DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY

CIRCULAR NO.ACAD/NP/M.E.E.P.S./Engg./Syll./40/2013

It is hereby informed to all concerned that, on the recommendation of the Dean, Faculty of Engineering and Technology, the Hon'ble Vice-Chancellor has accepted the ***"Revised Syllabus with Cumulative Grade Point Average [CGPA] for M.E. Electrical Power Systems"*** on behalf of the **Academic Council Under Section-14(7) of the Maharashtra Universities Act, 1994** ***as appended herewith.***

This is effective from the **Academic Year 2013-2014** and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO.ACAD/NP/ENGG./SYLLABUS/
2013/36836-44

Date:- 08-10-2013.

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S.B.Zambare.

Director,
Board of College and University Development.

Copy forwarded with compliments to :-

1] The Principals, affiliated concerned Colleges,
Dr. Babasaheb Ambedkar Marathwada University.
2] The Director, University Network & Information Centre, UNIC, with **a request to upload the above syllabus on University Website [www.bamu.ac.in].**

Copy to :-

1] The Controller of Examinations,
2] The Superintendent, [Engineering Unit],
3] The Programmer [Computer Unit-1] Examinations,
4] The Programmer [Computer Unit-2] Examinations,
5] The Superintendent, [Eligibility Unit] ,
6] The Director, [E-Suvidha Kendra], in-front of Registrar's Quarter,
Dr. Babasaheb Ambedkar Marathwada University,
7] The Record Keeper,
Dr. Babasaheb Ambedkar Marathwada University.

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S/081013/-*

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD.

Revised Syllabus of

M.E.

ELECTRICAL POWER SYSTEMS

[Effective from 2013-14 & onwards]

Dr. Babasaheb Ambedkar Marathwada University Aurangabad.

Faculty of Engineering & Technology

Rules and Regulations for M.E. & M.Tech. Courses

- **What is a credit system**

  A credit system is a systematic way of describing an educational program by attaching credits to its components. The definition of credits in higher education systems may be based on different parameters, such as student workload, learning outcomes and contact hours.

- **Advantages of the Credit System**
  - Represents a much-required shift in focus from teacher-centric to learner-centric education since the work load estimated is based on the investment of time in learning, not in teaching.
  - Helps to record course work and to document learner work load realistically since all activities are taken into account-not only the time learners spend in lectures or seminars but also the time they need for individual learning and the preparation of examinations etc.
  - Segments learning experience into calibrated units, which can be accumulated in order to gain and academic award.
  - Helps self-paced learning. Learners may undertake as many credits as they can cope with without having to repeat all the courses in a given semester if they fail in one or more courses. Alternatively, they can choose other courses and continue their studies.

- **What is Grading?**

  The word Grade derived from the Latin word gradus, meaning, step. Grading, in the educational context is a method of reporting the result of a learner's performance subsequent to his evaluation. It involves a set of alphabets which are clearly defined and designated and uniformly understood by all the stake holders. A properly introduced grading system not only provides for a comparison of the learner's performance but it

also indicate the quality of performance with respect to the amount of efforts put in and the amount of knowledge acquired at the end of the courses by the learners.

- **CURRICULUM:**

1.1 Curriculum:

Every program with specialization has a prescribed course structure which in general terms is known as Curriculum. It prescribes course to be studied in each semester; the relevant information containing course structure along with detail syllabus for each course of each program is updated periodically and is uploaded on the website.

1.2 Semesters:

The Faculty of Engineering & Technology implements a credit based curriculum and grade based evolution system for P.G. program is of four semesters. The academic courses are delivered in the first two semesters. Dissertation work is carried out by a student in the third and fourth semester. The first semester begins in the last week of July ends by the last week of November while the second semester begins in the first week of January and ends by the second week of May. Total duration for each semester is generally of 20 weeks including the period of examination, evaluation and grade declaration.

1.3 Course Credit:

Education is organized around the semester-based credit system of study. The prominent features of the credit system are a process of continuous evaluation of a student's performance/progress and flexibility to allow a student to progress at an optimum pace suited to his/her ability or convenience, subject to fulfilling minimum requirements for continuation.

A student's performance/progress is measured by the number of credits that he/she has earned, i.e. completed satisfactorily. Based on the course credits and grades obtained by the student, grade point average is calculated. A minimum grade point average is required to be maintained for satisfactory progress and continuation in the program. Also a minimum number of earned credits and a minimum grade point average should be acquired in order to qualify for the degree. All programmers are defined by the total credit requirement and a pattern of credit distribution over courses of different categories.

1.4 Course credits assignment

Each courses, except a few special courses, has a certain number of credits assigned to it depending upon its lecture, tutorial and laboratory contact hours in a week. This weightage is also indicative of the academic expectation that includes in-class contact and self-study outside of class hours.

Lectures and Tutorials: One lecture or tutorial hour per week per semester is assigned one credit.

Practical/Laboratory: One laboratory hour per week per semester is assigned one credit.

Example: Course: XYZ Engg: 4 credits (3-1-2)

The credits indicated for this course are computed as follows:

3 hours/week lectures = 3 credits

1 hours/week tutorial = 1 credit

2 hours/week practical = 2 x 0.5 = 1 credit

2 hours/week seminar = 2 x 0.5 = 1 credit

Dissertation seminar = 2 x 1= 2 credit

(3-1-2) 3 credit course = (3 h Lectures + 1 h Tutorial + 2 h Practical) per week

= 6 Contact hours per week

1.5 Earning Credits

At the end of every course, a letter grade is awarded in each course for which a student had registered. On obtaining a pass grade, the student accumulates the course credits as earned credits. A student's performance is measured by the number of credits that he/she has earned and by the weighted grade point average.

The credit system enables continuous evaluation of a student's performance, and allows the students to progress at an optimum pace suited to individual ability and convenience, subject to fulfilling minimum requirement for continuation.

1.6 Evaluation System

1. Semester Grade Point Average (SGPA) =

   SUM (course credits in passed courses X earned grade points)

   SUM (Course credits in registered courses)

2. Cumulative Grade Point Average (CGPA) =

   SUM (course credits in passed courses X earned grade points) of all Semester
   ---
   SUM (Course credits in registered courses) of all Semester

3. At the end of M.E & M. Tech Program, student will be placed in any one of the divisions as detailed below.(According to AICTE Handbooks)

   I[st] Division with distinction : CGPA ≥ 8.25 and above

   I[st] Division : CGPA ≥ 6.75 and < 8.25

   II[nd] Division : CGPA ≥ 6.75 and < 6.25

As per AICTE Handbook (2013-14), new gradation suggested as follows,

Table 1

Grade Point	Equivalent Range
6.25	55%
6.75	60%
7.25	65%
7.75	70%
8.25	75%

Conversion of CGPA to percentage marks for CGPA ≥ 5.0 can be obtained using equations.

Percentage marks = (CGPA X10) – 7.5

An example of these calculations is given below:

Typically one example for academic performance calculations of semester -I

Table 2

Course No. (1)	Course Credit (2)	Grade Awards (3)	Earned Credit (4)	Grade Points (5)	Points Secured (6)=(4) x (5)
Subject 1	4	B	4	6	24
Subject 2	4	C	4	5	20
Subject 3	4	O	4	10	40
Subject 4	4	A+	4	8	32
Subject 5	4	C	4	5	20
Seminar	2	A++	2	9	18
Total	22		22	38	134

1. Semester Grade Point Average (SGPA) = $\frac{(134)}{(22)} = 6.09$

2. Cumulative Grade Point Average (CGPA) =
   Cumulative points earned in all passed courses = 134 (past semester) + 134 (this sem.) = 268

   Cumulative earned credits = 22 (past semesters) +22 (this sem) = 44

   $\frac{\sum (134 + 134)}{\sum (22 + 22)} = 6.09$

System Evaluation Table

Table 3

Grade	Grade Points	Marks Obtained (%)			Description Performance
		Regular Semester	Re-Examination	Summer Semester Examination/Re-appear	
O	10	91-100	--	--	Outstanding
A++	09	86-90	91-100	91-100	Excellent
A+	08	76-85	86-90	81-90	Very Good
A	07	66-75	76-85	71-80	Good
B	06	56-65	66-75	61-70	Fair
C	05	46-55	56-65	51-60	Average
D	04	40-45	40-55	40-50	Poor
F	00	Below 40	Below 40	Below 40	Fail
EE					Incomplete
WW					Withdrawal
XX	--	--	--	--	Detained
ABSENT	--	--	--	--	Absent
PP	--	--	--	--	Passed (Audit Course)
NP	--	--	--	--	Not Passed (Audit Course)

Grade Awards:

i) A ten point rating scale shall be used for the evaluation of the performance of the student to provide letter grade for each course and overall grade for the Master's Programme. Grade points are based on the total number of marks obtained by him/her in all the heads of examination of the course. These grade points and their equivalent range of marks are shown separately in Table-4.

Table 4: Ten point grades and grade description

Sr.No.	Equivalent Percentage	Grade Points	Grade	Grade Description
1	90.00 – 100	10	O	Outstanding
2	80.00 – 89.99	9	A++	Excellent
3	70.00 – 79.99	8	A+	Exceptional
4	60.00 – 69.99	7	A	Very Good
5	55.00 – 59.99	6	B+	Good
6	50.00 – 54.99	55	B	Fair
7	45.00 – 49.99	5	C+	Average
8	40.01 – 44.99	4.5	C	Below Average
9	40	4.00	D	Pass
10	<40	0.00	F	Fail

ii) Non appearance in any examination/assessment shall be treated as the student have secured zero mark in that subject examination/assessment.

iii) Minimum D grade (4.00 grade points) shall be the limit to clear/pass the course/subject. A student with F grade will be considered as 'failed' in the concerned course and he/she has to clear the course by reappearing in the next successive semester examinations. There will be no revaluation or recounting under this system.

iv) Every student shall be awarded Grade points out of maximum 10 points in each subject (based on 10 Point Scale). Based on the Grade points obtained in each subject, Semester Grade Point Average (SGPA) and then Cumulative Grade Point Average (CGPA) shall be computed. Results will be announced at the end of each semester and cumulative Grade card with CGPA will be given on completion of the course.

Proposed Coding System of M.E/M.Tech Subjects

Six Digit Code for a subject (PG Course)

	Digits→	1 2 3	4	5 6
Sr. No.	**Branch ↓**	**Branch code**	**Year**	**Subject**
1	Electronics	MEX	PG I year – 6	**Semester –I/III**
2	Communication Engineering	MEC	PG II Year - 7	1-20 Theory
3	Electronics & Telecom.	MET		21-30 Practical
4	Digital Communications	MDC		31 Dissertation-I
5	Embedded System	MES		41-49 Electives
6	Structure Engineering	MSE		**Semester –II/IV**
7	Environmental Engineering	MEV		51-70 Theory
8	Water Resource Engineering	MWR		71-80 Practical
9	Computer Engineering	MCE		81 Dissertation-II
10	Computer Network	MCN		91-99 Electives
11	Software Engineering	MSW		
12	Mechanical Engineering	MME		
13	Thermal Engineering	MTE		
14	CAD/CAM	MCC		
15	Manufacturing	MMF		
16	Heat Power	MHP		
17	Machine Design	MMD		
18	M.Tech Mechanical	MTM		
19	CSE & IT	MCI		
20	Manufacturing Processing Engineering	MMP		

Note: - Kindly, Allot Same Code for same Electives/ subjects for different branches to avoid repetitions of Question papers/settings/assessments.

DEGREE OF MASTAR OF ENGINEERING
(Course with effective from academic year: 2013-2014)

I	1	The examination for the Degree of Master of Engineering will be held in four semesters, M.E. Semester-I, M.E. Semester-II, M.E. Semester-III, and M.E. Semester-IV in case of full time course.
II	**Rules & Eligibility**	
	1	Rule for admission to P.G. Degree course in Engineering and Technology as per rules and regulation of AICTE/DTE & Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.
III	**Evaluation method**	
	1	Each theory course will be of 100 marks and be divided in to internal examination of 20 marks and semester examination of 80 marks (20+80=100 marks). Each practical course will be of 50 marks
	2	There shall be two class tests within a semester. First based on 40% syllabus taught and second based on 60% syllabus taught. The setting of question paper and assessment will be done by the concerned teacher who has taught the syllabus. Average marks obtained out of two examinations will be considered for the preparation of final sectional marks/ grade.
	3	The Question papers in theory subjects shall be set by the Examiners appointed for the purpose by the University on the recommendations of the Board of studies of the concerned PG Course.
	4	The assessment of the term work for any subject will be done by recognized post-graduate teacher.
	5	To pass the examination a candidate must obtain a minimum CGPA of 6.25 (CGPA to the scale of 10).
	6	Candidate who secures CGPA $\geq$ 6.25 and CGPA < 6.75 declared to have passed examination in second class.
	7	Candidate who secures CGPA $\geq$ 6.75 and CGPA < 8.25 declared to have passed examination in first class.
	8	Candidate who secures CGPA $\geq$ 8.25 declared to have passed examination in first class with distinction.

IV	1	In case candidate fails to get D grade in one or more heads of passing examination, he will be allowed at his option, to reappear for only those heads of passing in which he has failed or got less than D grade at subsequent examinations.
	2	The grades obtained by the candidate in any head of passing at the examination will be carried forward unless the candidates reappear for the head of passing in accordance with ref. IV (1)
	3	In case the candidate passes in all heads of passing under M.E. Semester-I, M.E. Semester-II examination and obtained a minimum CGPA of 6.25 in M.E. Semester-I, M.E. Semester-II taken together as required under ref. II(2) above, he will not be allowed to reappear for any head of passing under M.E. Semester-I, M.E. Semester-II in accordance with ref. IV(1)
	4	A candidate will not be allowed to appear for M.E. Semester-III examination unless he passes in all heads of passing under M.E. Semester-I, M.E. Semester-II examination and obtains a minimum CGPA of 6.25 in M.E. Semester-I, M.E. Semester-II taken together under reference II(2).
	5	Whenever a candidate reappears for M.E. Semester-III and M.E. Semester-IV examinations he will have to resubmit the dissertation with suitable modification and must also reappear for oral examination on it.
	6	A candidate registered for M.E. Examination must clear his examination within five years from the date of registration.
V	**Attendance Requirement**	
	1	Each semester of the course shall be treated as a separate unit for calculation of the attendance
	2	A candidate shall be considered to have satisfied the attendance requirement if he/she has attended not less 75% of the class in each subject of all the semesters (Theory, Laboratory, Semester Practical training and Dissertation work) actually conducted up to the end of the semester.
	3	A Candidate, who does not satisfy the attendance required, mentioned as above, shall not be eligible to appear for the Examination of that semester and shall be required to repeat that semester along with regular students later.
	4	The Principal of the concerned College shall display regularly, the list of such candidates who fall short of attendance, on the Notice Boards.

	5	The list of the candidates falling short of attendance shall be sent to the University at least one week prior to the commencement of theory/practical examination, whichever is earlier.
VI		The following are the syllabi in the various subjects of the examination for the Degree of Master of Engineering.

Dr. Babasaheb Ambedkar Marathwada University, Auranagabad
Syllabus Structure of M.E.(Electrical Power Systems) w.e.f. Academic Year 2013-14

Semester I

Course Code	Name of the Subject	Teaching Scheme Contact hours per week				Examination scheme Marks					Duration of Theory Exam	Credit
		L	T	P	Total hrs	Theory	Class Test	Term Work	Viva Voce	Total		
MEP601	Electrical Machine Analysis & Modelling	3	1	--	4	80	20	--	--	100	3 Hrs	4
MEP602	Power System Planning & Economic operation	3	1	--	4	80	20	--	--	100	3 Hrs	4
MEP603	Computer Aided Power System (CAPS)	3	1	--	4	80	20	--	--	100	3 Hrs	4
MEP604	Power System Dynamics & Stability(PSDS)	3	1	--	4	80	20	--	--	100	3 Hrs	4
MEP641	Elective I	3	1		4	80	20	--	--	100	3 Hrs	4
MEP621	CAPS Lab	--	--	4	4	--	--	50	--	50	--	2
MEP622	PSDS Lab	--	--	2	2	--	--	--	50	50	--	1
MEP623	Seminar-I	--	--	2	2	--	--	--	50	50	--	1
	Total	**15**	**5**	**8**	**28**	**400**	**100**	**50**	**100**	**650**	**15Hrs**	**24**

Semester II

Course Code	Name of the Subject	Teaching Scheme Contact hours per week				Examination scheme Marks					Duration of Theory Exam	Credit
		L	T	P	Total hrs	Theory	Class Test	Term Work	Viva Voce	Total		
MEP651	Advanced Power Electronics (APE)	3	1	--	4	80	20	--	--	100	3 Hrs	4
MEP652	Digital Protection of Power System (DPPS)	3	1	--	4	80	20	--	--	100	3 Hrs	4
MEP653	H.V.D.C. Transmission	3	1	--	4	80	20	--	--	100	3 Hrs	4
MEP654	Flexible AC Transmission	3	1	--	4	80	20	--	--	100	3 Hrs	4
MEP691	Elective II	3	1	--	4	80	20	--	--	100	3 Hrs	4
MEP671	DPPS Lab	--	--	4	4	--	--	--	50	50	--	2
MEP672	APE Lab	--	--	2	2	--	--	50	--	50	--	1
MEP673	Seminar-II	--	--	2	2	--	--	--	50	50	--	1
	Total	**15**	**5**	**8**	**28**	**400**	**100**	**50**	**100**	**650**	**15Hrs**	**24**

Semester III

Course Code	Name of the Subject	Teaching Scheme hours per week			Examination scheme Marks				Credit
		L	CH	Total hrs	Theory	Term Work	Viva Voce	Total	
MEP731	Dissertation Phase I	---	12	12	---	50	50	100	12
	Total	**---**	**12**	**12**	**---**	**50**	**50**	**100**	**12**

Semester IV

Course Code	Name of the Subject	Teaching Scheme hours per week			Examination scheme Marks				Credit
		L	CH	Total hrs	Theory	Term Work	Viva Voce	Total	
MEP781	Dissertation Phase II	---	20	20	---	100	200	300	20
	Total	---	20	20	---	100	200	300	20
	Grand Total							**1700**	**80**

Elective - I
Modern Electric Drives
Energy Audit And Conservation
EHV Transmission

Elective - II
Power System Design
Special Topics in Power system
Optimization Techniques

L: Lecture hours per week T: Tutorial hours per week P: Practical hours per week CH: Contact Hours

Total Credits = SEM 1 + SEM 2 + SEM 3 + SEM 4 = 24+24+12+20 = 80
Total Marks = SEM 1 + SEM 2 + SEM 3 + SEM 4 = 650+650+100+ 300 = 1700

MEP601 : ELECTRICAL MACHINE MODELING AND ANALYSIS

Teaching Scheme:
Lecture : 3 Hrs/week
Pract./Tutorials : 1 Hrs/week

Examination Scheme:
Theory Paper : 80 Marks (3 Hrs.)
Class Test : 20 Marks

Unit 1 : Basic Principals of Electrical Machine Modeling and Analysis
Introduction, Magnetically coupled circuits, Electromechanical Energy conversion, Machine windings and air gap MMF, winding inductances and voltage equations.

Unit 2: Theory of Direct Current Machines
Introduction, Elementary direct current machine, voltage and torque equations in machine variables, Basic types of direct current machines, Block Diagrams of Direct Current Machines, Dynamic characteristics of shunt motor supplied from a Constant voltage source, Linearized Machine Equations, Speed Control.

Unit 3 : Reference Frame Theory
Introduction, Background, Equations of transformation – Change of Variables, Commonly used reference frames, transformation between reference frames, trannformation of a balanced set, Balanced steady state phasor relationships, Balanced steady state voltage Equations, variables observed from several frames of references.

Unit 4 : Theory of Symmetrical Induction Machines
Introduction, Voltage Equation in machine variables, torque equation in machine variables, equation of transformation for rotor circuits, voltage equations in arbitrary reference frame variables, commonly used reference frames, per unit system, analysis of steady state operations, free acceleration characteristics, free acceleration characteristics viewed from various reference frames, dynamic performance during sudden changes in load torque, dynamic performance during a three phase fault at the machine terminals.

Unit 5 : Theory of Synchronous Machines
Introduction, Voltage Equation in machine variables, torque equation in machine variables, stator voltage equations in arbitrary reference frame variables, voltage equations in rotor reference frame variables, park's equations, torque equation in substitute variable, rotor angle and angle between rotors, per unit system, analysis of steady state operations, dynamic performance during sudden change in input torque, dynamic performance during a three phase fault at the machine terminals, approximate transient torque versus rotor angle characteristics, comparison of actual and approximate transient torque angle characteristics during sudden change in input torque – First swing transient torque angle characteristics during a three phase fault at the terminals – Critical Clearing time, Equal Area Criterion.

Unit 6 : Simple models of Non Electrical Components
Simple models of Non electrical components such as boiler, steam, and hydro turbines and governer systems. Modeling of Electrical Components such as Transformers, Transmissions Lines, excitation systems and Loads.

Reference Books:

1. P.C. Krause "Analysis of Electric Machinery" McGraw Hill, NY,1987.
2. C.V. Jones "The Unified Theory of Electrical Machines" Butterworth, London, 1967
3. P.S. Bhimra "Generalized Theory of Electrical Machines", Khanna Publishers
4. Filezgerald , A and Kingsley, C "Electric Machinary"

MEP602 : POWER SYSTEM PLANNING AND ECONOMIC OPERATION

Teaching Scheme:
Lecture : 3 Hrs/week
Pract./Tutorials : 1 Hrs/week

Examination Scheme:
Theory Paper : 80 Marks (3 Hrs.)
Class Test : 20 Marks

Unit 1: Introduction:
Power planning, strategic planning, national and regional planning, planning tools, planning organization, electricity regulation.

Unit 2: Forecasting:
Classification & characteristics of loads, long term, mid term and short term forecasting, forecasting techniques and its modeling, spatial load forecasting, peak load forecast, reactive load forecast.

Unit 3: Planning:
Generation, transmission and distribution planning, planning software packages, power sector, finance institutions, reforms to power structure, restructuring of system, deregulation IPPS, project financing alternatives, modes of contracting (BOT etc.)

Unit 4: Economic Operation:
System interconnection and integrated operation, thermal unit characteristics, transmission loss formula and its coefficients, practical calculation, evolution and application of economic scheduling of generation.

Unit 5: Automatic Generation & Voltage Control:
Introduction, load frequency control (single area& two area load case) and economic dispatch control, automatic voltage control. Load frequency control with GRCs digital LF controllers, decentralized control.

Unit 6: Reactive Power Control:
Methods for Reactive Power Control.

Reference Books:

1. R. N. Sullivan "Power system planning" Tata MC Graw Hill.
2. A.S. Pabla "Electrical power system planning" Mc Millan India Ltd.
3. L.K. Khirchmayer "Economic operation of power system" Willey Eastern Ltd.
4. P. S. R. Murthy, "Power system operation & control" Tata Mc Graw Hill.
5. I. J. Nagrath, D. P. Kothari, "Modern Power System Analysis", Tata Mc Graw Hill.

MEP603 : COMPUTER AIDED POWER SYSTEM ANALYSIS

Teaching Scheme:
Lecture : 3 Hrs/week
Pract./Tutorials : 1 Hrs/week

Examination Scheme:
Theory Paper : 80 Marks (3 Hrs.)
Class Test : 20 Marks

1. Review of fundamentals: -
P.U. calculations, Change of Base, Conversion from P.U. to system values, phasor notation, a-operator, basic matrix algebra, matrix operations, rank and linear dependence of a matrix, linear equations.

2. Symmetrical Components: - Symmetrical components of 3 and n-phase system, current phasors, sequence components of unbalanced network impedances and machine impedances, definition of sequence networks.

3. Analysis of unsymmetrical faults: -
Shunt faults (SLG, LL, 2LG, 3-phase), shunt fault calculations, series faults, unequal series impedances, single line open, 2 line open and other series faults.

4. Sequence Impedances: -
Sequences impedances of transmission lines, sequence capacitances of transmission line, sequence impedance of synchronous and induction machines, transformers, three winding transformers.

5. Change of Symmetry: -
Creating symmetry by labeling, generalized fault diagrams for shunt and series faults, Computation of fault currents and voltages, Constraint matrix, Kron's primitive network, other useful transformations, shunt fault transformations, transformations of shunt faults with impedance, series fault transformations

6. Simultaneous faults: -
Simultaneous faults by two-port network theory (Z, Y and H type faults), Simultaneous faults by matrix transformations, analytical simplification of series and shunt faults.

7. Computer Solution Methods: -
Solution using the admittance and impedance matrix, Comparison of admittance and impedance matrix techniques.

8. Power-Flow Solutions: -
The power-flow problem, Gauss –Seidal, Newton Raphson methods, Power Flow studies in System design and operation, decoupled power flow method.

Reference Books:
1. J. J. Grainger, W.D. Stevenson, "Power System Analysis", McGraw Hill, 1994
2. G. W. Stagg and A. H. El-Abiad, "Computer methods in power system analysis", McGraw Hill, 1968
3. I. J. Nagrath and D. P. Kothari, "Modern Power System Analysis", Tata McGraw Hill, 1980
4. G. L. Kusic, "Computer Aided Power System Analysis", Prentice Hall, 1986

MEP604 : POWER SYSTEM DYNAMICS AND STABILITY

Teaching Scheme:
Lecture : 3 Hrs/week
Pract./Tutorials : 1 Hrs/week

Examination Scheme:
Theory Paper : 80 Marks (3 Hrs.)
Class Test : 20 Marks

1. Introduction: -
Requirements of Reliable Power System, Effect of an impact upon system components, definitions of various terms, historical review.

2. Elementary mathematical model: -
Swing Equation, mechanical and electrical torques, power angle curve of synchronous machine, natural frequencies of oscillations of a synchronous machine, system of one machine against infinite bus, equal area criterion, classical model of multimachine system.

3. System response to small disturbances: -
Introduction, types of problems, unregulated synchronous machine, modes of oscillation of an unregulated multimachine system, regulated synchronous machine, distribution of power impacts.

4. Synchronous Machine: -
Park transformation, Voltage and flux linkage equations, formulation of state space equations, normalizing torque and voltage equation, equivalent circuit, the flux linkage state space model, load equations, sub transient and transient impedances and time constants, simplified model of synchronous machine, turbine generator dynamic model, machine connected to an infinite bus through a transmission line, machine connected to an infinite bus with local load, determining steady state conditions, initial conditions of multimachine system, determination of machine parameters from manufacturer's data, digital simulation of synchronous machine, linearization of state space current and flux linkage models, simplified linear model, state space representation of simplified model.

6. Excitation Systems: -
Simplified view of excitation control, Typical excitation configurations, Voltage regulator, Exciter buildup, Excitation System response, State space description of excitation system, Effect of excitation system on generator, Effect on stability, Generator Power limits, transient and dynamic stability.

7. Analysis: -
Analysis of single and multimachine systems. Small signal angle instability, damping and synchronizing torque analysis, eigen value analysis, Mitigation using power system stabilizers and supplementary modulation control of FACTS devices, small signal angle instability.

7. **Transient instability:** - Analysis using digital simulation and energy function methods, Transient stability controllers, Introduction to Voltage unstability, Analysis of voltage instability.

Reference Books:
1. P. M. Anderson and A. A. Fouad, "Power System Control and Stability", The IOWA state university press, USA
2. P. Kunder, "Power System Stability and Control", McGraw Hill, New York
3. P. Sauer and M. A. Pai, "Power System dynamics and stability", Prentice Hall, 1997
4. K. R. Padiyar, "Power System Dynamics, Stability and Control", Interline Publishers, Bangalore – 1996

ELECTIVE I : ENERGY AUDIT AND COSERVATION

Teaching Scheme:
Lecture : 3 Hrs/week
Pract./Tutorials : 1 Hrs/week

Examination Scheme:
Theory Paper : 80 Marks (3 Hrs.)
Class Test : 20 Marks

Unit 1 : Review of Energy Sources
Renewable and anon renewable resources, energy recycling, cogeneration significance and limitations of resources, standalone photovoltaic systems for AC load, solar water pumping system, standalone wind solar photovoltaic system, wind energy system, grid status and power generation system, status of solar thermal technology.

Unit 2 : Economics of Energy Conservation
Simple payback period analysis, significance of payback period, time value of money, net present value method, internal rate of return method, profitability index for benefit cost ratio, study and selection of proper tariff for particular application, fixed and variable components to tariff, impact of tariff on energy management.

Unit 3 : Energy Conservation: Objectives of energy conservation, planning of energy conservation

a) Motive power : Potential for saving electric Energy in motors, selection of proper size and speed, improving efficiency of the existing motors, use of soft starters, variable frequency drives for energy conservation
b) Energy Efficient Motors : Features, high efficiency motor design, europian aggrement on low voltage electric motor efficiency, NEMA high efficiency motors, determination of cost effectiveness, implementation of motor management program, economic evaluation methods, case studies of energy efficient motors in Indian manufacturing sectors. IEEMA Standard 19-2000 and IS 12615. Energy conservation bill of government of India.
c) Lighting: Level of illumination for different areas, use of right source of lamp for different application, energy efficient lamps, fixtures and types of illumination controllers
d) Heating Process : Selection of most efficient space, furnace, water heating and welding processes
e) Cooling Systems : Energy savings in coolers, air conditioners , ventilating systems and refrigeration.

Unit 4 : Energy Conservation in Industrial and Agriculture, Commercial, domastic and municipal sectors

Unit 5 : Energy conservation in Generation, Transmission and Distribution, Effective measures to reduce T & D losses

Unit 6 : Enery Management
Concept, energy inputs to different loads, comparison of different energy inputs on the basis of availability , storage feasibility, cost per unit output, Electrical Energy Management – Energy Accounting, measurement and management of power factor, voltage profile, current energy requirement, power demand monitoring, target setting etc. demand side and supply side management.

Unit 7 : Energy Audit :
Principle of energy audit, preliminary and detail energy audit, procedures for carrying out energy audit, energy production, relationship, specific energy consumption, least square method, cusum technique, data energy flow diagram, sankey diagram, instruments used for energy audit.

Reference Books :

1. "Emerging Trends in Power systems Vol. I and II" proceedings of the 8th national power system conference, Dec.94
2. Proceedings on International Conference on "Energy Conservation, Audit and Metering" Jan.2002
3. S.C. Tripathy "Electric Energy Utilization and Conservation"
4. S. Rao "Energy Technology"
5. Dr. S.P.Sukhatme "Solar Energy"
6. B.E. Kushare "Handbook on Energy Efficient Motors", International Copper promotion counsel (India).

MEP621 LAB: COMPUTER AIDED POWER SYTEM ANALYSIS

Teaching Scheme:
Pract./Tutorials : 4 Hrs/week

Examination Scheme:
Term work : 50 Marks

Minimum Eight Practicals under this subject will be performed on computer simulation using MATLAB/PSCAD/EMTDC/ETAB and will be based on the following topics.

1. Modeling of power system components such as Alternators, Transformers, and Transmission lines.
2. Formation of Y bus and Z Bus matrices for given networks.
3. Representation of Sequence Networks.
4. Programming of power flow using Newton-Raphson Method.
5. Programming of power flow using Gauss Seidel Method.
6. Programming of power flow using Fast Decoupled Method.
7. Representation of Two port Networks in Z, Y, H type.
8. Study of effect of Faults (LG, LL, LLG, 3 phase) on a single machine connected to infinite Bus.
9. Study of different Transformations in power systems.
10. Simulations based on the symmetry in Power System.

MEP622 LAB: POWER SYSTEM DYNAMICS AND STABILITY

Teaching Scheme:	Examination Scheme:
Pract./Tutorials : 2 Hrs/week	Viva-Voce : 50 Marks

Minimum Eight Practicals under this subject will be performed on computer simulation using MATLAB/PSCAD/EMTDC/ETAB and will be based on the following topics.

1. Solution of Swing Equation by any one method.
2. Representation of Equal Area Criteria for different conditions.
3. Modeling of Synchronous machines.
4. State Space Representation of Synchronous machines.
5. Representation of System Responses to small disturbances.
6. Representation of a single machine connected to infinite bus.
7. Representation of Excitation Systems.
8. Representation of Clarke's Diagram for Calculation of Steady State Stability of System.
9. Study of faults (LG, LLG, LL, 3 Phase) on stability of power systems.
10. Analysis of Multimachine Systems.

Seminar – I

The subject seminar I during the first semester in full time ME (EPS) course shall be based upon the technical essay or a report or analysis topics of dissertation chosen by the candidates. She/he shall submit short report on the topic and will deliver a talk there on, which along with the report, will be assessed by two internal examiners, one of whom will be the guide and the other being appointed by the principal of the institution.

MEP651 : ADVANCED POWER ELECTRONICS

Teaching Scheme:
Lecture : 3 Hrs/week
Pract./Tutorials : 1 Hrs/week

Examination Scheme:
Theory Paper : 80 Marks (3 Hrs.)
Class Test : 20 Marks

Unit 1 : Review of Power Semiconductor Devices:
Operating Characteristics and gate drive requirements of power devices SCRs, BJT, MOSFET, IGBT and GTOs, Device Comparison, Smart Power Control Chips.

Unit 2 : Controller rectifiers and AC voltage controllers:
Single and Three phase semi and full converters for various kinds of loads, dual converters, power factor improvement of converters, series converters, principle of phase control, single phase and three phase half and full wave ac voltage controllers with various loads, design of converter and ac voltage controller, effect of load and source inductances on performance.

Unit 3 : DC-DC converters:
Principle of operation of buck, boost, buck-boost, cuk, fly-back, forward, push-pull, half bridge, full bridge and isolated cuk converters, input and output filter design.

Unit 4 : Inverters:
Voltage source inverters, single phase and six step inverters, voltage control and PWM strategies and implementation aspects, SPWM, Third harmonic injected PWM, Delta PWM, Staircase & Other advanced modulation techniques, space vector modulation, open and closed loop control schemes for PWM controls, Current Source Inverters: single phase and three phase power circuit configurations and analysis, Load commutated inverters, principle of operation.

Unit 5 : Resonant inverters:
DC link inverters, modified circuit topologies for DC link voltage clamping, voltage control-PWM techniques, quasi resonant inverters, DC-DC converters series resonant and parallel resonant, application of zero voltage and zero current switching for DC-DC converters (buck and boost)

References:
1. Ned Mohan, T.M. Undeland and W. P. Robbins. 'Power Electronic Converters, Application and Design', John Wiley and sons 1989
2. M. H. Rashid, 'Power Electronics', Prentice Hall of India, 1994
3. B. K. Bose, 'Power Electronics and AC Drives' , Prentice Hall, 1986
4. B. K. Bose, ' Power Electronics and Variable Frequency Drive', IEEE Press, 2000

MEP652 : DIGITAL PROTECTION OF POWER SYSTEM

Teaching Scheme:
Lecture : 3 Hrs/week
Pract./Tutorials : 1 Hrs/week

Examination Scheme:
Theory Paper : 80 Marks (3 Hrs.)
Class Test : 20 Marks

Unit 1 : Review of technological trends in power system protection
Review of basics of electromagnetic and solid state protection, study of various amplitude and phase comparators, configurations of various solid state protection schemes, solid state protection of generators, transformers, feeders,busbars,substation, transmissions linesetc.

Unit 2: Digital protection
Evoluation of microprocessor, advantages of digital protection, use of microprocessor and microcontroller in protection,study of 8 bit microprocessor, data aquition, configuration of microprocessorbased controls for overcurrent, overvoltage, unvdervoltage,underfrequecncy, loadshedding,distance protection schemes.

Unit 3: DSP and its use in power systems
Introduction of DSP,study of Texas DSP 320XX. Review of DSP technioques,sampling,carrier,discrete fourier and FFT. Numerical algorithms.CT/PT modeling and standards, simulation of transients, electromagnetic transients program (EMTP)

Reference Books:

1. L.P.Singh "Digital Protection", Wiley Eastern Publictions.
2. A.G.Phadke and Thorpe "Power System Protection "
3. Y.P. Paithankar "Power System Protection"
4. T.S. Madhavrao "Power system Protection : static relays with microprocessors applications", Tata Mc Graw Hill Pub.
5. Crussell Mason "The art and Science of protective relaying " Wiley Eastern Publictions
6. A.R. Warrington "Protective Relays – Their Theory and Practice" Chapman and Hall

MEP653 : HVDC TRANSMISSION

Teaching Scheme:	Examination Scheme:
Lecture : 3 Hrs/week	Theory Paper : 80 Marks (3 Hrs.)
Pract./Tutorials : 1 Hrs/week	Class Test : 20 Marks

Unit 1 : Introduction: Principles of HVDC transmission, terminal equipments and their controls, reactive power control.

Unit 2 : Analysis of HVDC Converters: Choice of converter configuration, analysis of Graetz circuit, converters bridge characteristics, twelve pulse converters, detailed analysis of converter.

Unit 3 : HVDC System Control: DC link control, converter control characteristics, control of firing angle, current, extinction angle and power.

Unit 4 :Harmonics and Filters: Generation of Harmonics, design of ac and dc filters, carrier frequency and RI noise.

Unit 5 : Multiterminal dc systems: Introduction, potential applications, types, control and protection

Unit 6 : Analysis of AC/DC systems: Converter model and control, modeling of AC and DC networks, modeling of DC links, solution of DC load flow, per unit system for DC quantities, solution of AC-DC power flow.

Unit 7 : Protection: Converter faults, protection against over currents, over voltages, HVDC Circuit breakers, protection by dc reactors, insulation coordination

Unit 8 : Earth return: Use of earth and sea return, advantages and problems.

Unit 9 : Simulation of HVDC systems: HVDC system simulation, digital dynamic simulation of converters and DC systems, some case study of HVDC installation.

Reference Books:

1. Adams and Hingorani, 'HVDC Transmission', Grraway Ltd.
2. E.W.Kimbark,'DC transmission Vol. I and II
3. K. R. Padiyar,' HVDC Power transmission systems – Technology and System Ineractions', New Age International Ltd.
4. S.S.Rao,'EHV-AC & HVDC transmission engg. & practice', khanna publisher.

MEP654 : FLEXIBLE AC TRANSMISSION

Teaching Scheme:
Lecture : 3 Hrs/week
Pract./Tutorials : 1 Hrs/week

Examination Scheme:
Theory Paper : 80 Marks (3 Hrs.)
Class Test : 20 Marks

Unit 1 : FACTS Concept and General System Considerations:
Transmission Interconnections, Flow of Power in an AC System, Loading Capability, Power Flow and Dynamic Stability Considerations of a Transmission Interconnections, Relative importance of controllable parameters, Basic Types of FACTS Controllers, Brief description and definition of FACTS controllers, Benefits from FACTS technology, HVDC vs. FACTS

Unit 2 : Static Shunt Compensators:
SVC and STATCOM: Objectives of shunt compensation, Methods of controllable VAR generation, Static VAR compensators: SVC and STATCOM, Comparison between SVC and STATCOM, Static Var systems.

Unit 3 : Static series compensators:
GCSC, TSSC,TCSC and SSSC: Objectives of Series compensation, Variable Impedance Type series compensators, Switching converter type series compensators, External(System) control for series reactive compensators, Summary of characteristics and features.

Unit 4 : Static Voltage and Phase angle regulators:
TCVR and TCPAR: Objectives of voltage and phase angle regulators, Approaches to thyristor controlled voltage and phase angle regulators(TCVRs and TCPARs) Switching converter-based voltage and phase angle regulators, Hybrid phase angle regulators.

Unit 5 : Combined Compensators:
Unified Power Flow Controller(UPFC) and Interline Power Flow Controller(IPFC), Introduction, The unified power flow controller, The interline power flow controller, Generalized and multifunctional FACTS controllers.

Unit 6 : Special purpose FACTS controllers:
NGH-SSR Damping scheme and Thyristor-Controlled braking resistor, Subsynchronous resonance, NGH-SSR Damping scheme, Thyristor Controlled braking resistor(TCBR)

Reference Books:

1. N.G. Hingorani, 'Understanding FACTS', IEEE Press, 1999
2. Yong Hua Song, ' Flexible AC Transmission systems (FACTS)' ,IEEE Press, 1999

Elective – II: SPECIAL TOPICS IN POWER SYSTEM

Teaching Scheme:
Lecture : 3 Hrs/week
Pract./Tutorials : 1 Hrs/week

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test : 20 Marks

Any three topics of the following will be covered in the semester.

Unit 1: Power Quality: Power quality problems in distribution systems, factors defining power quality, harmonics, harmonics creating loads, modeling, harmonic propagation, series and parallel resonance, harmonic power flow, mitigation of harmonics and power quality problems using power electronics conditioner.

Unit 2: Power System Reliability:
Basic reliability concept, general reliability function, Marko process, Recursive techniques, generation reliability, transmission and distribution system reliability.

Unit 3: Expert system applications
Fault diagnosis, short termload forecasting, expert system in high voltage engineering

Unit 4: Artificial neural networks in power system
Short term load forecasting, ANN based transient stability assessment, load forecastinf static security assessment, voltage stability, economic load dispatch.

Unit 5: Fuzzy logic applications to power system
Fuzzy logic based power system stabilizers, fuzzy logic control of static condenser for shunt reactive power compensation. A fuzzy expert system for daily average and peak load prediction.

Unit 6: Operation and Control of interconnected Power System:
Function of SCADA system, common features to all SCADA systems, alarm function, integration of measurement control & protection functions by SCADA system, SCADA configurations.

Reference Books:

1. G. T. Heydt, 'Power Quality', Stars in circle publications Indiana, 1991.
2. Roy Billinton, "Power system reliability"
3. Erdnyei, "Power System reliability"
4. A.S. Pabla, "Power System Planning"
5. "Emerging trends in power system" proceedings of 8th National Power System Conference VOL I & II
6. S. S. Rao, "Switchgear Protection", Khanna Publications
7. Recent publication on Power System & Power Delivery.
8. J. M. Zurada, "Introduction to artificial Neural Network", Jaico Publishers.

MEP671 LAB: DIGITAL PROTECTION OF POWER STSTEM

Teaching Scheme:
Pract./Tutorials : 4 Hrs/week

Examination Scheme:
Viva Voce : 50 Marks

Minimum Eight Practicals under this subject will be performed and will be based on the following topics. Simulations will be performed on Test panels and computer simulations using MATLAB/PSCAD/EMTDC/ETAB.

1. Simulation of Merz price protection of Alternator with relay.
2. Simulation of Merz price protection of Transmission Lines.
3. Simulation of Distance protection of Transmission Lines.
4. Simulation of Electromechanical overcurrent Relay.
5. Simulation of Electromechanical Overvoltage Relay.
6. Simulation of 8 Bit Microprocessor and its interfacing techniques.
7. Microprocessor based Control for Overcurrent protection schemes.
8. Microprocessor based Overvoltage protection schemes.
9. Microprocessor based Distance Protection Schemes.
10. Simulation on DSP 320XX and its interfacing.
11. Simulation of Transients or electromagnetic transient program using DSP.
12. CT/PT Modeling.

MEP672 LAB: ADVANCED POWER ELECTRONICS

Teaching Scheme:
Pract./Tutorials : 2 Hrs/week

Examination Scheme:
Term Work : 50 Marks

Minimum Eight Practicals under this subject will be performed and will be based on the following topics. Simulations will be performed on Test panels or computer simulations using MATLAB/PSPICE/PSCAD.

1. To perform single or three phase, semi or full converter operation for resistive load, inductive load.
2. To perform single or three phase, semi or full converter operation with the effect of source inductance.
3. To perform simulation on DC to DC convertor topologies by using buck converter
4. To perform simulation on DC to DC convertor topologies by using boost converter
5. To perform simulation on DC to DC convertor topologies by using buck-boost converter
6. To perform simulation on Inverter topologies by using VSI with or without PWM techniques.
7. To perform simulation on Inverter topologies by using CSI.
8. To perform simulation on Resonant inverter topologies using DC link voltage clamping.
9. To perform simulation on Resonant inverter topologies using PWM technique.
10. To perform zero voltage or zero current switching for DC to DC converter.
11. To perform simulation on advanced modulation techniques such as space vector modulation.

Seminar – II

The subject seminar I during the first semester in full time ME (EPS) course shall be based upon the technical essay or a report or analysis topics of dissertation chosen by the candidates. She/he shall submit short report on the topic and will deliver a talk there on, which along with the report, will be assessed by two internal examiners, one of whom will be the guide and the other being appointed by the principal of the institution.

DISSERTATION – I & SEMINAR III

Dissertation (Part – I) at the end of third semester of full time course in M.E. (Electrical Power Systems) will be based upon the dissertation chosen by the candidate. She/he will be deliver a talk there on, which along with the report, will be assessed by two internal examiners, one of whom will be the guide and the other being appointed by the principal of the institution.

DISSERTATION – II

The dissertation shall consist of a report on any research work done by the candidate or a detailed report of the project work consisting of a design and development work that the candidate has done.

The candidate shall submit the dissertation report in triplicate to the Head of the institution, duly certified that the work has been satisfactorily completed.

Term Work/ Internal Examination:

The dissertation will be assessed by two internal examiners, one of whom will be the guide and the other senior staff member of the respective department being appointed by the principal of the institution.

External Examination:

It shall consist of a defence presented by the examinee on his work in the presence of examiners, appointed by the University, one of whom will be the guide and other an external examiner.