy.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand different types of energy from waste to produce electrical power.
CO 2	Estimate the use of bio waste to produce electrical energy.
CO 3	Understand different types of bio waste and its energy conversions.
CO4	Analyze the bio waste utilization and to avoid the environmental pollution.

UNIT I

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT II

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT IV

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Text Books:

1. Biogas Technology- Transfer and Diffusion, M.M. Halwagi, Elsevier.
2. C. Y. WereKo-Brobby and E. B. Hagan, "Biomass Conversion and Technology", John Wiley & Sons, 1996.
3. Introduction to Biomass Energy Conservations, Sergio Capareda.

Reference Books:

1. Desai, Ashok V, "Non Conventional Energy", Wiley Eastern Ltd., 1990.
2. Khandelwal, K. C. and Mahdi, S. S, "Biogas Technology - A Practical Hand Book" -, Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Challal, D. S., "Food, Feed and Fuel from Biomass", IBH Publishing Co. Pvt. Ltd., 1991.

Course Title	DISSERTATION (PHASE-I)					M.Tech PS III Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1852310	MAJOR PROJECT	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		0	0	20	10	100	--	100
Internal Assessment								

Course Objectives:

-

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Students will learn to survey the relevant literature such as books, national/international refereed journals and contact resource persons for the selected topic of research.
CO 2	Students will be able to use different experimental techniques.
CO 3	Students will be able to use different software/ computational/analytical tools.
CO4	Students will be able to design and develop an experimental set up/ equipment/testing.
CO 5	Students will be able to conduct tests on existing set ups/equipments and draw logical conclusions from the results after analyzing them.
CO 6	Students will be able to either work in a research environment or in an industrial environment.

Syllabus Contents:

The Project Work will start in semester III and should preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution. Seminar should be based on the area in which the candidate has undertaken the dissertation work as per the common instructions for all branches of M. Tech. The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by Head and PG coordinator. The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student.

M.TECH.-

IV- SEMESTER SYLLABUS

<table>
<tr><td>Course Title</td><td colspan="5">DISSERTATION (PHASE-II)</td><td colspan="3">M.Tech PS IV Sem</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">1852401</td><td rowspan="2">MAJOR PROJECT</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>0</td><td>0</td><td>32</td><td>16</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="5">Internal Assessment</td><td colspan="4">External Assessment</td></tr>
<tr><td colspan="9">Course Objectives:
•</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Students will develop attitude of lifelong learning and will develop interpersonal skills to deal with people working in diversified field will.</td></tr>
<tr><td>CO 2</td><td colspan="8">Students will learn to write technical reports and research papers to publish at national and international level.</td></tr>
<tr><td>CO 3</td><td colspan="8">Students will develop strong communication skills to defend their work in front of technically qualified audience.</td></tr>
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Syllabus Contents:

It is a continuation of Project work started in semester III. He has to submit the report in prescribed format and also present a seminar. The dissertation should be presented in standard format as provided by the department. The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study. . The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a guide, co-guide etc. as decided by the Head and PG coordinator. The candidate has to be in regular contact with his guide.

AUDIT COURSE-I & II SYLLABUS

Course Title	ENGLISH FOR RESEARCH PAPER WRITING (Audit Course)				M.Tech PS I / II Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
1870A01	Audit Course	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		2	0	0	0	40	--	40
Mid Exam Duration: 2 Hours								

Course Objectives:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand Writing skills and level of Readability.
CO 2	Analyze what to write in each section.

UNIT - I

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

UNIT - II

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

UNIT - III

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

UNIT - IV

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature

UNIT - V

skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Reference Book:

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

Course Title	DISASTER MANAGEMENT (Audit Course)				M.Tech PS I / II Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
1870A02	Audit Course	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		2	0	0	0	40	--	40
Mid Exam Duration: 2 Hours								

Course Objectives:

- Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand foundations of hazard, disasters and natural/social phenomena.
CO 2	Analyze Repercussions of disasters and hazards.
CO 3	Understand key concepts in disaster risk reduction and humanitarian response.

UNIT I

Introduction to Disaster: Definition, Factors and Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

UNIT II

Repercussions of Disasters And Hazards: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III

Disaster Prone Areas In India

Study of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics.

UNIT IV

Disaster Preparedness and Management

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT V

Risk Assessment

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People'sParticipation In Risk Assessment. Strategies for Survival.

Disaster Mitigation

Meaning, Concept and Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

Text Books:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.

2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.

3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

Reference Books:

1. Fundamentals of Disaster Management, Shekhawat R.S, Bhatnagar Harshul.
2. Disaster management, Ruthra, Lakshmi Publications.
3. Disaster Management and Preparedness, Nidhi Gauba Dhawan, Ambrina Sardar Khan, CBS Publishers.

Course Title	SANSKRIT FOR TECHNICAL KNOWLEDGE (Audit Course)				M.Tech PS I / II Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
1870A03	Audit Course	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		2	0	0	0	40	--	40
Mid Exam Duration: 2 Hours								

Course Objectives:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning.
- Learning of Sanskrit to develop the logic in mathematics, science &other subjects enhancing the memory power.
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand Sanskrit grammar and Composition.
CO 2	Ancient Sanskrit literature about science & technology can be understood
CO 3	Being a logical language will help to develop logic in students

UNIT I

Alphabets in Sanskrit,
Past/Present/Future Tense,
Simple Sentences

UNIT III

Order
Introduction of roots
Technical information about Sanskrit Literature

UNIT III

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Text Books:

1. Dr.Vishwas, "Abhyaspustakam" – Samskrita-Bharti Publication, New Delhi.

2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication.

3. Suresh Soni , "India's Glorious Scientific Tradition", Ocean books (P) Ltd., New Delhi.

Course Title	VALUE EDUCATION (Audit Course)				M.Tech PS I / II Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
1870A04	Audit Course	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		2	0	0	0	40	--	40
Mid Exam Duration: 2 Hours								

Course Objectives:

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

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Knowledge of self-development
CO 2	Learn the importance of Human values
CO 3	Developing the overall personality

UNIT I

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgments

UNIT II

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness.
Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

UNIT III

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline.
Punctuality, Love and Kindness.
Avoid fault Thinking.
Free from anger, Dignity of labour.
Universal brotherhood and religious tolerance.
True friendship.
Happiness Vs suffering, love for truth.
Aware of self-destructive habits.
Association and Cooperation.
Doing best for saving nature

UNIT IV

Character and Competence –Holy books vs Blind faith.
Self-management and Good health.
Science of reincarnation.
Equality, Nonviolence ,Humility, Role of Women.
All religions and same message.
Mind your Mind, Self-control.
Honesty, Studying effectively

Text Books:

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi.
2. John Haffai, Lead on & How to win over worry, World Book Publisher.
3. Swami Vivekananda, Call to the Youth for Nation Building, Advaita Ashrama, Calcutta.
4. Swami Vivekananda, Youth and Modern India, Rama Krishna Mission, Chennai.

Reference Books:

1. M.G. Chitakra, Education and Human values, A.P.H. Publishing corporation, New Delhi.

Course Title	CONSTITUTION OF INDIA (Audit Course)				M.Tech PS I / II Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
1870A05	Audit Course	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		2	0	0	0	40	--	40
Mid Exam Duration: 2 Hours								

Course Objectives:

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

Course Outcomes: On successful completion of this course, the students will be able to

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

UNIT I

History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working)

Philosophy of the Indian Constitution: Preamble, Salient Features

UNIT II

Contours of Constitutional Rights & Duties:

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT III

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions.

Executive: President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT IV

Local Administration:

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.

Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role.

Block level: Organizational Hierarchy (Different departments),

Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT V

Election Commission: Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners.

State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

Text Books:

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

Course Title	PEDAGOGY STUDIES (Audit Course)				M.Tech PS I / II Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
1870A06	Audit Course	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		2	0	0	0	40	--	40
Mid Exam Duration: 2 Hours								

Course Objectives:

- Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
CO 2	What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
CO 3	How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

UNIT I

Introduction and Methodology:

Aims and rationale, Policy background, Conceptual framework and terminology
Theories of learning, Curriculum, Teacher education.
Conceptual framework, Research questions**.**
Overview of methodology and Searching.

UNIT II

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
Curriculum, Teacher education.

UNIT III

Evidence on the effectiveness of pedagogical practices
Methodology for the in depth stage: quality assessment of included studies.
How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?
Theory of change.
Strength and nature of the body of evidence for effective pedagogical practices.
Pedagogic theory and pedagogical approaches.
Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV

Professional development: alignment with classroom practices and follow- up support

Peer support

Support from the head teacher and the community.

Curriculum and assessment

Barriers to learning: limited resources and large class sizes

UNIT V

Research gaps and future directions

Research design
Contexts
Pedagogy
Teacher education
Curriculum and assessment
Dissemination and research impact.

Text Books:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.

Reference Books:

1. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
2. Chavan M (2003) Read India: A mass scale, rapid, ‘learning to read’ campaign.

Web Links:

1. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Title	STRESS MANAGEMENT BY YOGA (Audit Course)				M.Tech PS I / II Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
1870A07	Audit Course	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		2	0	0	0	40	--	40
Mid Exam Duration: 2 Hours								

Course Objectives:

- To achieve overall health of body and mind.
- To overcome stress

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Develop healthy mind in a healthy body thus improving social health also
CO 2	Improve efficiency.

UNIT I

Definitions of Eight parts of yog. (Ashtanga)

UNIT II

- Yam and Niyam. Do`s and Don't's in life.

i) Ahinsa, satya, astheya, bramhacharya and aparigraha
ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT III

- Asan and Pranayam

  i)Various yog poses and their benefits for mind & body

  ii)Regularization of breathing techniques and its effects- Types of pranayam

Text Books:

1. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur
2. Swami Vivekananda, "Rajayoga or conquering the Internal Nature" .
3. Advaitashrama (Publication Department), Kolkata.
4. Acharya Yatendra, Yoga & Stress Management, Finger Print Publishing.

Course Title	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS (Audit Course)				M.Tech PS I / II Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1870A08	Audit Course	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		2	0	0	0	40	--	40
Mid Exam Duration: 2 Hours								

Course Objectives:

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

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
CO 2	The person who has studied Geeta will lead the nation and mankind to peace and prosperity
CO 3	Study of Neetishatakam will help in developing versatile personality of students

UNIT I

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

UNIT II

- Approach to day to day work and duties.
- Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

UNIT III

- Statements of basic knowledge.
- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

Text Books:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath,Rashtriya Sanskrit Sansthanam, New Delhi.
3. Enlightenment: Personality Development and management, Sagir Ahmed, Independently Published.