CURRICULUM & SYLLABI

2013-2014

M. TECH.

IN

ELECTRICAL POWER SYSTEMS MANAGEMENT (EPSM)

DEPARTMENT OF ELECTRICAL ENGINEERING
FACULTY OF ENGINEERING AND TECHNOLOGY
JAMIA MILLIA ISLAMIA
(A CENTRAL UNIVERSITY)
NEW DELHI-110025

CONTENTS

P R E F A C E

Technology is constantly growing and changing aspect of our field that is creating a need for content and resources. To address this emerging need Department of Electrical Engineering, JAMIA MILLIA ISLAMIA, New Delhi, has designed, developed and upgraded its previous syllabus. It creates new learning tools and makes students more knowledgeable.

This booklet presents the course structure and detailed syllabi, internal assessment, marks distribution in theory and lab courses for two M. Tech. Programmes offered by the Department of Electrical Engineering i.e.; M. Tech. in Electrical Power System Management and M. Tech. in Control and Instrumentation Systems.

The revised course curriculum is being designed to meet the AICTE and UGC norms on one hand and covering syllabi of competitive exams conducted by UPSC, NTPC, Power Grid, BHEL and GATE. The bulk courses are offered in core discipline of electrical engineering along with electives in emerging areas to specialize in chosen discipline. In addition, due weightage has been given to foundation courses in basic sciences, humanities and engineering. The main motive of curriculum development has been to imbibe a sense of confidence amongst the students in the area of electrical engineering. The syllabus has been framed so as to cover all basic aspects of electrical engineering education at par with national/international standards. Keeping in view the recent developments such as HVDC, FACT devices, SCADA and Automation systems, renewable energy, embedded systems, sensor technology, advances in power electronics, microcontroller design, digital signal processing, and soft computing etc., the department has updated its syllabi to include the latest areas.

Emphasis has been laid down towards self-learning through tutorials, seminars, colloquium and field visits, and industrial training components. Students have to undertake practical training in labs, and class-room teaching.

The booklet has been the outcome of **Workshop on Curriculum Revision for B. Tech. and M. Tech. Courses** held on December 3-4, 2012. I am indebted to all staff members for their continuous contribution for about one semester in the process of course revision.

I hope this booklet shall be of great help to all the M. Tech. students of Electrical Engineering Department, Jamia Millia Islamia.

(**Prof. Zaheeruddin)**
Head

WORKSHOP ON CURRICULUM REVISION

B. TECH. AND M. TECH. COURSES
DECEMBER 3-4, 2012

Workshop Committee

Chief Coordinator: **Prof. Zaheeruddin**
Coordinator: **Prof. Mini S. Thomas**
Convener: **Dr. Shabana Mehfuz**

Subject Groups:

1. **Power System**
   Expert: Dr. Subir Sen, Director, Power Grid Corporation of India Ltd.
   Group Coordinator: Prof. Mini S. Thomas
   Faculty members: Prof. Majid Jamil, Prof. Anwar Shehzad Siddiqui, Dr. Naimul Hasan, Dr. Arunesh Kumar Singh, Dr. Iqbal Ali

2. **Control & Instrumentation**
   Expert: Prof. R. P. Maheshwari, IIT Roorkee
   Dr. Subrata Mukhopadhyay, Chief Engineer (retired), CEA
   Group Coordinator: Prof. Ibraheem
   Faculty members: Prof. Shahida Khatoon, Prof. Shakeb A. Khan, Dr. Tariqul Islam, Mr. Rajveer

3. **Machines and Power Electronics**
   Expert: Dr. Sohail Akhtar, Director, Ministry of New and Renewable Energy
   Group Coordinator: Prof. H. E. Akhter,
   Faculty members: Dr. Haroon Ashfaq, Mr. Ahteshamul Haque, Mr. Sheeraj Kirmani

4. **Electronics & Communication**
   Group Coordinator: Prof. A. Q. Ansari
   Faculty members: Prof. Z. A. Jaffery, Prof. Munna Khan

5. **Computer Technology**
   Expert: Prof. Moinuddin, Pro VC, DTU Delhi
   Group Coordinator: Prof. Zaheeruddin
   Faculty members: Dr. Shabana Mehfuz, Dr. Manaullah

In addition, advice was sought from the following experts who could not attend the workshop:

1. Prof. Sukumar Mishra, IIT Delhi
2. Prof. D. R. Kohli (Retired), IIT Roorkee
3. Prof. B. H. Khan, AMU Aligarh
4. Dr. D. K. Lobiyal, JNU New Delhi
5. Prof. D. T. Sawhney, IIT Delhi
6. Prof. H. K. Verma (Retired), IIT Roorkee

Acknowledgement: The Department expresses profound gratitude and sincere thanks to Mr. Najeeb Jaung (IAS), Vice Chancellor of Jamia Millia Islamia for providing financial support.

JAMIA MILLIA ISLAMIA

Jamia was established in 1920 by a group of nationalist Muslim intelligentsia at Aligarh (Uttar Pradesh). Its campus shifted from Aligarh to Delhi in 1925 and the foundation stone of the present campus was laid on 1st March 1930. Since then, the university has expanded and become known as a premier educational institution of the country. Recognizing its contributions in the field of teaching, research and extension work, the University Grants Commission (UGC) bestowed the "deemed university" status to it in 1962, and it was designated a Central University in 1988. The journey from Aligarh to Delhi, not only presents the physical expansion of Jamia, but also presents a lesson for those who want to build educational institutions for the nation. It is therefore not surprising that Rabindranath Tagore once called the University as "one of the most progressive educational institutions of the country".

Jamia and the Nationalist Alternative

Jamia was conceived as the *National Muslim University* in October 1920 on the campus of the Mohammedan Anglo-Oriental College set up by Sir Syed Ahmed Khan at Aligarh. Since its inception in 1892, the Aligarh College had produced an elite and middle class leadership that was actively involved with the nationalist movement in one manner or the other. The landed gentry connected with the Aligarh College had helped to form the All India Muslim League in 1906. At the same time, the educated and secular Muslim intelligentsia from the college was associated with the khilafat and noncooperation movements led by Gandhiji and whose main plank of political mobilisation was Hindu-Muslim unity. The changing character of the nationalist movement in the Gandhian leadership had its impact on those connected with the Aligarh College. The syndicate of the college proclaimed that it had been founded to turn out "worthy and useful subjects of the British Crown". In contrast, freedom fighters like, Mohamed Ali (the khilafat leader and the first vice-chancellor) and Hakim Ajmal Khan wanted to build an educational institution which would serve to inculcate both, modern education and nationalist ideals in students from all communities, particularly the Muslims. They also actively opposed the "two nation theory" propagated by the Muslim League. This stand brought about a split between the Muslim intelligentsia and the Jamia was born out of this ideological conflict.

The formation of Jamia was supported by Gandhiji and Tagore who had himself initiated such an effort in Santiniketan. The start, with the foundation stone laid down by Shaikhul Hind Maulana Mahamud Hasan in Krishna Ashram of the Aligarh College campus, was also a difficult one due to lack of funds and infrastructure. The new university demonstrated that a society with diverse cultures could be groomed into a modern nation on the basis of a shared culture and perspective. In Jamia, Hindu, Muslim and other students not only studied together, they also ate and lived together in a Spartan lifestyle. Teachers came from all over the country and lived the same simple lifestyles. The use of 'khaddar' for uniforms epitomised the nationalist principle that was to follow throughout its development.

In 1924, after the withdrawal of khilafat, the institution faced a serious threat of closure. It then moved to Delhi and its reins were handed over to Dr Zakir Husain in 1926 who aptly remarked: "The biggest objective of Jamia is to prepare a roadmap for the future of Indian Muslims with the religion of Islam at its core and to fill that roadmap with the colour of the civilisation of India in such a way that it merges with the colours of the life of the common man." Jamia survived this transitional phase with the active support and involvement of leaders like Hakim Ajmal Khan,

M.A. Ansari, Abid Hussain and Mohammad Mujeeb who shared Zakir Husain's vision for the institution. This phase of Jamia's development was characterised by the equal sacrifices that were made by the staff and students of the university and were ably aided by Gandhiji in their fund collection.

Jamia: A reflection of a self reliant modern and secular nation

From its inception, the Jamia had catered to students from disadvantaged backgrounds (in contrast to the elite Aligarh College) and its course curriculum was suited to meet the needs of such students. The medium of instruction and learning was Hindi, Urdu and English. By 1937, the Jamia campus had already shifted to Okhla. The university was an active participant in spreading Gandhiji's idea of *nai talim* which was popularly known as the 'Wardha Scheme'. Under the leadership of Zakir Husain, the chief architect of Wardha Scheme, Jamia started the "Book Bank" project, the "Village (dehat) Project", and "Subzi Mandi Project". They also started programmes on *sehat aur safai* (health and hygiene), *kapda* (weaving), carpentry and soap making where students learnt the merits of combining manual labour along with broadening their intellectual horizons. Vocational training and school education became one of the cornerstones of Jamia education and models for innovative teaching.

At the threshold of independence, Jamia was emerging as a dynamic and unique institution that aspired for support from the independent Indian government. The trials and tribulations of a newly formed nation were also reflected in Jamia, which faced enormous financial difficulties in this period. However, the coping strategies used by the administration, staff and students themselves reflected the values of self-reliance and democratic functioning that were to form the core principles of Nehruvian India. Nehru assigned many roles to the founders of Jamia: both Zakir Husain and Mujeeb were inducted into the Planning Commission to develop a plan for integrated education. But despite these contributions to national development, they were forced to fight hard for a university status.

Contemporary Jamia

It was in 1962 that Jamia became a deemed university recognised by the University Grants Commission Act, 1956 under the leadership of Mohammad Mujeeb, "At last Jamia employees were able to draw regular salaries". By 1963, regular teaching programmes like masters in history and education, and undergraduate programmes in sciences were started. Thereafter, in 1969 doctoral programmes were started. The emergence of the university as a premier institution of learning was recognised in 1988 when it was accorded the status of a Central University. Today, Jamia Millia Islamia is an ensemble of a multi layered educational system which covers all aspects of schooling, under-graduate and postgraduate education. The university recognises that teaching and research are complementary activities that can advance its long-term interest. It has Natural Sciences, Social Sciences, Engineering & Technology, Education, Humanities & Languages, Architecture & Ekistics, Fine Arts, Law and Dentistry Faculties. Also, it has a well known AJK Mass Communication Research Centre. Jamia Millia Islamia has also started several other research centres that have given an edge to Jamia in terms of critical research in various areas. Obviously, these initiatives aim to promote new and emerging areas of research and programmes that can offer opportunities to its students and teachers to expand their horizons.

The Jamia Millia Islamia conducts Undergraduate, Postgraduate, M. Phil. and Ph.D. as well as Diploma and Certificate programmes. The number of students in the University is 15094 of

which 7253 are enrolled in undergraduate programmes, 2875 in postgraduate, 146 in M. Phil./M.Tech., 1570 Ph. D and 3250 in Diploma/Certificate programmes.

Jamia Millia Islamia, as before, continues to cater to the interests of students from all communities, but also aims to meet the particular needs of the disadvantaged sections of the Muslim society. True to the legacy of its founders, it continues to support measures for affirmative action and foster the goals of building a secular and modern system of integrated education. Thus, Jamia Millia Islamia is constantly learning from its history to negotiate the new and emerging challenges facing a nation of the twenty first century.

OFFICERS OF THE JAMIA

Amir-i-Jamia (Chancellor)	Lt. Gen. (Retd.) M.A. Zaki
Shaikh-ul-Jamia (Vice-Chancellor)	Mr. Najeeb Jung, IAS
Naib Shaikh-ul-Jamia (Pro-Vice-Chancellor)	Prof. S. M. Sajid
Musajjil (Registrar)	Prof. Shahid Ashraf
Dean, Faculty of Humanities & Languages	Prof. G. P. Sharma
Dean, Faculty of Social Sciences	Prof. Khan Masood Ahmed
Dean, Faculty of Natural Sciences	Prof. Khalil Ahmad
Dean, Faculty of Education	Prof. Ahrar Husain
Dean, Faculty of Engineering & Technology	Prof. Khalid Moin
Dean, Faculty of Law	Prof. Rose Varghese
Dean, Faculty of Architecture & Ekistics	Prof. S. M. Akhtar
Dean, Faculty of Fine Arts	Prof. Z. A. Zargar
Dean, Faculty of Dentistry	Prof. Ragini
Dean, Students' Welfare	Prof. Tasneem Meenai
Finance Officer	Prof. Shahid Ahmad
Librarian	Dr. Gayas Makhdumi

FACULTY OF ENGINEERING AND TECHNOLOGY

Faculty of Engineering and Technology was established in the year 1985. The Faculty is presently running undergraduate programmes leading to the degree of B. Tech. in Civil, Electrical, Mechanical, Electronics & Communication and Computer Engineering. Postgraduate programmes leading to degree of M. Tech. in Environmental Science and Engineering, Electrical Power System Management, M. Tech. in Control and Instrumentation System, Mechanical Engineering & Earthquake Engineering and M.Sc. Electronics programmes are also offered. Research Programmes leading to the degree of Ph.D. are also offered by all the departments. The Faculty is also running Evening Programmes (part-time) in Civil, Electrical, Mechanical, Electronics & Communication and Computer Engineering at undergraduate (B.E.) level. The Evening Programmes at B.E. level are designed and conducted to provide opportunities to improve technical qualification of in-service Diploma holders with the objective to equip the students with the knowledge and experience of modern technology relevant to their profession. In addition to these programmes, University Polytechnic offers Diploma Engineering programmes in Civil, Electronics, Electrical, Mechanical and Computer Engineering. As an extension of continuing education program, University Polytechnic also offers part-time Diploma Engineering programmes in Civil, Electronics, Electrical, Mechanical and Computer Engineering branches in the evening for in-service vocational professionals.

Faculty of Engineering and Technology has highly qualified faculty members in all the Departments. The laboratories of all the departments are well equipped and strengthening of these laboratories are continuously pursued. The Faculty has its own library and computer centre in addition to the central library and a Centre for Information Technology to cater to the specialised needs of the students of the Faculty. The University has an excellent facility for the games & sports (indoor and outdoor both) and gymnastics, which is shared by all the faculties.

In all such programmes that follow Semester System, each Academic Year is divided into two semesters viz. odd semesters and even semesters each of which is ordinarily of 20 weeks duration followed by Winter vacation and Summer vacation respectively. The Academic Schedule for all the semesters is notified by Dean's office at the commencement of the Annual Academic Session. End Semester Examinations are conducted and completed in two weeks time allotted for this purpose. Under normal circumstances, a maximum gap of one day between End Semester examinations of two theory programmes of a Semester is permissible.

The Training & Placement Office of the University is actively looking after the training and placement needs of the students of Faculty of Engineering & Technology. A large number of leading organizations are regularly visiting for campus placements. The graduates of earlier batches have been gainfully employed in reputed public and private sector organizations in India and abroad. Many have opted for higher education in India and abroad.

Faculty of Engineering and Technology comprises of the following:

1. Department of Civil Engineering
2. Department of Mechanical Engineering
3. Department of Electrical Engineering
4. Department of Electronics & Communication Engineering
5. Department of Computer Engineering
6. Department of Applied Sciences & Humanities
7. University Polytechnic

DEPARTMENT OF ELECTRICAL ENGINEERING

The Department of Electrical Engineering was incepted in 1985. Since then it has registered tremendous growth in teaching and research and has got its recognition at national and international levels. The Department offers the following courses:

Undergraduate programmes

Bachelor of Technology (B. Tech.) in Electrical Engineering
Four year programme after XII standard

Bachelor of Engineering (B. E.) in Electrical (Evening Programme)
Four year programme for working professionals with Diploma in Electrical Engineering

Postgraduate programmes

Master of Technology (M. Tech.) in Electrical Power System Management
Two years programme after B. Tech. in Electrical Engineering

Master of Technology (M. Tech.) in Control and Instrumentation Systems
Two years programme after B. Tech. in Electrical/Instrumentation/Control/Electronics and Communication Engineering

Ph. D. Programmes

The Department offers Ph. D. programmes in five major areas namely;

(1) Power System
(2) Machines, Drives and Power Electronics
(3) Control and Instrumentation
(4) Electronics and Communication
(5) Computer Technology

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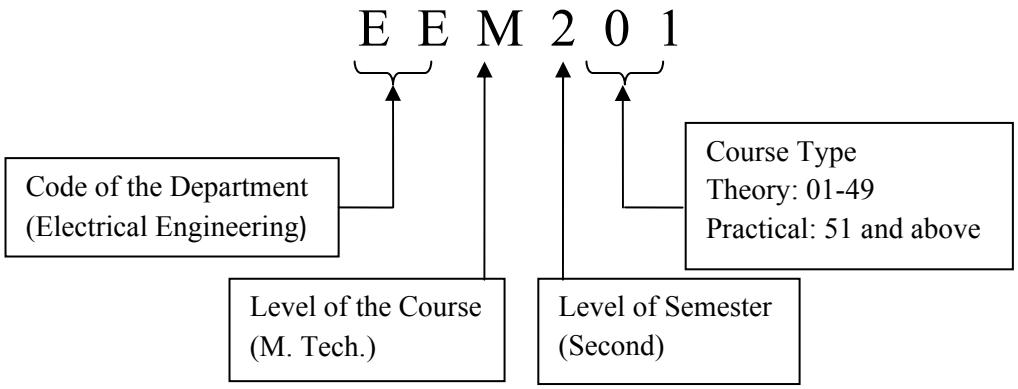
COURSE NOMENCLATURE AND CREDIT SYSTEM

Course numbering scheme
Each course number is denoted by six alpha-numerals, three alphabets followed by three numerals:



Weightage for Course Evaluation

Evaluation in every course is based on the weightage assigned to various components of the course curriculum. These components are designated as under:

L Lecture
T Tutorial
P Practical
CCA Continuous Class Assessment
MTE Mid Term Exam

Course credits assignment

Each course has a certain number of credits assigned to it depending upon its lecture, tutorial and laboratory contact hours in a week.

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 half credit.

Examples:

Theory Course *EEM-101 Intelligent Techniques*; 4 credits (3-1-0)
The credits indicated for this course are computed as follows:
3 hours/week lectures = 3 credits
1 hours/week tutorial = 1 credit
0 hours/week practical = 0 credit
So, (3-1-0) **4** credit course = (**3** h Lectures + **1** h Tutorial + **0** h Practical) per week
= **4** contact hours per week

Practical Course *EEM-152 SCADA Lab*; 2 credits (0-0-4)
The credits indicated for this course are computed as follows:
(0-0-4) **2** credit course = (**0** h Lectures + **0** h Tutorial + **4** h Practical) per week
= 4 hours/week practical = 4 x 0.5 credit = 2 credit

ORDINANCE 15-A (XV-A)

University Examinations in
Postgraduate Programmes under Credit-based Semester System

1. Definitions

1.1. 'Programme' means the entire course of study and examinations.

1.2. Unless otherwise provided for, 'Semester' means a term consisting of a minimum of 90 teaching days.

1.3. 'Course' means a segment of subject matter to be covered in a semester.

1.4. 'Grade' in a course is a letter symbol (A+, A, B+, B, C+, C, D) which indicates the comparative level of performance of a student in a course.

1.5. Each letter grade is assigned a 'Grade Point' (G) which is an integer indicating the numerical equivalent of the performance of a student in a course.

1.6. 'Credit' (Cr) of a course is a measure of the weekly unit of the work assigned for the course.

1.7. 'Credit Point' (P) of a course is the value obtained by multiplying the grade point (G) by the credit (Cr) of the course: P = G x Cr.

1.8. 'Semester Grade Point Average (SGPA) is the value obtained by dividing the sum of credit points (P) obtained by a student in the various courses taken in a semester by the total number of credits taken by him/her in that semester. The grade point shall be rounded off to two decimal places. SGPA determines the overall performance of a student at the end of a semester.

1.9. 'Cumulative Grade Point Average' (CGPA) is the value obtained by dividing the sum of credit points in all courses taken by the student for the entire programme by the total number of credits and shall be rounded off by two decimal places.

1.10. 'Grade card' is a card containing grades secured by a student in each course in a semester-based programme, together with his/her SGPA and CGPA, and Division.

2. General

2.1. Notwithstanding anything contained to the contrary, the following Ordinance shall apply to all Postgraduate Programmes (except for the M.Phil. programme) offered by the University under the 'semester system'.

2.2. An academic year will consist of two semesters.

2.3. The odd and even semesters will commence from July and January, respectively, or as decided by the Academic Council from time to time.

2.4. This Ordinance shall be applicable to the programmes as incorporated in Annexure 15A-1, which may be modified by the Academic Council from time to time.

2.5. The programmes governed by respective regulatory councils such as Council of Architecture, All India Council for Technical Education, Dental Council of India, NCTE, etc. shall be governed by the rules of respective councils. Provided that, if the detailed rules are not provided for by the respective councils, the provisions contained herein shall apply to such courses also.

2.6. A student shall be allowed to complete a programme within a maximum period of four semesters if the duration of the programme is of two semesters, within six semesters for a programme of three-semester duration, within eight semesters if the duration of the programme is of four semesters, and within ten semesters if the programme is of six-semester duration.

2.7.1 For each semester-based postgraduate programme, the concerned Board of Studies/Committee of Studies shall determine the number of courses to be offered in each semester, assigning the number of credits to each course.

2.7.2 In a Theory/Tutorial course, a course of 'n' hours a week will be assigned 'n' credits; whereas in a Laboratory course of '2n' hours a week 'n' credits will be assigned. The latter will also be applicable to Field Work/Teaching Practice or such activities as decided by the Academic Council from time to time.

2.7.3. The number of credits to be assigned to various courses offered in a semester will be between 20 and 30, depending upon the requirement of the programme.

2.7.4. To be declared successful, a student shall have to secure the minimum number of credits as prescribed by the concerned Faculty/Board of Studies/Committee of Studies, which will in no case be less than 40/60/80/120 credits in a two/three/four/six semester programme, respectively.

3. Attendance

For appearing in semester examinations, the provisions of Attendance as prescribed in the academic Ordinance 35 (XXXV), shall be applicable.

4. Evaluation

4.1. A programme may be comprised of some of the following components: theory courses, laboratory courses, field work, block placement, project, dissertation, seminar, industrial training etc. as prescribed by the concerned Board of Studies/ Committee of Studies and approved by the Academic Council on recommendation of the concerned Board of Studies/ Committee of Studies. For various components, the weightage of marks will be as follows:

For Theory Course

Internal Assessment	25% of allocated marks
End Semester Examination	75% of allocated marks

For Laboratory/ Practical Course

Internal Assessment	50% of allocated marks
Practical Examination and Viva Voce Examination	50% of allocated marks

4.2. In case of other components, such as Project/ Dissertation/ Industrial Training/ Field Work/ Teaching Practice etc., the distribution of marks may be decided by the concerned Board of Studies/ Committee of Studies.

4.3. Internal Assessment

4.3.1. The Internal Assessment in a theory course may comprise of written tests, assignments, presentations, seminars, tutorials, term papers etc. as prescribed by the concerned Board of Studies/ Committee of Studies from time to time.

4.3.2. In a laboratory course, each practical performed by a student will be evaluated by the concerned teacher(s). Evaluation will involve documentation of the practical exercise/ experiment, precision in the performance of experiment, viva voce examination etc.

4.3.3. In the case of Industrial Training/ Project, the Internal Assessment will include periodical progress report.

4.3.4. In the case of field work, the Internal Assessment will include: Professional Development, Record Keeping, Use of Supervision, Regularity in Field Work, Individual and Group Conferences, Rural Camp, Behavioural Laboratory, Skill Laboratories etc.

4.3.5. The modalities of evaluation of various components in para # 4.3.1 - 4.3.4 shall be decided by the concerned Board of Studies/ Committee of Studies from time to time and shall be duly approved by the concerned Faculty/Board of Management.

4.3.6. The concerned Department/ Centre shall maintain the complete record in respect of the Internal Assessment and display it in the respective departments/centres.

4.4. Semester-End Examination

The Semester-End Examination will ordinarily commence during the first week of December/ first week of May for the Odd Semester/ Even Semester courses, respectively or as decided by the Academic Council from time to time.

5. Award of Grades

5.1. Letter Grades and Grade Points

Students will be awarded letter grades on 10-Points Scale for each course on the basis of their performance in that course. The procedure for award of grades is as follows:

5.1.1. All evaluations will be done in marks.

5.1.2. The marks obtained by a student in the End Semester Examination and Internal Assessment in a theory/ laboratory course/ Field work/ Industrial Training/ Teaching Practice/ Project, as the case may be, will be added together. These combined marks would be converted to a 100-Point Scale. The rounding off (if required) will be done to the nearest integer.

5.1.3. Letter grades will now be awarded for each course as per the following table:

Grade	Range of Marks (M)#	Grade Point (G)
A+	$85 \leq M \leq 100$	10
A	$70 \leq M < 85$	9
B+	$60 \leq M < 70$	8
B	$55 \leq M < 60$	7
C+	$50 \leq M < 55$	6
C	$40 \leq M < 50$	5
D	$M < 40$	0

#M: Marks obtained by a student on the 100-point scale.

For the programmes listed in Annexure 15A-1, the lowest passing grade in a course and also for awarding a degree will be 'C' and a candidate having obtained the 'D' grade in a course shall be declared as failed in that particular course.

For the programmes listed in Annexure 15A-2, the lowest passing grade in a course, based on the combined marks of Internal Assessment and Semester-End Examination, will be 'C+'and a student having secured a grade lower than this shall be declared as failed in that course.

5.2. Credit Point (P)

It is the value obtained by multiplying the grade point (G) by the credit (C) of the course:

$$P_n = G_n \times Cr_n$$

where,

'P_n' is the Credit point for the 'n'th course,

'G_n' is the Grade point awarded in the 'n'th course,

'Cr_n' is the number of credits assigned to the 'n'th course,

'n' is the number of course in which a student is appearing in a semester.

5.3. Semester Grade point Average (SGPA)

It is the weighted average of the grade points of all courses during the semester. After the successful completion of a semester, Semester Grade Point Average (SGPA) of a student in that semester is calculated using the formula given below.

$$SGP = \frac{P_1 + P_2 + ... + P_n}{Cr_1 + Cr_2 + ... + Cr_n}$$

5.4. Cumulative Grade Point Average (CGPA)

The Cumulative Grade Point Average (CGPA) of a student is calculated at the end of a programme. For the computation of CGPA, only the best performed courses with maximum credit points (P) alone shall be taken subject to the minimum credits requirements. The CGPA of a student determines the overall academic level of the student in a programme and is the criterion for ranking the students. CGPA can be calculated by the following formula:

$$CGPA = \frac{(SGPA)_1 S_1 + (SGPA)_2 S_2 + ... + (SGPA)_n S_n}{S_1 + S_2 + ... + S_n}$$

where $(SGPA)_n$ is the SGPA of the n^{th} semester and S_n is the total credits taken in the n^{th} semester.

6. Promotion of Candidates:

6.1. For a student of the 1st semester/ subsequent semesters of any programme of study, who is detained due to shortage of attendance, the provisions of Ordinance 5 (V) (*academic*) Para no. 5.1 and 5.2 shall apply respectively.

6.2. The lowest passing grade for Internal Assessment/End-Semester Examination in each theory/laboratory course/field work etc. shall be 'C', separately for each component.

6.3. If a student could not appear in the Internal Assessment of a course due to illness or any other valid reason beyond his/her control or failed in the Internet Assessment, he/she may be given another chance to appear in the Internal Assessment of the said course before the commencement of the End-Semester Examination.

Provided that if the student fails in the Internal Assessment in the additional chance given to him/her, he/she will be declared as failed in the Internal Assessment and will not be allowed to appear in the Semester-End examination in the said course. Such a student may however be permitted to appear in the next odd/even semester-end examination only if he/she has passed the Internal Assessment in the concerned course.

Provided further that his/her promotion to the next semester will, however, be determined as per the promotion rules.

6.4. In a programme of three or more semesters duration, a student will automatically be promoted from the odd semester to the even semester, provided that he/she has fulfilled the minimum requirement of attendance and field work wherever applicable, failing which he/she may be permitted to appear as an ex-student in the next odd/even semester examination, as the case may be.

In a two-semester programme, a student of the first semester shall have to fulfill the minimum requirement of attendance and Internal Assessment, and obtain passing grades in at least 50% of the courses in the Semester-end Examination, failing which his/her admission shall stand cancelled. However, such a student may be given re-admission in the same semester in the next year as per the provisions of Ordinance 5 (V) (Academic).

Provided further that in a two-semester programme, a student will become an ex-student if he/she has fulfilled the minimum requirement of attendance and Internal Assessments, but has failed to secure passing grades in 50% of the courses of the first and the second semesters combined.

6.5. A student who failed in a semester examination or could not appear in the examination for reasons other than shortage of attendance, will not be readmitted. However, he/she may be allowed to reappear as an ex-student in the next odd/even semester examination, as the case may be.

6.6. A student of other than 1st semester of any programme who has not taken examinations due to shortage of attendance may be given re-admission in the consecutive concerned semester of the programme. In case, he/she fails to fulfil the requirement of attendance after being given re-admission, his/her admission shall stand cancelled.

6.7. No candidate shall be permitted to move to the third semester if he/she has a backlog of more than 50% of the courses of the first and second semesters combined. For the programmes of the duration of six semesters, promotion from the fourth semester to the fifth semester, a student will be required to clear at least 75% of the courses upto 4th semester.

In case the value of 50% or 75% of the courses comes out to be a non-integer, it will be rounded off to the nearest integer.

6.8. In case a student is unable to clear the required number of courses in the second semester (in a programme of four semester duration) or fourth semester ((in a programme of six semester duration) in accordance with para # 6.6 above, he/she shall be declared as failed. However, such a student may appear as an ex-student in the ensuing semester examinations.

6.9. An ex-student will be required to appear only in such courses in which he/she has failed to obtain the minimum passing grade, with the odd/even semester examination as the case may be.

6.10. A candidate will be declared as passed in a programme if his/her CGPA is not less than 5 and that he/she has obtained the minimum passing grade in any course.

7. **Division**

Division will be awarded in the following manner (with maximum CGPA of 10 as base)

$10.0 \leq$ CGPA ≥ 8.0 First Division with Distinction

$6.5 \leq$ CGPA < 8.0 First Division

$5.5 \leq$ CGPA < 6.5 Second Division

$5.0 \leq$ CGPA < 5.5 Pass without Division

8. **Re-evaluation of Answer Scripts**

No request for re-evaluation of the result declared in any course shall be entertained. However, the retotalling of marks of an answer book will be permitted on submission of an application along with the prescribed fee by the candidate to the Controller of Examinations.

9. **Moderation of Examination Results *and Redressal of Grievances***

9.1. For each Faculty there shall be an "Examination Results Moderation-cum-Grievance Committee" comprising of the following members:

(a) Dean of the Faculty (Chairperson),

(b) Head of the concerned Department,

(c) One faculty member of the concerned department to be nominated by the Head of the Department,

(d) One faculty member of the concerned Faculty to be nominated by the Vice-Chancellor.

9.2. In the case of *AJK-Mass Communication Research Centre,* the composition of the committee shall be as follows:

(a) Director of AJK-MCRC,

(b) One faculty member of the centre to be nominated by the Director,

(c) Two faculty members of Jamia to be nominated by the Vice-Chancellor.

9.3. For Other *Centres*, the composition of the Committee shall be as follows:

(a) Dean, Faculty of Humanities and Languages/ Dean, Faculty of Natural Sciences/ Dean, Faculty of Social Sciences (Chairperson)
(*for centres engaged in study and research in the fields of Languages & Culture/ Sciences/ Social Sciences, respectively*),

(b) Director of the concerned Centre,

(c) One faculty member of the Centre nominated by the Director of the Centre,

(d) One faculty member from amongst the Centres to be nominated by the Vice-chancellor.

9.4. The quorum for holding a meeting of the Committee shall be 3/4th of the total number of committee members.

9.5. Before the examination results are declared, the committee shall ensure that there are no discrepancies and internal inconsistencies in the results. In case of minor discrepancies, involving upto 10% of marks leading to change in the result, the committee will be empowered to moderate the results by recording the reasons thereof. In case of major discrepancies noticed by the Committee, the matter shall immediately be brought to the notice of the Vice-Chancellor for further action.

9.6. The Committee shall forward the moderated results to the Controller of Examinations for their declaration.

9.7. In exceptional circumstances, the committee, either on its own initiative or any complaint received, may inspect the answer books of a candidate or that of the entire class and look for discrepancies in marks awarded and submit its recommendations to the Vice-Chancellor.

10. Improvement Examination

10.1. A student may be allowed to improve his/her grade in any two of the courses in the next semester. However, the improvement of the odd/even semester course will be permitted in the next odd/even semester examination only.

10.2. Improvement examination will be held in Theory courses only.

10.3. The appearance at such an examination in the course will be allowed only once. No further chance will be given under any circumstances.

10.4. For the purpose of determining the final division/ grade, the grades obtained by the candidate in the improvement examination only will be taken into consideration.

11. Compartment Examinations:

As per the provisions laid down in Para No. 24.4 of Ordinance 15 *(academic)*, candidates failing in the final year/final two semesters of any programme/course may be allowed to appear in the Compartment Examination which will be held after the final annual/ semester-end examination is over. The date(s) of such examinations will be notified by the Controller of Examinations.

12. Ranking of Successful Students

The ranking of successful students of a programme shall be determined on the basis of the CGPA obtained by them in all semester examinations within the minimum prescribed period of the programme. In the case of tie, the students shall be awarded ranking on the basis of the grades obtained in theory courses. In case there is still a tie, the students will be awarded the same ranking.

13. Grade Card

At the end of each semester, a student will be given a 'Grade Card' which will contain grades secured by him/her in each course, together with his/her SGPA in that semester. On the completion of the programme, a Final Grade Card will be issued to the students, giving full semester-wise details about the grades obtained by him/her in each course together with his/her SGPA and also the CGPA and Division awarded to him/her.

Ordinance 35 (XXXV) (Academic)

ATTENDANCE

(for Regular Students)

1. In order to be eligible to appear at the Annual/Semester End Examination, a student shall be deemed to have undergone a regular course of study in the University, if he/she has attended at least 75% in lectures/tutorials, AND separately 75% in practicals/ field work/teaching practice and/or such other activities as decided by the Academic Council from time to time.

   Provided that a relaxation to the maximum extent of 10% of the total attendance may be accorded to a student on account of serious sickness/excruciating medical disability*, participation in the university-approved co-curricular/extra-curricular activities and prescribed educational/cultural tours.

   Provided further that in case of medical disability as mentioned herein above, an application for condonation shall be supported by a medical certificate advising such a condonation issued by a Public Hospital or such hospitals as notified by Jarnia Millia Islamia (as per the appended annexure). The University may, at its discretion, refer such cases to the Ansari Health Centre of Jamia. The decision of the medical experts of the Ansari Health Centre shall be final and conclusive. ***Such applications must be submitted either during the period of treatment/hospitalization or within two weeks following recovery.*** In case of review/rejection by the Ansari Health Centre, the same shall be communicated to the applicant by the concerned department *vithin two weeks* of receipt of application for condonation.

2.** In the case of B.A. LL.B. (Hons.) programme, in terms of the requirements of the Bar Council of India, no student shall be allowed to take the End-Semester Examination in a subject if the student concerned has not attended a minimum of 70% of the classes held in the subject as also in the 'moot court', room exercises, tutorials and practical training conducted in the subject taken together.

   Provided that if a student for any exceptional reason(s) fails to attend 70% of the classes as mentioned herein above, a committee set up by the Vice-Chancellor, on the recommendation of the Dean of the Faculty, may examine the case and submit its recommendation to the Vice-Chancellor to allow/ disallow the student to take the examination if the student concerned attended at least 65% of the classes held in the subject concerned and attended 70% of the classes in all the subjects taken together.

3. In the case of B.D.S. programme, a student shall be required to satisfy the following requirements pertaining to attendance:

   (a) No student shall be permitted to appear in the annual examination unless he/she has fulfilled all the requirements of the course and has secured not less than 75% attendance in theory and 75% in practical and clinical, individually in all subjects.

   (b) In case of a subject in which there is no examination at the end of the academic year, the percentage of attendance shall not he less than 70% in theory/ practical/ clinical individually. However, at the time of appearing for the University Examination in

those subjects, the aggregate percentage of attendance in each subject should satisfy the condition (a) above.

4. Notwithstanding anything contained in the Paras 1-3, a Faculty/Department/Centre, as it may deem fit, may include certain other components of the programme/courses like agency placement, conferences, self development modules, camps, training and other allied activities for regulating attendance, as approved by the Academic Council from time to time on the recommendation of the concerned Board of Studies/ Committee of Studies.

   Provided that the attendance requirements in the components of such programme of study/ courses shall in no way be less than 75%.

5. In consonance with these Ordinances, the University may frame regulations for effective implementation of the rules pertaining to attendance.

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* Serious sickness/ excruciating medical disability shall include all diseased conditions requiring hospitalization or such diseases that render immobility for the period duly certified by the State Government/Central Government hospitals/dispensaries and all such hospitals that have been empanelled by Jamia Millia Islamia as per the C.G.H.S. rules.

** Paras 2 and 3 are as per the regulations of the Bar Council of India and Dental Council of India, respectively.

Regulation R-35 (R-XXXV) *(academic)*

Counting of Attendance of Students

1. Subject to the provisions laid down in Ordinance 35 (academic), the attendance of students, who have registered themselves in various programmes/courses of study, shall be computed as per the procedure described in this Regulation.

2. Attendance of students admitted to the 1st semester/ 1st year of any programme/course of study shall be counted from the date of admission in the respective classes.

3. Classes of the consecutive semesters/years shall commence from the 1st working day after the summer/winter vacations and all students who have been/are likely to be promoted to the next semester/year of the class will be deemed to have been given 'provisional' admission, even if the examination results of such students are awaited or they have not completed their re-admission. The attendance of all such provisionally admitted students shall be counted from the 1st working day of the respective semester/year.

   Provided that in the Bachelor of Dental Surgery (B.D.S.) course where there is a provision of 'supplementary examination' as per the ordinance of the said course, if a student passes the supplementary examination, his/her attendance shall be counted from the date of his/her provisional admission. However, if a student fails in the supplementary examination, his/her attendance shall be counted from the date of his/her re-admission to the previous class, which he/she has been reverted back.

   Provided further that the provisionally admitted students shall be required to complete their re-admission by 31st of July of each year or within 15 days of the declaration of result, whichever is latter. In case the student is unable to complete the re-admission as per the above time limit, he/she will be allowed to complete the re-admission within the next 15 days after the expiry of the cut-off date with the provision of late payment of such fees as is notified from time to time.

   Provided further that if a student fails to complete his/her re-admission by the above extended schedule of late payment of fee, his/her admission shall stand cancelled.

4. If a student is found to be continuously absent from the class without information, communicated in writing explaining with valid cause, the reason for such absence, for a period of 30 days or more (15 days in case of the Faculty of Engineering & Technology/ Architecture & Ekistics/ Education/ Dentistry), his/her name shall be struck off the rolls.

5. A student whose admission is cancelled due to his/her inability to pay the late payment fee within the prescribed time limit or due to his/her absence from classes as per the provision of para no. 4 above, he/she may only be re-admitted after getting permission from the Vice-Chancellor.

   It is clarified that the late submission of fee by the student will not entitle him/her for any relaxation in attendance and that his/her attendance shall be counted from the date of commencement of classes

COURSE STRUCTURE AND CURRICULUM

(w.e.f. 2013-2014)

M. TECH. PROGRAMME
ELECTRICAL POWER SYSTEMS MANAGEMENT

COURSE STRUCTURE

M. Tech. (Electrical Power Systems Management)

SEMESTER I

COURSE NUMBER	COURSE NAME	TEACHING SCHEME (PERIODS PER WEEK)			EXAMINATION SCHEME (DISTRIBUTION OF MARKS)			TOTAL MARKS	CREDIT
		L	T	P	Mid Semester Evaluation		End Semester Evaluation		
					CCA	MTE			
EEM-101	Intelligent Techniques	3	1	0	10	30	60	100	4
EEM-102	Automation System	3	1	0	10	30	60	100	4
EEM-103	Instrumentation Systems	3	1	0	10	30	60	100	4
EEM-104	Power System Modelling	3	1	0	10	30	60	100	4
	Elective-I	3	1	0	10	30	60	100	4
EEM-152	SCADA Lab	0	0	4	20	10	20	50	2
TOTAL		**15**	**5**	**4**	**70**	**160**	**320**	**550**	**22**

SEMESTER II

COURSE NUMBER	COURSE NAME	TEACHING SCHEME (PERIODS PER WEEK)			EXAMINATION SCHEME (DISTRIBUTION OF MARKS)			TOTAL MARKS	CREDIT
		L	T	P	Mid Semester Evaluation		End Semester Evaluation		
					CCA	MTE			
EEM-201	Optimization Techniques	3	1	0	10	30	60	100	4
EEM-202	Communication Protocols	3	1	0	10	30	60	100	4
EEM-203	Transmission and Distribution Automation	3	1	0	10	30	60	100	4
EEM-204	Energy Management Systems	3	1	0	10	30	60	100	4
	Elective-II	3	1	0	10	30	60	100	4
EEM-251	Seminar	0	0	4	20	10	20	50	2
EEM-253	Power System Automation Laboratory	0	0	4	20	10	20	50	2
TOTAL		**15**	**5**	**8**	**90**	**170**	**340**	**600**	**24**

SEMESTER III

COURSE NUMBER	COURSE NAME	TEACHING SCHEME (PERIODS PER WEEK)			EXAMINATION SCHEME (DISTRIBUTION OF MARKS)			TOTAL MARKS	CREDIT
		L	T	P	Mid Semester Evaluation		End Semester Evaluation		
					CCA	MTE			
	Elective-III	3	1	0	10	30	60	100	4
	Elective-IV	3	1	0	10	30	60	100	4
EEM-351	Project	0	0	16	40	80	80	200	8
TOTAL		**6**	**2**	**16**	**60**	**140**	**200**	**400**	**16**

SEMESTER IV

COURSE NUMBER	COURSE NAME	TEACHING SCHEME (PERIODS PER WEEK)			EXAMINATION SCHEME (DISTRIBUTION OF MARKS)			TOTAL MARKS	CREDIT
		L	T	P	Mid Semester Evaluation		End Semester Evaluation		
					CCA	MTE			
EEM-451	Dissertation	0	0	24	80	100	120	300	12
TOTAL		**0**	**0**	**24**	**80**	**100**	**120**	**300**	**12**

Elective I

1. EEM-106 Modeling and Simulation
2. EEM-107 Applied Mathematics for Electrical Engineers

Elective II

1. EEM 206 Digital Protection of Power Systems
2. EEM 207 Power System Reliability

Elective III

1. EEM-301 Restructuring & Deregulation of Power
2. EEM-302 EHV AC & DC Transmission

Elective IV

1. EEM-306 Advanced Power Electronics
2. EEM-307 Renewable and Sustainable Energy Systems
3. EEM-308 Power Quality and FACTS

EEM-101 Intelligent Techniques

L-T-P (3-1-0) Credit (4)

Unit I: Soft Computing

Hard Computing: Features of Hard Computing, Soft Computing: features of soft computing, Hybrid Computing, Fuzzy Set Theory: fuzzy versus crisp sets, basic fuzzy set operations, linguistic variables, membership functions, fuzzy Cartesian product, fuzzy relations, fuzzy rules.

Unit II: Fuzzy Implications

Approximate reasoning, fuzzy modelling, fuzzification, inferencing and defuzzification, fuzzy modeling and control schemes for nonlinear systems, applications in power system.

Unit III: Fundamentals of Neural Networks

Biological neural networks, models of an artificial neuron, neural network architectures, characteristics of neural networks, McCulloch-Pitts neuron, learning methods, Hebbian learning rules, Hebb nets.

Unit IV: Backpropagation Networks

Architecture of backpropagation networks, perceptron model, single layer and multi-layer perceptron models, backpropagation learning, tuning parameters of backpropagation networks, neuro-fuzzy models, adaptive neuro-fuzzy inference system (ANFIS), applications.

Unit V: Neuro-Fuzzy Systems

Architectures of neuro-fuzzy systems; Cooperative neuro-fuzzy systems, Neural Network driven fuzzy reasoning, Hybrid neuro-fuzzy system; Construction of neuro-fuzzy systems: Structure if identification phase, parameter learning phase.

Text/Reference Books:

1. Fakhreddine O. Karray and Clarence W De Silva, “Soft Computing and Intelligent Systems Design: Theory, Tools and Applications” Pearson Education.
2. S. Rajasekaran and G. A. Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications”, Prentice Hall of India, New Delhi.
3. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic: Theory and applications, Prentice Hall of India, New Delhi.
4. Jyh-Shing Roger, Chuen-Tsai Sun, Eui Mizutani, Neuro-fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence, Prentice Hall of India, New Delhi.
5. Simon S Haykin, “Neural networks and learning machines”, Prentice Hall of India, New Delhi.

EEM 102 Automation Systems

L-T-P (3-1-0) Credit (4)

Unit I

Automation systems, Advantages of automation, Components of process control systems, Evolution of Control systems. Single loop control, Centralized control, Distributed control systems, Open systems, SCADA systems. Types of data available, Analog, Digital, Pulse data, Redundancy. Data communication components and protocols.

Unit II:

Programmable Logic Controllers (PLC) Functional description, input/output systems, CPU, memory Unit, Programmer Units, Peripheral devices, PLC Vs Computers, Advantages of PLCs, controller programming tools, Ladder Diagram programming. phase locked loop, Interposing relays, type and structure of relays.

Unit III:

Distributed Control Systems (DCS) PLC Vs DCS systems, DCS architecture, Local control units, dedicated card controllers, Unit Operations controllers, DCS multiplexers, DCS system integration, Automation Standards, salient features.

Unit IV:

Supervisory Control and Data acquisition (SCADA) Systems, Types of supervisory systems, Components of SCADA Systems. Remote terminal unit (RTU), Communication subsystem, Protocols, Logic subsystem, termination subsystem, test and power supply subsystem, Phasor measurement Units, Phasor Data concentrator and communication, Intelligent Electronic Devices.

Unit V:

SCADA master station configurations, hardware and software components, Communication systems, Human Machine interface. SCADA application functions, Intelligent Electronic devices. Practical PLC, DCS, PMU and SCADA applications and implementations

Reference Books:

1. Automation Handbook Vol I Bela G. Liptac, CRC Press.
2. Fundamentals of Supervisory systems, IEEE tutorial.
3. John W Webb & Ronald A Reiss, Programmable Logic Controllers, principles and applications, Prentice Hall of India.
4. Related Research papers

EEM-103 Instrumentation Systems

L-T-P (3-1-0) Credit (4)

Unit- I

Transducer Characteristics **:** General concepts and terminology of measurement systems: Transfer Function, Span (Full-Scale Input), Full-Scale Output, Accuracy, Calibration, Calibration Error, Hysteresis, Nonlinearity, Saturation, Repeatability, Dead Band, Resolution, Special Properties, Output Impedance, Excitation, Dynamic Characteristics, Environmental Factors, Reliability. Modeling and analysis of the measuring system, standards and calibration of the measuring instrument.

Unit-II

Transducers: Classifications, working principle, construction and design of various active and passive transducers. Voltage and current transducers, Tap position transducers. Hall effect transducers, optical transducers. Semiconductor traducers for physical and chemical parameters measurement**.**

Unit-III

Design of detection electronics and signal conditioning circuits for various resistive, capacitive, inductive transducers. Active filters, Impedance matching, loading effect. Introduction to electromagnetic coupling (EMC), inference coupling mechanism, shielding. Concepts of interfaces with digital device like computer, microcontroller microprocessor.

Unit-IV

Applications of Industrial transducers: Hotwire anemometer, infrared, seismic and nuclear energy transducer, Transducers activated RFID tags.

Unit-V

Controller modes Discontinuous, two positions, multi position, floating control, continuous control, proportional, integral, derivative and composite modes of control.

Text/Reference Books:

1. C.D. Jhonson, Process Control Instrumentation Technology, PHI, India.
2. Doeblin E.O. Measurement Systems-Application and Design, Fourth Edition, McGraw Hill International Edition, New York-Fifth Edition.
3. Jacob Fraden, Hand book of Modern Sensors: Physics, Design and applications, publication by Springer, Fourth Edition.
4. John P. Bentley, Principle of measurement systems, Third edition, addition Wesley Longman Ltd. UK.
5. Gregory K. McMillan and Doughlas M. Considine, Industrial Instruments and Controls handbook, Tata Mc Graw Hill Edition.
6. L.D. Goettsche, Maintenance of Instruments and Systems – Practical guides for measurements and control, ISA.

EEM-104 Power System Modelling

L-T-P (3-1-0) Credit (4)

Unit I

Review of network matrices; introduction to graph theory, basic loops, basic cut-sets, incidence matrices, augmented cut-set and loop incidence matrices, primitive network, network performance equations, bus admittance matrix, direct inspection method, step by step procedure, singular transformation and non singular transformation.

Unit II

Bus impedance matrix, partial network, procedure for finding elements of Z- bus, algorithm for formulation of Z-bus with and without coupled elements, addition of branch, addition of link, modification of Z- bus for changes in network.

Unit III

Introduction to load flow analysis, development of load flow equations, iterative methods, Techniques used in N-R method, sparse matrix, triangular factorization, fast decoupled load flow.

Unit IV

Modeling of Single Machine infinite bus system, Mathematical modeling of multi machine system, Dynamics and transient stability analysis of single machine system and multi machine system.

Unit V

Short circuit studies of large power system networks, algorithm for calculating system condition after the occurrence of faults, comparison between symmetrical components and phase coordinated method of short circuit studies.

Text/Reference Books:

1. Modern Power system Analysis, I.J. Nagrath and D. P. Kothari; Tata Mc Graw Hill, New Delhi.
2. Electrical Power System; New Age International Publishers.
3. Power System Analysis, B. Subramanyam, B. Venkata Prasantha, I. K. International Publishing House, New Delhi.
4. Power Generation, Operation and Control, Wood and Woollenberg, John Wiley and Sons.
5. Computer Method in Power Systems, Stas El Abiad.
6. Advanced Power System Analysis and Dynamics, L.P. Singh, Wiley Eastern Limited, New Delhi.

EEM-106 Modeling and Simulation

L-T-P (3-1-0) Credit-4

UNIT-1: System Models

The concepts of a system, System environment, Stochastic activities, Continuous and Discrete Systems, System Modeling, Types of models, Static physical models, Dynamic physical models, Static mathematical models, Dynamic mathematical models, Principles used in modeling.

UNIT-II: System Simulation

The technique of Simulation, The Monte Carlo method, Comparison of simulation and analytical methods, Experimental nature of simulation, Types of system simulation, Numerical computation technique for continuous models, Numerical computation technique for Discrete models, Distributed lag models, Cobweb models, Progress of a simulation study.

UNIT-III: Probability Concepts in Simulation

Stochastic variables, Discrete probability functions, Measures of probability functions, Continuous uniformly distributed random numbers, Random number generators (RNG), multiplicative congruential method, Mixed multiplicative congruential method, Other methods of random number generation.

UNIT-IV: Basic Queuing Models and Arrival patterns

Congestion in Systems, Arrival patterns, Poisson arrival patterns, Exponential distribution, Coefficient of variation, The Erlang distribution, Hyper-exponential distribution, Service times, Normal distribution, Basic queuing models, Short hand notation for queuing and loss models, Queuing disciplines, Measures of queues, Mathematical solutions of queuing problems.

UNIT-V: Simulation Experiments and Statistical Data Analysis

Experiments and Statistical inference, Nature of the problem, Estimation methods, Simulation run statistics, Replication of runs, Elimination of initial bias, Batch means, Regenerative techniques, Time series analysis, autoregressive processes, Validation and Testing of simulation models.

Text/Reference Books:

1. Gordan G., "System Simulation," Prentice Hall of India.
2. Kobayashi H., mark B. L., "System Modeling and Analysis," Pearson Education, Inc, New Delhi.

EEM-107 Applied Mathematics for Electrical Engineers

L-T-P (3-1-0) Credit (4)

UNIT-I Advanced Matrix Theory

Eigen-values using QR transformations – Generalized eigen vectors – Canonical forms – Singular value decomposition and applications – Pseudo inverse – Least square approximations.

UNIT-II Linear Programming

Formulation – Graphical Solution – Simplex Method – Two Phase Method – Transportation and Assignment Problems.

UNIT-III One Dimensional Random Variables

Random variables - Probability function – moments – moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a Random Variable.

UNIT-IV Queueing Models

Poisson Process – Markovian queues – Single and Multi Serve r Models – Little's formula – Machine Interference Model – Steady State analysis – Self Service queue.

UNIT-V Computational Methods In Engineering

Boundary value problems for ODE – Finite difference methods – Numerical solution of PDE – Solution of Laplace and Poisson equations – Liebmann's iteration process – Solution of heat conduction equation by Schmidt explicit formula and Crank- Nicolson implicit scheme – olution of wave equation.

Text/Reference Books:

1. Bronson, R., Matrix Operation, Schaum's outline series, McGraw Hill, New York.
2. Taha, H. A., Operations Research: An Introduction, Seventh Edition, Pearson Education Edition, Asia, New Delhi.
3. R. E. Walpole, R. H. Myers, S. L. Myers, and K. Ye, Probability and Statistics for Engineers & Scientists, Asia, 8th Edition.
4. Donald Gross and Carl M. Harris, Fundamentals of Queueing theory, 2nd edition, John Wiley and Sons, New York.

EEM-152 SCADA Lab

L-T-P (0-0-4) Credit (2)

This laboratory course is designed based on theory course of "Automation System" (EEM-102). There are around 8-10 experiments to be conducted by the students covering almost all units of theory course. The experiments include hardware of SCADA system, software structure of SCADA lab, system configuration and I/O mapping, Engineering and operator software customization, graphics development etc. Also it is expected that the students must learn to use the latest equipment and software so that the Industry gets trained Engineers.

EEM-201 Optimization Techniques

L-T-P (3-1-0) Credit (4)

UNIT-I

Introduction to optimization, functions of single variable, functions of several variables, formulation of optimization problems. Review of classical methods, linear programming, non-linear programming.

UNIT-II

Constraint optimality criteria, constrained optimization, constraint direct search method, linearization methods for constrained problems, transformation method. Nonlinear programming: problem formulation, Quadratic Approximation Methods for Constrained Problems Unconstrained minimization techniques.

UNIT-III

Dynamic programming: sub-optimization, multistage optimization problem. Multi-objective and goal programming: problem formulation, solution of a multi-objective problem. Case studies

UNIT-IV

Introduction to Stochastic Optimization Techniques, types: Local Search, Population Based, Introduction to Genetic Algorithms, Motivation from Nature, Genetic Algorithms: Working Principle: Representation, Fitness Assignment, Reproduction, Crossover, Mutation, Constraint Handling, Real Parameter Genetic Algorithms, Combined Genetic Algorithm, Advanced Genetic Algorithms, Applications.

UNIT-V

Ant Colony Optimization: Introduction, Ant System, Ant Colopny System, ANTS, Significant Problems, Convergence Proofs. Discrete Particle Swarm Optimization (PSO): Introduction, PSO Elements: Position and State Space, Objective Function, Velocity, PSO Algorithm, Examples and Results, Applications.

Text/Reference Books:

1. Singiresu S. Rao, 'Optimization Techniques', New Age International Publishers.
2. D. P. Kothari and J. S. Dhillon, 'Power System Optimization, Tata McGraw Hill.
3. C. Mohan and Kusum Deep, 'Optimization Techniques, New Age International Publishers.
4. Godfrey C. Onwubolu, B. V. Babu, "New Optimization Techniques in Engineering", Springer-Verlag.
5. Marco Dorigo, Thomas Stützle, "Ant colony optimization", MIT Press.
6. Thomas Wiesi, "Global Opimization Algorithms", ebook. http://www.it-weise.de/.

EEM-202 Communication Protocols

L-T-P (3-1-0) Credit (4)

UNIT-I: Introduction to Communication Protocols
Data Communication basics, OSI reference model, Network Classification, Device Networks, Control Networks, Enterprise Networks.

UNIT-II: Networks in Process Automation
Introduction to Networks in process automation, Information flow requirements, Industry Networks, Network selection.

UNIT-III: Proprietary and open networks
Network Architectures, Building blocks, Industry open protocols: RS-232, RS- 422, RS-485, Ethernet, Modbus, Profibus, Fieldbus; Hardware: Fieldbus Design, Advantages and Limitations.

UNIT-IV: Introduction to wireless Protocols
WPAN, Wi-Fi, Bluetooth, ZigBee, Z-wave, IRIB-B.

UNIT-V: Communication Protocols for Power System
Communication requirements for power system automation, Protocols used, Need for Interoperable Communication, Overview of IEC 61850 Standard: Data Models, Communication Services, GOOSE Communication: Implementation and its advantages.

Text/References/Books:

1. B.G. Liptak, '*Process Software and Digital Network"*, CRC Press ISA- The Instrumentation, Systems, and Automation Society.
2. User Manuals of Foundation Fieldbus, Profibus, Modbus, Ethernet, Devicenet, Controlnet, IEC 61850.
3. Peterson Davie, "Computer Networks—A System Approach", Maugann Kauffmann Publisher.

EEM-203 Transmission and Distribution Automation

L-T-P (3-1-0) Credit (4)

Unit I:

Overview of transmission system, SCADA in Power systems. AGC, Energy Management Systems, FACTS, HVDC, Under Frequency Relay (UFR), df/dt control, Islanding. Regional grids, Specifications and details. Functions of the SCADA hierarchical levels in Transmission Master stations.

Unit II:

Utility distribution system, Types of distribution feeder configurations; Grid network, radial, loop, grounding, Load and fault characteristics. Distribution transformers and regulators. Application of capacitors for distribution system,. Losses and loss reduction in Distribution systems. Over voltages in Distribution systems.

Unit III:

Introduction to Distribution Automation (DA), Constituents of DA, Feeder automation application functions, Outage management, customer information systems, AMI, Distribution load flow & fault location algorithms for distribution system.

Unit IV:

Substations, Bus Switching Schemes, Types of substations; GIS, Air Insulated, HV Power Electronic. Smart Grid; Smart Transmission (WAMS, Smart Distribution, Demand Side Integration (Demand Response & Demand Side Management), Energy Storage, Renewable Source Integration.

Unit V:

Substation integration and automaton, Application functions Interface between substation and automation. Open systems, architecture functional data paths, new vs existing substations.

Text/Reference Books:

1. Power Distribution Engineering: James J. Burke, Marcel Dekker, Inc.
2. Electric Power Substation Engineering John D. Mc Donald CRC Press, , Taylor and Francis
3. Control and Automation of Electrical Power Distribution systems, James Northcote-Green, R Wilson, CRC Press, Taylor and Francis.
4. Electric Power Distribution, Automation, Protection and Control, James Momoh, CRC press, Taylor and Francis.
5. Related Research papers.

EEM -204 Energy Management Systems

L-T-P (3-1-0) Credit (4)

Unit I

Power system security, , factors affecting power system security, contingency analysis, linear sensitivity factors, contingency selection, concentric relaxation, calculation of network sensitivity factors. Transmission planning criteria.

Unit II

Power system state estimation. Maximum likely hood weighted least squares estimation, matrix formation. State estimation of an AC network.

Unit III

Detection and identification of bad measurements in state estimation. Network observability. Applications. Dynamic (linear) state estimation using PMU measurements

Unit IV

Economic load dispatch, system constraints, economic dispatch with and without losses, exact transmission loss formula, modified coordination equation, economic scheduling of hydrothermal plants, optimal power flow, multiobjective optimal power flow.

Unit V

Economy interchange between interconnected utilities. Interchange evaluation. Power pools, transmission effects and issues

References:

1. Power generation Operation & Control, Allen J. Wood and Bruce Woollenberg, John Wiley & Sons.
2. Transmission planning criteria: CEA manual.
3. PMU Dynamic State Estimation: CEA Manual.
4. POSOCO Operator examination handbook.

EEM-205 Digital Protection of Power System

L-T-P (3-1-0) Credit (4)

UNIT-1:
Relaying Evolution, Disadvantages of Conventional Relays, Computer Relaying Architecture, Performance and Operational Characteristics, Cost/Benefits considerations, Substation Computer Hierarchy.

UNIT-2:
Signal Conditioning Subsystems, Analog-to-Digital Conversion, Sampling, Digital Filtering in Protection Relays; Time domain, Frequency domain, Types of Digital Filters, Spectral Analysis; Discrete Fourier Transform, Fast Fourier Transform, Walsh Function Analysis.

UNIT-3:
Relaying as Parameter Estimation, Transmission Line Protection, Transformer Protection, Generator Protection, Bus Protection, Reactor Protection, Symmetrical Component Distance Relay, Distribution Over-current Protection.

UNIT-4
Substation Communication Networks, Bandwidth, Data Rate, End-to-end Delays, Digital Data Transmission, Ethernet in Substation, Fiber Optic Communication, End-to-end Delay Standards for Protection Applications.

UNIT-5
Substation Environment, Industry Environment Standards, EMI and Countermeasures, Supplementary Equipments in Substation, Travelling Waves due to faults, Directional wave Relay, Travelling wave Distance Relay, Travelling wave Differential Relay, Fault Location Algorithm.

Text/References Books:

1. Phadke A.G., James S. Thorp, "Computer Relaying for Power System", John Wiley & Sons Inc.
2. James J. Bruke, "Power Distribution Engineering", Mark Dekker Inc.
3. John A. T., Salman S. K., " Digital Protection for Power System", Power & Energy Series, Issue 15 of IEE power series, ISBN-086341303X, 9780863413032, IET.
4. Singh L. P., "Digital Protection- Protective Relaying from Electromechanical to Microprocess", New Age International.

EEM-206 Power System Planning and Reliability

L-T-P (3-1-0) Credit (4)

Unit I: System Planning

Introduction, Objectives & Factors affecting to System Planning , Short Term Planning, Medium Term Planning, Long Term Planning, Reactive Power Planning.

Unit-II: Reliability

Reliability, Failure, Concepts of Probability, Evaluation Techniques (i) Markov Process (ii) Recursive Technique, Stochastic Prediction of Frequency and Duration of Long & Short Interruption, Adequacy of Reliability, Reliability Cost.

Unit III: Generation Planning and Reliability

Generation Sources, Integrated Resource Planning, Generation System Model, Loss of Load (Calculation and Approaches), Outage Rate, Capacity Expansion, Scheduled Outage, Loss of Energy, Evaluation Methods, Interconnected System, Factors Affecting Interconnection under Emergency Assistance.

Unit IV: Transmission Planning and Reliability

Introduction, Objectives of Transmission Planning, Network Reconfiguration, System and Load Point Indices, Data required for Composite System Reliability.

Unit V: Distribution Planning and Reliability

Radial Networks, Network Reconfiguration, Evaluation Techniques, Interruption Indices, Effects of Lateral Distribution Protection, Effects of Disconnects, Effects of Protection Failure, Effects of Transferring Loads, Distribution Reliability Indices. Parallel & Meshed Networks, Bus Bar Failure, Scheduled Maintenance, Temporary and Transient Failure, Breaker Failure.

Text/Reference Books:

1. Power System Planning - R.L. Sullivan, Tata McGraw Hill Publishing Company Ltd.
2. Reliability Evaluation of Power System - Roy Billinton & Ronald N. Allan, Springer Publication.
3. Electricity Economics & Planning – T. W. Berrie, Peter Peregrinus Ltd., London.

EEM-251 Seminar

L-T-P (0-0-4) Credit (2)

All the students of II semester will be required to deliver a seminar on the topic relevant to recent trends in Electrical Power Systems using power point presentation. Topics are selected in consultation with their supervisors. Presentation will be of 15 minutes duration followed by a question answer session at least two times in a semester before the duly constituted committee of the Faculty Members of the department. The assessment by the committee members are a part of Mid Term Evaluation. A report of the seminar in the form of hard copy must also be submitted in the office before the final evaluation by External Examiners.

EEM-253 Power System Automation Laboratory

L-T-P (0-0-4) Credit (2)

This laboratory course is designed based on theory course of "Transmission and Distribution Automation" (EEM-203). There are around 8-10 experiments to be conducted by the students covering almost all units of theory course. The experiments include power system simulation studies like load flow study, short circuit analysis etc. using PSCAD software, testing and performance of IEDs, PMUs etc. Also it is expected that the students must learn to use the latest equipment and software so that the Industry gets trained Engineers.

EEM-301 Restructuring and Deregulation of Power System

L-T-P (3-1-0) Credit (4)

UNIT-1:
Open access in electricity sector, types of open access- medium term. Competitive Electricity Market and Balancing Mechanism, Scheduling.

UNIT-2:
Traditional Central Utility Model, Reform Motivations, Separation of Ownership and Operation, Central Dispatch versus Market Solution, Independent System Operator (ISO). Components of Restructured Systems: Gencos, Discos and Retailers, ,

UNIT-3:
Wholesale Electricity Market Characteristics: Central Auction, Bidding, Market Clearing and Pricing, Bilateral Trading, Scheduling, Gaming, Ancillary. Maximalist ISO, Minimalist ISO Model. Deregulation in Distribution.

UNIT-4:
Role of TP: Vertically Integrated Utility, Three Models of the Electricity Market, For-profit TP. Incentive Rate Design, Priority Insurance Scheme, Transmission Expansion in deregulated Environment. Transmission Owners

UNIT-5:
ISOs, Power Exchange (PX), Scheduling Coordinators. PX and ISO: Functions and Responsibilities, Trading Arrangements: The Pool, Pool and Bilateral Trades, Multilateral Trades, Congestion Management in Open-access Transmission Systems, Open-access Coordination Strategies.

Text/Reference Books:

1. Loi Lei Lai, "Power System Restructuring and Deregulation: Trading Performance and Information Technology", John Wiley & Sons Ltd.
2. CERC Regulations on Grand og Connectivity, Medium term Open Access and Long Term Open Access; Regulations.
3. CERC Regulation on Open Access-2008 [CERC Compendium].
4. POSOCO Manual on Electricity Market.

EEM-302 EHVAC and HVDC Transmission

L-T-P (3-1-0) Credit (4)

UNIT-1

Introduction to EHV AC and HVDC transmission-Comparison –Economic, Technical performance – Reliability – Limitations for EHVAC and HVDC transmission, Distance-problems involved in EHVAC transmission, Modeling of AC and DC Networks, Modeling of DC links, Solution of DC load flow, Per Unit System for DC Quantities, Solution of DC power flow.

UNIT-II

Principles of HVDC Transmission, Terminal equipments and their controls, Reactive power control. Choice of converter configuration, Modeling and analysis of HVDC converters, Analysis of converters for HVDC System: characteristics and their control, DC Link Control Harmonics and filters, Generation of harmonics, multi-terminal DC system.

UNIT-III

Protection, Converter Faults, Protection against over currents, over-voltages, HVDC circuit breakers, Protection by DC reactors, Insulation coordination, Earth return: Use of earth and sea return. Simulation of HVDC Systems: Digital dynamic simulation of converters and DC systems.

UNIT-IV

Parameters of EHVAC Lines for modes of propagation, resistance and Inductance of ground returns, Voltage Gradient of conductors Corona effects: Power loss and Audible Noise, Charge-Voltage diagram. Attenuation of traveling waves, Audible noise levels. Power frequency voltage control: Generalised constants, Cascade connection of components-shunt and series compensation. Sub-synchronous Resonance in series- capacitor compensated lines.

UNIT-V

Origin of overvoltage and their types, short circuit current and circuit breaker. Recovery voltage and the circuit breaker, Overvoltage caused by interruption of inductive and capacitive currents, Ferro resonance over voltage, calculation of switching surges single phase equivalents, Reduction of switching surges on EHV systems.

TEXT/REFERENCE BOOKS:

1. Begamudre R.D , "*Extra High Voltage AC Transmission Engineering*", Wiley Eastern Ltd., Second edition.
2. K.R, Padiyar, *HDVC Power Transmission System*, Wiley Eastern Ltd.
3. E.W. Kimbark, *Direct Current Transmission, Vol*:1 Wiley Interscience.
4. D. Chakrabarti, D.P.Kothari, A.K. Mukhopdadhyay ,"*Performance, Operation & Control of EHV Power Transmission System* ", Wheeler publications.
5. J. Arrillage et. Al *Computer Modeling of Electrical Power System,* John Wiley.
6. Adams and Hingorani, "*HVDC transmission*".New Age.
7. P.S.Kundur, *Power System Stability and Control,* Wiley Eastern Ltd.

EEM-306 Advance Power Electronics

L-T-P (3-1-0) Credit (4)

UNIT- 1

Steady state and switching characteristics of BJT, Power Mosfet, Cool MOS, SITs, IGBT. Series and Parallel Operation. MOSFET Operation: Operating principle , characteristics, Turn on, Turn Off losses.

UNIT- II

Review of Step- down, Step up Operation, Performance parameters, Converter classifications, Switching mode regulators- Buck, Boost and Buck-Boost, Cuk, SEPIC regulators. DC Power Supplies- SMPS DC Power supplies, Flyback converter, Forward Converter, Push-Pull Converter, Half bridge Converter, Full Bridge Converter, Resonant DC Power Supplies.AC Power Supplies – SMPS AC Power Supplies, Resonant AC Power supplies.

UNIT- III

Review of Voltage source and control source inverters, PWM strategies- Sinusoidal, Trapezoidal, Staircase, stepped, harmonic injected, delta modulation. Space Vector modulation- Concept of Space Vector, space vector switching. Multilevel Inverters – Diode Clamped, improved diode clamped, flying capacitor, cascaded. Application of Multilevel inverters.

UNIT – IV

Transformer Design, DC Inductor, Magnetic Saturation, Capacitor design and ESR effect, Control Circuits, Stability Analysis of Power supply converters.

UNIT- V

Electromagnetic Interference- Common mode, Differential mode noise, EMI Filter, FCC, IEC Standards, UL standards, Active Power Factor correction, Electronic Ballast for various lamps.

Text Book/References:

1. Rashid. M.H., " Power Electronics, Circuits, Devices and Application.", Pearson Education Inc, New Delhi.
2. B. Keith, " SMPS Handbook" McGrawHill Handbook.
3. Ned Mohan, Undeland, Robin, "Power Electronics, Converters, Application and Design", John Wiley and Sons. Inc, New York.
4. P.C. Sen, "Modern Power Electronics", Wheeler publishing corporation, New Delhi.

EEM-307 Renewable and Sustainable Energy Systems

L-T-P (3-1-0) Credit (4)

Unit I:
Overview of conventional and renewable energy technologies, World and India's energy scenario & Energy Security, energy growth patterns, projection of energy Demands.

Unit II:
Solar radiation, availability, measurement, estimation and modelling, solar photovoltaic's and Concentrated Solar Power (CSP), solar thermal systems, application of photovoltaic system for power generation, concentrating solar power generation, applications, Inverters.

Unit III :
Wind resource assessments and Forecasting, site assessment, power in wind, general theories of wind machines, wind energy conversion systems (WECS) and Integration to the Grid.

Unit IV:
Potential, availability of biomass, bio conversion process, bio gas and bio power.

Unit V:
Micro grid; Fuel cell, hydrogen energy, Energy Storage, hybrid and integrated energy systems.

Text/ References Books:

1. B. H. Khan, Non Conventional Energy Resources, TMH.
2. D. P. Kothari, Renewable Energy and Emerging Technologies, PHI.
3. C. S. Solanki, Solar Photovoltaics, PHI.
4. C. S. Solanki, Renewable Energy, PHI.
5. Freris L. L., Wind Energy Conversion Systems, PHI.
6. J. A. Duffie and W. A. Beckmen, Solar Engineering of Thermal Processes, John Wiley.
7. S. P. Sukhatme, Solar Energy-Principles of Thermal Collection and Storage, TMH.
8. MNRE Manual.

EEM-308 Power Quality and FACTS

L-T-P (3-1-0) Credit (4)

UNIT-1

Definition of Power Quality, Power Quality Issues, power quality indices, Power Quality v/s Equipment Immunity, Electric Power Quality Standards. Power Frequency Disturbances, Voltage Sag, Isolation Transformers, Voltage Regulators, Uninterruptible Power Source Systems and non-linear loads.

UNIT-II

Types and Causes of Transients, Definition of Harmonics, Causes of Voltage and Current Harmonics. Individual and Total Harmonic Distortion, Effect of Harmonics on Power System Devices, Guidelines for Harmonic Voltage and Current Limitation, Harmonic Mitigation.

UNIT-III

Power Quality Measurement Devices: Harmonic Analyzers, Transient- disturbance analyzers, Analysis: Analysis in the periodic steady state, Time domain methods, Frequency domain methods , Elimination/suppression of harmonics using passive, active and hybrid filters.

UNIT-IV

FACTS concepts and general considerations, converters for static compensation, SVC and STATCOM: Operation control and comparison, static series compensation, static voltage phase angle regulators: TCVR & TCPAR, Unified Power Flow Controllers-operation, comparison with other FACTS devices, control of P and Q, special purpose FACTS devices, Interline Power Flow Controllers: operation and control.

UNIT-V

Power Quality issues related to distribution systems – custom power devices – Distribution STATCOM – Dynamic Voltage restorer – Unified Power Quality Conditioner – Application of D-STATCOM, DVR and UPQC for improving power quality in distribution systems.

TEXT/REFERENCE BOOKS:

1. G.T. Heydt, *Electric Power Quality,* West Lafayette, IN: Stars in a Circle.
2. A Ghosh, G. Ledwich, *Power Quality Enhancement Using Custom Power Devices.* Kluwer Academic.
3. R.C. Dugan, M.F. McGranaghan and H.W. Beaty, *Electric Power Systems Quality* New York: McGraw-Hill.
4. Math. H. J. Bollen, *"Understanding Power Quality Problems - Voltage Sags and Interruptions*", IEEE Press.
5. J. Arrillaga, D.A Bradely and P.S. Bodger, *Power System Harmonics.* New York: Wiley.
6. Derek A. Paice, Power electronic converter harmonics.
7. N.G. Hingorani & L. Gyugyi, *Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems*, IEEE Press.
8. T.J.E Miller, *Reactive Power Control in Electric Systems*, John Wiley & Sons.
9. K. R. Padiyar, *FACTS Controllers in Power Transmission and Distribution,* New Age International, First Edition, Narosa Pub.

EEM-351 Project

L-T-P (0-0-16) Credit (8)

The Project is aimed at training the students to analyze any problem in the field of power systems independently. The project may be analytical, computational and experimental or combination of them based on the latest developments in relevant areas. It should consist of objectives of study, scope of work, critical literature review and preliminary work done pertaining to the seminar undertaken in Semester II. All the students are required to implement a research paper already published. During the project period, every student has to give a power point presentation of about 15 minutes duration of the progress of their works at least two times in a semester before the duly constituted committee of the Faculty Members of the department. The assessment by the committee members are a part of Mid Term Evaluation. A report of the project in the form of hard copy must be submitted in the office before the final evaluation by the External Examiners.

EEM-451 Dissertation

L-T-P (0-0-24) Credit (12)

Dissertation is a continuation of the project work done by the student during Semester III. The dissertation report is expected to show clarity of thought and expression, critical appreciation of the existing literature and analytical computation and experimental aptitude of the students as applicable. During the dissertation period, every student has to give a power point presentation of about 15 minutes duration at least two times in a semester of the progress of their works before the duly constituted committee of the Faculty Members of the department. The assessment by the committee members are a part of Mid Term Evaluation. A report of the dissertation in the form of hard copy must be submitted in the office at least two weeks before the final viva voce is conducted by the External Examiner.