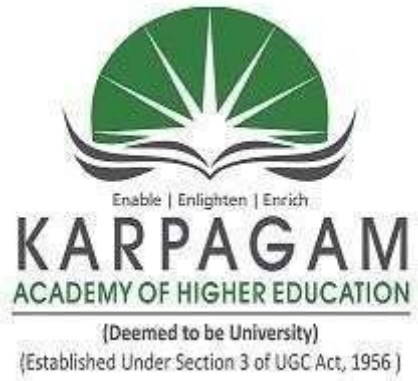
M.E. POWER SYSTEMS ENGINEERING

CURRICULUM & SYLLABI 2024

(REGULAR PROGRAMME)

Department of Electrical and Electronics Engineering

FACULTY OF ENGINEERING



KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University)

(Established Under Section 3 of UGC Act, 1956)

Pollachi Main Road, Eachanari Post,

Coimbatore- 641 021, India.

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University)

(Established Under Section 3 of UGC Act 1956)

(Accredited with A+ Grade by NAAC in the Second cycle)

Coimbatore – 641 021. INDIA

FACULTY OF ENGINEERING

POST–GRADUATE PROGRAMME
REGULAR PROGRAMME
REGULATIONS 2024-2025
(CHOICE BASED CREDIT SYSTEM)

These Regulations are effective from the academic year 2024-2025 and applicable to the students admitted to M. E. / M. Tech. Programmes during the academic year 2024- 2025 and onwards.

1. PROGRAMMES OFFERED, MODE OF STUDY AND ADMISSION REQUIREMENTS.

PROGRAMMES OFFERED: M. E. and M. Tech.

The various P.G. Programmes offered by the Karpagam Academy of Higher Education are listed in Table 1.

Table – 1

M. E./M. TECH. DEGREE (REGULAR) PROGRAMMES

Sl. No.	Name of the Programme
DEPARTMENT OF COMPUTER SCIENCE ANDENGINEERING	
1.	M.E Computer Science and Engineering
DEPARTMENT OF CIVIL ENGINEERING	
1.	M.E Structural Engineering.
DEPARTMENT OF ELECTRICAL ANDELECTRONICS ENGINEERING	
1.	M.E. Power Systems Engineering
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING	
1.	M.E VLSI Design
DEPARTMENT OF MECHANICAL ENGINEERING	
1.	M.E CAD/CAM Robotics

MODE OF STUDY:

Full–Time:

Candidates admitted under 'Full–Time' should be available in the Karpagam Academy of Higher Education during the complete working hours for curricular, co– curricular and extra– curricular activities assigned to them.

Change from one programme to another programme is not permitted.

ADMISSION REQUIREMENTS:

Candidates for admission to the Master's Degree Programme shall be required to have passed an appropriate Degree Examination of any University accepted by the Board of Management of Karpagam Academy of Higher Education as equivalent thereto. Admission shall be offered only to the candidates who possess the qualification prescribed against each course, given in the Table–2.

Table – 2

M. E. / M.TECH. PROGRAMMES QUALIFICATIONS FOR ADMISSION

S. No.	Degree and branch Of study	Qualification for Admission
1.	M.E. Computer Science and Engineering	B.E./B. Tech. – Computer Science and Engineering/ Information Technology/ Artificial Intelligence and Data Science/ Cyber Security/ Computer Science and Business System/ Computer Science and Design
2.	M.E. Structural Engineeri ng.	B.E./B. Tech. – Civil Engineering
3.	M. E. Power Systems Engineering	B. E./B.Tech. – Electrical and Electronics Engineering / Electronics and Communication Engineering
4.	M.E. VLSI Design	B.E/B.Tech. – Electrical and Electronics Engineering / Electronics and Communication Engineering
5.	M.E. CAD/C AM Robotics	B.E/B.Tech Mechanical Engineering

2 DURATION OF THE PROGRAMMES:

The minimum and maximum period for completion of the P.G. Programmes are given below:

Programme	Min. No. of Semesters	Max. No. of Semesters
M. E./M. Tech.	4	8

Each semester shall normally consist of 90 working days or 360 hours for full–time mode of study. The Dean and HOD shall ensure that every teacher imparts instruction as per the number of periods specified in the syllabus and that the teacher teaches the full content of the specified syllabus for the course being taught.

The prescribed credits required for the award of degree shall be within the limitsspecified below.

PROGRAMME	PRESCRIBED CREDIT RANGE
M. E./M. Tech.	**65 to 75**

Credits will be assigned to the courses for different modes of study as given below: No. of credits per lecture period per week 1

No. of credits per tutorial period per week 1

No. of credits for 3 periods of laboratory course per week 2

No. of credits for 3 periods of project work per week 2

3. STRUCTURE OF THE PROGRAMME

Every programme will have a curriculum and syllabi consisting of core theorycourses, elective courses, seminars / practical courses and project work.

The elective courses from the curriculum are to be chosen with prior approvalfrom the Head of the Department.

The medium of instruction for all courses, examinations, seminar presentationsand project thesis shall be English**.**

Choice Based Credit System is implemented offering choice in professionalcore and professional electives.

MAXIMUM MARKS

The maximum marks assigned to different courses shall be as given below:

Each of the theory and practical course (excluding project work) shall carry maximum of 100 marks of which 40 marks will be through Continuous Internal Assessment (CIA) and 60 marks through End Semester Examination (ESE).

PROJECT WORK

The project work for M. E./ M. Tech. consists of two Phases, Phase– I and Phase – II. Phase – I is to be undertaken during III semester and Phase – II during IV semester.

All the students are advised to do their project work within the campus. However, as a special case, if a student is able to get a project from a government organization or private or public sector company with a turnover of about Rs.50 crore, he/she may be permitted to do his/her project work in that institution/research organization/industry.

4. EVALUATION OF PROJECT WORK

The evaluation of Project Work for Phase I & Phase II shall be done independently in the respective semesters. The total marks for project work including Phase I and II are 400.The project work pertained to Phase I is evaluated through Continuous Internal Assessment only. No End Semester Examination will be conducted for the Phase I. The maximum internal marks for Phase I is 100. For Phase – II, the maximum internal mark is 120 and the maximum End Semester Examination mark is 180. The total marks for Phase – II is 300. The overall passing minimum is 50%.

The Project Report prepared according to approved guidelines and duly signed by the supervisor(s) and the Head of the Department shall be submitted to the CoE through the HoD and the Dean.

The evaluation of the Project work Phase – I will be purely internal by forming a committee by HoD/ Dean. During CIA of Phase – I, there will be a Viva–Voce Examination by a team consisting of the Supervisor, and an Internal Examiner (other than the Supervisor). The evaluation of the Project work Phase – II will be based on the project report submitted in Phase – II and a Viva–Voce Examination by a team consisting of the Supervisor, an Internal Examiner and an External Examiner for each programme. The External Examiner shall be appointed by the Karpagam Academy of Higher Education for Phase – II evaluation.

If a candidate fails to submit the project report on or before the specified deadline, he/she is deemed to have failed in the project work and shall re–enroll for the same in the subsequent semester.

If a candidate fails in the Viva–Voce examinations of Phase–I, he/she has to resubmit the project report within 30 days from the date of declaration of the results. If he/she fails in the Viva–Voce examination of Phase–II of project work, he/she shall resubmit the project report within 60 days from the date of declaration of the results. For this purpose, the same Internal and External Examiner shall evaluate the resubmitted report.

Every candidate shall publish a paper of his or her findings in a peer reviewed journal or present in an International Conference or apply for a patent out of his / her project work. Reprints of the journal publication / acceptance letter from the journal publisher or Proceedings of the International conference/ acceptance letter from the Conference Organizer or application of patent shall be attached to the report of the project work. Such acknowledgements shall be sent to the Controller of Examinations along with the evaluation marks by the team of examiners without which the thesis shall not be accepted.

A copy of the approved project report after the successful completion of Viva– Voce Examination shall be kept in the respective department as well as in the Karpagam Academy of Higher Education library.

5 REQUIREMENTS FOR COMPLETION OF THE SEMESTER

A candidate will be permitted to take the End Semester Examination of any semester, if

i) the candidate secures not less than 75% of attendance during the semester and

ii) the conduct of the candidate has been satisfactory

A candidate who has secured attendance between 65% and 74% (both included),due to medical reasons (Hospitalization / Accident / Specific Illness) or due to participation in Karpagam Academy of Higher Education / District / State / National / International level sports or due to participation in Seminar / Conference / Workshop / Training Programme / Voluntary Service / Extension activities or similar programmes with prior permission from the Registrar shall be given exemption from prescribed attendance requirements and shall be permitted to take the examination on the recommendation of the concerned Head of the Department and Dean to condone the lack of attendance. The Head of the Department has to verify and certify the genuineness of the case before recommending to the Dean.

However, a candidate who has secured attendance less than 65% in the current semester shall not be permitted to appear for the current ESE. But he/she will be permitted to appear for his/her arrear examination if any and he/she has to re do the course by rejoining the semester in which attendance is less than 65% with proper approval of the "Students' Affairs Committee" and Registrar.

6 CLASS ADVISORS

To help the students in planning their courses of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a teacher of the Department who shall function as Class Advisor for those students throughout their period of study. Such Class Advisors shall advise the students andmonitor the courses undergone by the students, check the attendance and progress of the students attached to him/her and counsel them periodically. If necessary, the Class Advisormay display the cumulative attendance particulars in the Department Notice Board.

7 CLASS COMMITTEE

Every class shall have a class committee consisting of teachers of the class concerned, student representatives [two boys and two girls] and the concerned Head of the Department. It is like the 'Quality Circle' with the overall goal of improving the teaching–learning process. The functions of the class committee include

- Solving problems experienced by students in the class room and in the laboratories.
- Clarifying the regulations of the degree programme and the details of rules therein particularly Clause 2 and 3 which should be displayed on department Notice–Board.
- Informing the student representatives, the details of Regulations regarding weightage used for each assessment.
- Informing the student representatives, the academic schedule including thedates of assessments and the syllabus coverage for each assessment.
- In the case of practical courses (laboratory / project work, etc.) the breakup of marks for each experiment / exercise / module of work, should be clearly discussed in the class committee meeting and informed to the students.

- Analyzing the performance of the students of the class after each test and finding the ways and means of solving problems, if any.
- Identifying the weak students, if any, and requesting the teachers concerned to provide some additional academic support to them.
- The class committee shall be constituted within the first week of each semester.

At least 4 student representatives (usually 2 boys and 2 girls) shall be included in the class committee.

The Chairperson of the Class Committee may convene the meeting of the class committee.

The Dean may participate in any Class Committee of the Faculty.

The Chairperson is required to prepare the minutes of every meeting, submit the same to Dean within two days of the meeting and arrange to circulate it among the students and teachers concerned. If there are some points in the minutes requiring action by the Management, the same shall be brought to the notice of the Registrar by the HOD through the Dean.

The first meeting of the Class Committee shall be held within one week from the date of commencement of the semester, in order to inform the students about the nature and weightage of assessments within the framework of the regulations. Two or three subsequent meetings may be held in a semester at suitable intervals. During these meetings the student members representing the entire class, shall meaningfully interact and express their opinions and suggestions of the other students of the class in order to improve the effectiveness of the teaching–learning process.

8. COURSE COMMITTEE FOR COMMON COURSES

Each common theory course offered to more than one discipline or group, shall have a "Course Committee" comprising all the teachers handling the common course with one of them nominated as Course Coordinator. The nomination of the Course Coordinator shall be made by the Dean depending upon whether all the teachers teaching the common course belong to a single department or to several departments. The 'Course Committee' shall meet in order to arrive at a common scheme of evaluation for the test and shall ensure a uniform evaluation of the tests. Where ever feasible, the Course Committee may also prepare a common question paper forthe Internal Assessment test(s).

9. PROCEDURE FOR AWARDING MARKS FOR INTERNAL ASSESSMENT

Every teacher is required to maintain an 'ATTENDANCE AND ASSESSMENT RECORD' which consists of attendance marked in each theory or practical or project work class, the test marks and the record of class work (topic covered), separately for each course.

Continuous Internal Assessment (CIA):

The performance of students in each subject will be continuously assessed by the respective teachers as per the guidelines given below:

THEORY COURSES:

S. No.	CATEGORY	MAXIMUM MARKS
1.	Paper Presentation *	15
2.	Attendance	5
3.	Test – I #	10
4.	Test – II #	10
	TOTAL	40

* One refereed journal paper related to the subject and approved by the teacher should be critically presented. The Paper Presentation should be evaluated by a committee and marks should be entered in Automation software on or before 60th working day of the semester.

The test scripts should be evaluated and marks should be entered in Automation software on or before 4th working day after the last test.

PATTERN OF TEST QUESTION PAPER:

INSTRUCTION	REMARKS
Maximum Marks	60
Duration	2 Hours
Part- A	1 to 9 Two Mark Questions, uniformly covering the two and half units of the syllabus. All the 9 Questions are to be answered. **(9 x 2 =18Marks)**.
Part- B	Question 10 to 12 will be of either-or type, covering two and half units of the syllabus. Each Question may have subdivision. **(3 x 14 =42 Marks)**.

PRACTICAL COURSES:

S. No	CATEGORY	MAXIMUM MARKS
1.	Attendance	5
2.	Observation work	5
3.	Record work	5
4.	Model examination	15
5.	Viva – voce [Comprehensive]	10
	TOTAL	40

Every practical exercise / experiment shall be evaluated based on the conduct of exercise/ experiment and records maintained.

ATTENDANCE

MARKS DISTRIBUTION FOR ATTENDANCE

S. No.	Attendance %	Marks
1	91 and above	5.0
2	86-90	4.0
3	81-85	3.0
4	75-80	2.0
5	Less than 75	0

10. REQUIREMENTS FOR APPEARING FOR ENDSEMESTEREXAMINATION (ESE)

A candidate shall normally be permitted to appear for the ESE of any semester commencing from I semester if he/she has satisfied the semester completion requirements (Subject to Clause 5) and has registered for examination in all courses of the semester. Registration is mandatory for Semester Examinations as well as supplementary examinations failing which the candidate will not be permitted to move to the higher semester.

A candidate already appeared for a subject in a semester and passed the examination is notentitled to reappear in the same subject for improvement of grade.

11. END SEMESTER EXAMINATION

ESE will be held at the end of each semester for each subject, for 100 marks, later scaled down to 60 marks.

PATTERN OF ESE QUESTION PAPER:

INSTRUCTION	REMARKS
Maximum Marks	100
Duration	3 Hours
Part – A	Question no. 1 to 10 Two Mark Questions, covering all the 5 units. **(10 x 2= 20 Marks)**
Part- B	Question 11 to 15 will be of either or type, covering Five units of the syllabus. Each Question may have subdivision. **(5 x 16=80 Marks).**

12. PASSING REQUIREMENTS

Passing minimum: The passing minimum for CIA is 20 (i.e. out of 40 marks). The Passing minimum for End Semester Examination is 30 (i.e. out of 60 marks).

The overall passing minimum for theory/laboratory course is 50 (Sum of his/her score in internal and external examination) out of 100 marks.

If the candidate fails to secure a pass in a particular course ESE, it is mandatory that candidate shall register and reappear for the examination in that course during the subsequent semester when examination is conducted in that course. Further, the candidate should continue to register and reappear for the examination till a pass is secured in such supplementary exam within the stipulated maximum duration of the programme (Clause 2.1).

The CIA marks obtained by the candidate in his/her first or subsequent appearance where he/she secures a pass shall be retained by the office of the Controller of Examinations and considered valid for all remaining attempts till the candidate secures a pass in his/her ESE.

If a candidate fails to secure a pass in a particular course CIA, it is mandatory that candidate shall register and reappear for the CIA in that course during the subsequent

semester when CIA is conducted in that course by the faculty member assigned for that particular course during that semester by the concerned HOD. Further, the candidate should continue to register and reappear for the CIA till a pass is secured in such supplementary exam within the stipulated maximum duration of the programme (Clause 2.1).

13. AWARD OF LETTER GRADES

All assessments of a course will be done on absolute mark basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying certain number of points, will be awarded as per the range of total marks (out of 100) obtained by the candidate in each subject as detailed below:

Letter grade	Marks Range	Grade Point	Description
O	91 - 100	10	OUTSTANDING
A+	81- 90	9	EXCELLENT
A	71-80	8	VERY GOOD
B+	66- 70	7	GOOD
B	61 – 65	6	ABOVE AVERAGE
C	55 - 60	5	AVERAGE
P	50 - 54	4	PASS
RA	<50	-	REAPPEARANCE
AB		0	ABSENT

GRADE SHEET

After results are declared, Grade sheets will be issued to each student which will contain the following details:

i) The list of courses enrolled during the semester and the grade scored.

ii) The Grade Point Average (**GPA**) for the semester and

iii) The Cumulative Grade Point Average (**CGPA**) of all courses enrolled from first semester onwards.

GPA is the ratio of the sum of the products of the number of Credits (**C**) of courses enrolled and the Grade Points (**GP**) corresponding to the grades scored in those courses, taken for all the courses to the sum of the number of credits of all the courses in the semester.

CGPA will be calculated in a similar manner, considering all the courses enrolled fromfirst semester. **RA** grade will be excluded for calculating **GPA** and **CGPA**.

REVALUATION

A candidate can apply for revaluation of his/her semester examination answer paper in a theory course, within 2 weeks from the declaration of results, on payment of a prescribed fee through proper application to the Controller of Examinations through the Head of the Department and Dean. A candidate can apply for revaluation of answer scripts for not exceeding 5 subjects at a time. The Controller of Examinations will arrange for the revaluation and the results will be intimated to the candidate through the Head of the Department and Dean. Revaluation is not permitted for Supplementary examination, Practical examination and Project Work.

14. ELIGIBILITY FOR AWARD OF DEGREE

A student shall be declared to be eligible for award of Degree if he/she has

- Successfully gained required number of total credits as specified in the curriculum corresponding to his/her programme within the stipulated time.
- No disciplinary action is pending against him/her.

The award of degree must be approved by the Board of Management of KarpagamAcademy of Higher Education.

15. CLASSIFICATION OF THE DEGREE AWARDED

A candidate who qualifies for the award of the Degree (vide Clause 14) having passed the examination in all the courses in his/her first appearance within the specified minimum number of semesters (vide Clause 2.1) securing a CGPA of not less than 8.0 shall be declared to have passed the examination in First Class with Distinction.

A candidate who qualifies for the award of the Degree (vide Clause 14) having passed the examination in all the courses within the specified minimum number of semesters (vide Clause 2.1) plus one semester securing CGPA of not less than 6.5shall be declared to have passed the examination in First Class. For this purpose, the withdrawal from examination (vide Clause 16) will not be construed as an appearance. Further, the authorized break of study (vide Clause 18) will not be counted for the purpose of classification.

All other candidates (not covered in Clauses 15.1 and 15.2) who qualify for the award of the degree (vide Clause 14) shall be declared to have passed the examination in **Second Class**.

16. PROVISION FOR WITHDRAWAL FROM END–SEMESTER EXAMINATION

A candidate may for valid reasons and on prior application, be granted permission to withdraw from appearing for the examination of any one course or consecutive examinations of more than one course in a semester examination. Withdrawal application shall be valid only if the candidate is otherwise eligible to write the examination.

Such withdrawal shall be permitted only once during the entire period of study of the degree programme.

Withdrawal application is valid only if it is made within 10 days prior to the commencement of the examination in that course or courses and recommended by the Head of the Department and Dean and approved by the Registrar.

16.3.1 Notwithstanding the requirement of mandatory TEN days' notice, applications for withdrawal for special cases under extraordinary conditions will be considered on the merit of the case.\

Withdrawal shall not be construed as an appearance for the eligibility of a candidate for First Class with Distinction. This provision is not applicable to those who seek withdrawal during IV semester.

Withdrawal from the ESE is **NOT** applicable to supplementary courses.

The candidate shall reappear for the withdrawn courses during the examination conducted in the subsequent semester.

17. PROVISION FOR AUTHORISED BREAK OF STUDY

Break of Study shall be granted only once for valid reasons for a maximum of one year during the entire period of study of the degree programme. However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for break of study. If a candidate intends to temporarily discontinue the programme in the middle of the semester for valid reasons and to rejoin the programme in a subsequent year, permission may be granted based on the merits of the case provided he/she applies to the Registrar, but not later than the last date for registering for the ESE of the semester in question, through the Head of the Department and Dean

stating the reasons thereof and the probable date of rejoining the programme.

The candidate thus permitted to rejoin the programme after the break shall be governed by the curriculum and regulations in force at the time of rejoining. Such candidates may have to do additional courses, if any as per the curriculum and regulations in force at that period of time.

The authorized break of study (for a maximum of one year) will not be counted for the duration specified for passing all the courses for the purpose of classification (vide Clause15). However, additional break of study granted will be counted for the purpose of classification.

The total period for completion of the programme reckoned from, the commencement ofthe first semester to which the candidate was admitted shall not exceed the maximum period specified in Clause 2.1 irrespective of the period of break of study (vide Clause 18.1) in order that he/she may be eligible for the award of the degree.

If any student is detained for want of requisite attendance, progress and good conduct, the period spent in that semester shall not be considered as permitted 'Withdrawal' or 'Break of Study' Clause 16 and 18 respectively is not applicable for this case.

18. SPECIAL SUPPLEMENTARY ESE

After the publication of IV semester results, if a student has an arrear in any theory course of the entire programme, he/she will be permitted to apply within 15 days of the publication of results, and appear for a special supplementary examination.

19. DISCIPLINE

Every student is required to observe disciplined and decorous behavior both inside and outside the Karpagam Academy of Higher Education and not to indulge in any activity which will tend to bring down the prestige of the Karpagam Academy of Higher Education. The erring student will be referred to the Disciplinary Committee constituted by the Karpagam Academy of Higher Education, to inquire into acts of indiscipline and recommend to the Karpagam Academy of Higher Education about the disciplinary action to be taken.

If a student indulges in malpractice in any of the CIA/ESE he/she shall be liable for punitive action as prescribed by the Karpagam Academy of Higher Education from time to time.

20. REVISION OF REGULATION AND CURRICULUM

The Karpagam Academy of Higher Education may from time to time revise, amend or change the Regulations, Scheme of Examinations and syllabi if found necessary on the recommendations of Board of Studies, Academic Council and Board of Management of Karpagam Academy of Higher Education.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEEIRNG
FACULTY OF ENGINEEIRNG
PG PROGRAM (CBCS) – M.E. POWER SYSTEMS ENGINEERING
(FULL TIME)
(2024-2025 Batch and onwards)

Course Code	Name of the Course	Category	Outcomes and Specific Outcomes		Instruction hours / week			Credit(s)	Maximum Marks			Page No.
			POs	PSOs	L	T	P		CIA	ESE	Total	
SEMESTER I												
24MEPS101	Power System Analysis	PCC	1,2,3,4,5,6	1,2	**3**	**0**	**0**	**3**	**40**	**60**	**100**	7
24MEPS102	Power System Dynamics-I	PCC	1,2,3,4	1,2	**3**	**0**	**0**	**3**	**40**	**60**	**100**	9
24MEPS103 A/B/C	Renewable Energy Systems/ Smart Grid/ High Power Converters	PE	1,2,3,4/1,2,3,4,5,6/1,2,3,4,5,6	1,2/1,2/211,2	**3**	**0**	**0**	**3**	**40**	**60**	**100**	11/13/15
24MEPS104 A/B/C	Electrical Power Distribution System/Pulse Width Modulation for PE Converters/ Electric and Hybrid Vehicles	PE	1,2,3,4,5,6/1,2,3,4/1,2,3,4,5,6	1,2/1,2/1,2	**3**	**0**	**0**	**3**	**40**	**60**	**100**	17/19/21

24MEPS105	Research Methodology and IPR	HSMC	1,2,3,4	1,2	**3**	**0**	**0**	**2**	**40**	**60**	**100**	23
24MEPS111	Power System Steady State Analysis Lab	PCC	1,2,3,4	2	**0**	**0**	**3**	**2**	**40**	**60**	**100**	25
24MEPS112 A/B	Power System Dynamics Lab/ Renewable Energy Lab	PCC	1,2,3,4/1,2,3,4	2/2	**0**	**0**	**3**	**2**	**40**	**60**	**100**	26
VAC 24MEPS151 A/B/C (Audit 1)	English for Research Paper Writing/ Disaster Management/ Value Education	OE	1,2,3,4/1,2,3,4	2	**3**	**0**	**0**	**2**	**100**	**0**	**100**	28/ 30/ 32
Total					**15**	**0**	**9**	**20**	**380**	**420**	**800**	
SEMESTER II												
24MEPS201	Digital Protection of Power System	PCC	1,2,3,4,5,6	1,2	**3**	**0**	**0**	**3**	**40**	**60**	**100**	34
24MEPS202	Power System Dynamics-II	PCC	1,2,3,4,5,6	1,2	**3**	**0**	**0**	**3**	**40**	**60**	**100**	36
24MEPS203 A/B/C	Restructured Power System/ Dynamics of Electrical Machines/ Power Apparatus Design	PE	1,2,3,4,5,6/1,2,3,4/1,2,3,4	1,2/ 1,2/ 1,2	**3**	**0**	**0**	**3**	**40**	**60**	**100**	38/ 40/ 42

24MEPS204 A/B/C	SCADA Systems and Applications/ Power Quality/ Artificial Intelligence Techniques	PE	1,2,3 ,4,5, 6/1,2 ,3,4/ 1,2,3 ,4	1,2/ 1,2/ 1,2	**3**	**0**	**0**	**3**	**40**	**60**	**100**	44/ 46/ 48
24MEPS211 A/B/C	Power System Protection Lab/ Power Quality Lab/ Artificial Intelligence Lab	PCC	1,2, 3,4,5,6/1, 2,3,5/1,2, 3,4	1,2/ 1,2/ 1,2	**0**	**0**	**3**	**2**	**40**	**60**	**100**	50/ 51/ 52
VAC 24MEPS251 A/B/C/ (Audit 2)	Constitution of India/ Pedagogy Studies/ Stress Management by Yoga	HS MC	1,2, 3,4/1,2,3, 4		**3**	**0**	**0**	**2**	**100**	**0**	**100**	53/ 55/ 57
Total					**12**	**0**	**6**	**16**	**300**	**300**	**600**	
SEMESTER III												
24MEPS301 A/B/C	Power System Transients/ FACTS and Custom Power Devices/ Industrial Load Modeling and Control	PCC	1,2,3 ,4/1, 2,3/1 ,2,3, 4	1,2/ 1,2/ 1,2	**3**	**0**	**0**	**3**	**40**	**60**	**100**	59/ 61/ 63
24MEPS302 A/B/C	Industrial Safety/ Cost Management of Engineering Projects/ Waste to Energy	OE	1,2,3 ,4/1, 2,3,4 ,5/1, 2,3,4	1,2/ 1,2/ 1,2	**3**	**0**	**0**	**3**	**40**	**60**	**100**	65/ 67/ 69

24MEPS391	Phase – I Dissertation	PCC			**0**	**0**	**9**	**10**	**40**	**60**	**100**	71
Total					**6**	**0**	**9**	**16**	**120**	**180**	**300**	
SEMESTER IV												
24MEPS491	Phase-II Dissertation	PCC			**0**	**0**	**18**	**12**	**120**	**180**	**300**	72
Total					**0**	**0**	**18**	**12**	**120**	**180**	**300**	
Program Total					**33**	**0**	**42**	**64**	**920**	**1080**	**2000**	

L: Lecture Hour **T**: Tutorial Hour **CIA**: Continuous Internal Assessment

P: Practical Hour **C**: No. of Credits **ESE**: End Semester Examinations

PCC – Programme Core Course **PE** - Program Elective

OE – Open Elective **HSMC**-Humanities, Social Science and Management Course

**--Skill Development

**--Employability

**--Entrepreneurship

PROGRAM OUTCOMES (POs):

On successful completion of the program, graduates will have

PO1: An ability to independently carry out research /investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report/document.

PO3: An ability to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

PO4: An ability to continuously learn the new practices, principles and techniques of the electrical power industry.

PO5: An ability to apply knowledge of basic science and engineering in analysis and modeling of the power system components.

PO6: An ability to design power system protection schemes to enhance the stability of the power system and impart ethics in ensuring grid security in professional manner

PROGRAM SPECIFIC OUTCOMES (PSOs):

On successful completion of the program, graduates will have

PSO1: An ability to incorporate interdisciplinary knowledge to address the recent problems in the electrical power industry.

PSO2: An ability to work on application software packages for power system analysis and design under steady state and dynamic conditions

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1: To prepare the students to have career in the electrical power Industry/research organization/teaching.

PEO 2: To provide good foundation in mathematics and computational technology to analyze and solve problems encountered in electrical power industry.

PEO 3: Pursue lifelong learning and continuous improvement of their knowledge in the electrical power industry.

PEO 4: To understand the national and global issues related to the electrical power industry and to be considerate of the impact of these issues on the environment and within different cultures.

PEO 5: Apply the highest professional and ethical standards to their activities in the electrical power industry.

PEO 6: To provide the students with knowledge to be involved with the technology advancements and future developments in power generation, control and management as well as with alternate and new energy resources.

Program Educational Objective	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
PEO 1	√	√	√	√	√	√	√	√
PEO 2				√	√	√	√	√
PEO 3	√		√	√	√	√	√	√
PEO 4						√	√	√
PEO 5						√		√
PEO 6				√	√	√	√	√

SEMESTER I

24MEPS101	POWER SYSTEM ANALYSIS	3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Introduce various solution techniques to solve the large-scale power systems.
- Impart in-depth knowledge on different power flow solution methods for large power system networks.
- Perform short circuit fault analysis for various fault conditions on three phase system.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Relate large scale simultaneous linear equations and the ordering schemes for preserving sparsity. K3
- Solve the large-scale power flow problems K3
- Analyze optimal power flow problem using various solution methods K4
- Interpret the fault calculations for various fault conditions on three phase system. K2
- Explain about the studies under various disturbances using numerical integration methods K2

UNIT I SOLUTION TECHNIQUE **9**

Sparse Matrix techniques for large scale power systems - Optimal ordering schemes for preserving sparsity - Flexible packed storage scheme for storing matrix as compact arrays - Factorization by Bifactorization and Gauss elimination methods - Repeat solution using Left and Right factors and L and U matrices.

UNIT II POWER FLOW ANALYSIS **9**

Power flow equation in real and polar forms - Review of Newton Raphson method for solution; Adjustment of P-V buses - Review of Fast Decoupled Power Flow method - Sensitivity factors for P-V bus adjustment.

UNIT III OPTIMAL POWER FLOW **9**

Problem statement - Solution of Optimal Power Flow (OPF) - The gradient method - Newton's method - Linear Sensitivity Analysis - LP methods - With real power variables only - LP method with AC power flow variables and detailed cost functions - Security constrained Optimal Power Flow - Interior point algorithm - Bus Incremental costs.

UNIT IV SHORT CIRCUIT ANALYSIS **9**

Formation of bus impedance matrix with mutual coupling (single phase basis and three phase basis) - Computer method for fault analysis using ZBUS and sequence components - Derivation of equations for bus voltages -fault current and line currents - both in sequence and phase - symmetrical and unsymmetrical faults.

UNIT V TRANSIENT STABILITY ANALYSIS **9**

Introduction - Numerical Integration Methods - Euler and Fourth Order Runge-Kutta methods - Algorithm for simulation of SMIB and multi-machine system with classical synchronous machine model - Factors influencing transient stability - Numerical stability and implicit Integration methods.

TOTAL HOURS: 45

SUGGESTED READINGS:

1. M. A. Pai," Computer Techniques in Power System Analysis",Tata McGraw Hill Publishing Company Limited, New Delhi, 2006.
2. J. Wood and B. F. Wollenberg, "Power Generation Operation and Control", John Wiley and sons, New York, 2016.
3. G W Stagg, A.H El. Abiad, "Computer Methods in Power System Analysis", McGraw Hill,1968.
4. P. Kundur, "Power System Stability and Control", McGraw Hill, 1994.
5. D. P. Kothari and I. J. Nagrath, 'Modern Power System Analysis', Fourth Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2011.
6. K. Zollenkopf, "Bi-Factorization: Basic Computational Algorithm and Programming Techniques; pp:75-96 ; Book on "Large Sparse Set of Linear Systems" Editor:J.K.Rerd, Academic Press, 1971.

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	2	1	1	2	1	2	2
CO2	3	2	1	1	2	1	2	2
CO3	3	3	2	1	-	1	2	2
CO4	2	1	-	1	-	-	2	2
CO5	2	1	-	1	1	-	2	2
Average	**2.6**	**1.8**	**1.3**	**1**	**1.6**	**1**	**2**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER I

24MEPS102 POWER SYSTEM DYNAMICS-I 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Develop the transfer function model for excitation and speed governing systems.
- Model the single and multi-machine power systems with controllers for stability analysis
- Enhancing small signal stability concepts in power system

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Apply the mathematical modeling and inductance calculations in a synchronous machine K3
- Explain the transfer function model for excitation, speed governing and turbine systems. K2
- Develop the small signal stability of SMIB power systems. K3
- Analyze the small signal stability of SMIB and Multi-machine power systems with damping controllers. K4
- Summarize feedback controllers for small signal stability enhancement in power systems. K2

UNIT I SYNCHRONOUS MACHINE MODELLING 9

Physical description of a synchronous machine: armature and field structure - direct and quadrature axes-Mathematical Description: Basic equations of a synchronous machine: stator circuit equations, stator self, stator mutual and stator to rotor mutual inductances, dq0 Transformation: flux linkage and voltage equations for stator and rotor in dq0 coordinates, Physical interpretation of dq0 transformation, Per Unit Representations: power invariant form of Park‟s transformation; Equivalent Circuits for direct and quadrature axes, Steady-state Analysis: Voltage, current and flux-linkage phasor relationships, Computation of steady-state values.

UNIT II MODELLING OF EXCITATION AND SPEED GOVERNING SYSTEMS 9

Elements of an Excitation System: Types of Excitation System; Control and protective functions; Modeling of Excitation system components: Modeling of IEEE type ST1A (1992) excitation model, Turbine and Governing System Modeling: Classical transfer function of a hydraulic turbine (no derivation), Special characteristics of a hydraulic turbine, Electrical analogue of a hydraulic turbine, Governor for Hydraulic Turbine: Requirement for a transient droop, Block diagram of governor with transient droop compensation, Modeling of Single reheat tandem compounded type Steam Turbine.

UNIT III SMALL-SIGNAL STABILITY ANALYSIS WITHOUT CONTROLLERS 9

Classification of Stability, Concepts of Stability of Dynamic Systems: State-space representation, Eigen properties of the state matrix: Eigen values and eigenvectors for stability, Participation factor, Single-Machine Infinite Bus (SMIB) Configuration: Classical Machine Model stability analysis with numerical example, Effects of Field Circuit Dynamics: Block diagram representation with K-constants; expression for K-constants (no derivation), effect of field flux variation on system stability

UNIT VI SMALL-SIGNAL STABILITY ANALYSIS WITH CONTROLLERS 9

Effects of Excitation System: Thyristor Excitation System with AVR, Block diagram representation with Exciter and AVR, Effect of AVR on Synchronizing and Damping torque components, Power System Stabilizer: Block diagram representation with AVR and PSS, System state matrix including PSSIllustration of principle of PSS application with numerical example -Small Signal Stability of Multi machine systems: illustration of formation of system state matrix for a two-machine system with classical models for synchronous machines

UNIT V ENHANCEMENT OF SMALL SIGNAL STABILITY **9**

Power System Stabilizer – Stabilizer based on shaft speed signal (delta omega) – Delta P-Omega stabilizer-Frequency-based stabilizers – Digital Stabilizer – Excitation control design – Exciter gain – Phase lead compensation – Stabilizing signal washout and stabilizer gain – Stabilizer limits, Selection of PSS location

TOTAL HOURS : 45

SUGGESTED READINGS:

1.PrabhaKundur, "Power System Stability and Control", Tata McGraw-Hill, 2014.
2 R.Ramanujam," Power System Dynamics: Analysis and Simulation, PHI Learning Private Limited, Second print, New Delhi,2013.
3 J.Machowski, Bialek, Bumby, "Power System Dynamics and Stability", John wiley and sons, 3rd edition, 2020.
4 Vijay Vittal, James D. McCalley, Paul, P.M Anderson and A.A Fouad, "Power System Control and Stability", Iowa State University Press, Ames, Iowa, 3rd edition, 2019.
5 P. W. Sauer and M. A. Pai," Power System Dynamics and Stability", Stipes Publishing Co, 2007.

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	2	1	1	-	-	2	2
CO2	2	1	1	1	-	-	2	2
CO3	3	2	1	1	-	-	2	2
CO4	3	3	2	1	-	-	2	2
CO5	2	1	1	1	-	-	2	2
Average	**2.6**	**1.8**	1.2	1	**-**	**-**	**2**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER I

24MEPS103A RENEWABLE ENERGY SYSTEMS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Impart knowledge of geothermal, ocean and tidal energy and their applications
- Understand the design of wind mills and applications and about solar energy.
- Understand the important parts of a biogas plant, design and principle of bio-diesel.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

• Explain the fundamental principles and mechanisms behind renewable energy	K2
• Make use of the basic principles of wind energy and perform power analysis calculations.	K3
• Explain the principles of solar radiation and its conversion into thermal and electrical energy	K3
• Describe how biomass gasification converts organic material into syngas and its potential applications	K3
• Explain the availability and methods of utilizing geothermal resources for energy generation.	K2

UNIT I INTRODUCTION TO RENEWABLE ENERGY SYSTEMS

Causes of Energy Scarcity, Solution to Energy Scarcity, Factors Affecting Energy Resource Development, Energy Resources and Classification, Renewable Energy – Worldwide Renewable Energy Availability, Renewable Energy in India.

UNIT II WIND ENERGY SYSTEMS 9

Wind Energy: Basics & Power Analysis, Review of modern wind turbine technologies, Power Conversion Technologies and applications, Wind Power estimation techniques, Wind Turbine Selection, Cost economics & viability of wind farm.

UNIT III SOLAR ENERGY SYSTEMS 9

Sun as Source of Energy, Introduction to solar radiation, Solar thermal energy conversion, Flat plate collector, Concentric collectors, Solar Pond, Central receiver system, Solar pumping, Solar photovoltaic systems, Characteristics of PV cell, Photo voltaic modules.

UNIT IV BIOMASS ENERGY 9

Biomass Production, Energy Plantation, Biomass Gasification, Theory of Gasification, Gasifier and Their Classifications, Chemistry of Reaction Process in Gasification, Updraft, Downdraft and Cross-draft Gasifiers, Fluidized Bed Gasification, Use of Biomass Gasifier, Gasifier Biomass Feed Characteristics, Applications of Biomass Gasifier, Cooling and Cleaning of Gasifiers.

UNIT V GEOTHERMAL, HYDRO, TIDAL ENERGY 9

Geothermal Energy: availability and methods of utilization of geothermal resource for thermal applications and electricity generation Hydro Energy: Basic principle of hydroelectric power generation, classification of hydropower projects types of hydro turbine, Ocean Energy: Principles utilization, thermodynamic cycles, tidal and wave energy, potential and conversion technique, Principle of ocean thermal energy conversion system

TOTAL HOURS : 45

SUGGESTED READINGS:

1. RanjanRakesh, Kothari D.P, Singal K.C, "Renewable Energy Sources and Emerging Technologies", 2nd Ed. Prentice Hall of India ,2011
2. Math H.Bollen, Fainan Hassan, "Integration of Distributed Generation in the Power System", July 2011, Wiley –IEEE Press
3. Loi Lei Lai, Tze Fun Chan, "Distributed Generation: Induction and Permanent Magnet Generators", October 2007, Wiley-IEEE Press.
4. Roger A.Messenger, Jerry Ventre, "Photovoltaic System Engineering", 3rd Ed, 2010.

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	2	1	1	1	-	-	2	2
CO2	3	2	1	1	-	-	2	2
CO3	3	2	1	1	-	-	2	2
CO4	3	2	1	1	-	-	2	2
CO5	3	2	1	1	-	-	2	2
Average	**2.8**	**1.8**	**1**	**1**	**-**	**-**	**2**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER I

24MEPS103B	SMART GRID	3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
- Know about the function of smart grid.
- Familiarize the power quality management issues in Smart Grid.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Relate with the smart resources, smart meters and other smart devices. K3
- Explain the function of Smart Grid. K2
- Experiment with the issues of Power Quality in Smart Grid. K3
- Analyze the performance of Smart Grid. K4
- Recommend suitable communication networks for smart grid applications K2

UNIT I INTRODUCTION TO SMART GRID 9

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Comparison of Micro grid and Smart grid, Present development & International policies in Smart Grid, Smart Grid Initiative for Power Distribution Utility in India – Case Study.

UNIT II SMART GRID TECHNOLOGIES 9

Technology Drivers, Smart Integration of energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV) – Grid to Vehicle and Vehicle to Grid charging concepts.

UNIT III SMART METERS AND ADVANCED METERING INFRASTRUCTURE 9

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit (PMU) & their application for monitoring & protection. Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing, Peak Time Pricing.

UNIT IV POWER QUALITY MANAGEMENT IN SMART GRID 9

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

UNIT V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATION 9

Architecture and Standards -Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), PLC, Zigbee, GSM, IP based Protocols, Basics of Web Service and CLOUD Computing, Cyber Security for Smart Grid.

TOTAL HOURS: 45

SUGGESTED READINGS:

1. Stuart Borlase 'Smart Grid: Infrastructure, Technology and Solutions', CRC Press 2012.
2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, 'Smart Grid: Technology and Applications', Wiley, 2012.
3. Mini S. Thomas, John D McDonald, 'Power System SCADA and Smart Grids', CRC Press, 2015
4. Kenneth C.Budka, Jayant G. Deshpande, Marina Thottan, 'Communication Networks for Smart Grids', Springer, 2014
5. SMART GRID Fundamentals of Design and Analysis, James Momoh, IEEE press, A John Wiley & Sons, Inc., Publication.

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	2	1	1	1	1	2	1
CO2	3	3	2	1	-	1	2	1
CO3	3	2	1	-	-	-	2	1
CO4	2	1	-	1	1	1	2	1
CO5	2	1	-	1	1	2	2	1
Average	**2.6**	**1.8**	**1.3**	**1**	**1**	**1.3**	**2**	**1**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER I

24MEPS103C	HIGH POWER CONVERTERS	3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Power Electronics, Electronic Devices

COURSE OBJECTIVES:

The goal of this course is for students to:

- Understand the fundamentals of power electronic systems and requirement of high power converters.
- Provide a comprehensive understanding of phase-shifting transformers and multilevel voltage source inverters
- Know the design aspects for converters and the principles of protecting devices

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Interpret various types of power semiconductor devices and rectifiers. K2
- Design phase-shifting transformers and various multilevel voltage source inverters to optimize their performance. K4
- Apply diode clamped and flying capacitor multilevel inverters to enhance power quality and efficiency K3
- Examine PWM current source inverters, DC to DC switch-mode converters, and various AC voltage controllers K4
- Identify converters with appropriate protection strategies to safeguard devices and circuits K3

UNIT I INTRODUCTION **9**

Power electronic systems, An overview of PSDs, multi pulse diode rectifier, multi pulse, SCR rectifier, Thermal Management in Power electronic Devices.

UNIT II RECTIFIERS **9**

Phase shifting transformers, AC-DC Converters: Single-phase and three-phase rectifiers, Controlled rectifiers, and phase-controlled rectifiers

UNIT III VOLTAGE SOURCE INVERTERS **9**

Multilevel voltage source inverters: two level voltage source inverters, Diode clamped multilevel inverters, flying capacitor multilevel inverter, cascaded multilevel inverter, H bridge multilevel inverter

UNIT IV CURRENT SOURCE INVERTERS AND VOLTAGE CONTROLLERS **9**

DC-AC Converters (Inverters): Single-phase and three-phase inverters, PWM current source inverters, DC to DC switch mode converters, AC voltage controllers: Cyclo-converters, matrix converter, Power conditioners and UPS.

UNIT V PROTECTION AND CONTROL STRATEGIES **9**

Design aspects of converters, protection of devices and circuits: Fault Detection and Protection Techniques, Reliability Analysis and Lifetime Prediction, Control Strategies: Feedback Control Systems, Voltage and Current Control, Digital Control Techniques, Adaptive Control.

TOTAL HOURS: 45

SUGGESTED READINGS:

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

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	2	1	-	-	1	1	2	1
CO2	3	2	2	1	1	1	2	1
CO3	3	2	1	-	1	1	2	1
CO4	3	2	2	1	1	1	2	1
CO5	3	2	1	-	1	1	2	1
Average	**2.8**	**1.8**	**1.2**	**0.4**	**1**	**1**	**2**	**1**

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

SEMESTER I

24MEPS104A ELECTRICAL POWER DISTRIBUTION SYSTEM 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Acquire the knowledge in operation, control and protection of electric power distribution system.
- Evaluate the reliability of electric distribution system and develop strategies for its future expansion.
- Study the importance and concepts of distribution management automation.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

• Explain the fundamental concepts of electric power distribution system.	K2
• Understand the different methods of control and protection schemes in distribution system	K2
• Apply the gained knowledge in evaluating and analyzing the reliability of distribution system	K3
• Illustrate the different schemes of distribution automation.	K2
• Compare the different strategies for future expansion of distribution system	K2

UNIT I DISTRIBUTION SYSTEMS 9

Types of distribution systems - Section and size of feeders – Primary and secondary distribution design – Distribution substations – Economic design -Unbalance loads and voltage considerations – Industrial and commercial distribution systems – Energy losses in distribution system –System ground for safety and protection – comparison of overhead lines and underground cable system- Energy efficiency in electrical distribution and monitoring.

UNIT II CONTROL AND PROTECTION 9

Voltage control: Application of shunt capacitance for loss reduction – Harmonics in the system – Static VAR systems – loss reduction and voltage profile enhancement schemes. System protection: Over current protection - Under voltage and under frequency protection – Coordination of protective device- Fuses and sectionalizing Switches - Bellman's Optimality Principle- Calculation of optimum number of switches, capacitors, optimum switching device placement in radial distribution systems - Remote Terminal Units.

UNIT III RELIABILITY ANALYSIS 9

Distribution system, reliability analysis – reliability concepts – Markov model –distribution network reliability – reliability performance with renewable energy systems.

UNIT IV DISTRIBUTION AUTOMATION 9

Distribution automation: Definition, Restoration / Reconfiguration of Distribution Network - Power Factor Correction - Automation switching control – Management information systems (MIS) –Communication methods for data transfer – Consumer information service (CIS) –Graphical information systems (GIS) - Automatic meter reading (AMR) – Remote control load management- Substation automation – Feeder automation – Consumer side automation - SCADA applied to distribution automation- AI techniques applied to distribution automation.

UNIT V EXPANSION PLANNING 9

Load characteristics- load forecasting- Design concepts- Short term planning - Long term planning - dynamic planning – Sub transmission network configurations and substation design - Substation bus schemes - Distribution substations ratings - Service areas calculations - Optimal location of substation– Design of radial lines – Solution technique.

TOTAL HOURS : 45

SUGGESTED READINGS:

1. A.S. Pabla, "Electrical Power Distribution Systems", McGraw Hill Education (India) Pvt Ltd., Sixth edition, 2011.
2. James A. Momoh, "Electric Power Distribution, automation, protection and control", CRC Press, 2008
3. V. Kamaraju, "Electrical Power Distribution Systems", McGraw Hill Education, 2017.
4. M.K. Khedkar, G.M. Dhole, A Textbook of Electric Power Distribution Automation, University Science Press, New Delhi, 2012.
5. H Lee Willis, "Distributed Power Generation Planning and Evaluation", CRC Press, 2008
6. Turan Gonen, "Electrical Power Distribution System Engineering", Third edition, CRC Press, 2014.
7. James J. Burke, "Power distribution engineering: Fundamentals and Applications", CRC Press, 2017.

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	2	1	1	1	-	-	-	-
CO2	3	2	1	1	1	1	2	2
CO3	3	2	1	1	1	1	2	2
CO4	3	2	1	1	1	1	2	2
CO5	2	2	1	1	-	-	-	-
Average	**2.6**	**1.8**	**1**	**1**	**1**	**1**	**2**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER I

24MEPS104B PULSE WIDTH MODULATION FOR PE CONVERTERS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Develop a comprehensive understanding of various converter topologies.
- Acquire the skills to understand fundamental concepts of pulse width modulation (PWM) and converter topologies.
- Apply overmodulation techniques for single-phase and three-phase inverters.
- Develop the knowledge and skills to understand and apply various PWM techniques

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

• Outline different inverter topologies	K2
• Examine various PWM strategies and inverter topologies	K4
• Design and optimize inverter systems using overmodulation techniques	K3
• Utilize optimal PWM strategies to achieve minimum harmonic distortion	K3
• Analyze advanced PWM techniques and overmodulation strategies for various multilevel inverter configurations.	K4

UNIT I INTRODUCTION TO POWER ELECTRONIC CONVERTERS 9

Basic Converter Topologies- Voltage Source/Stiff Inverters- Switching Function Representation of Three-Phase Converters- Switching Function Representation of Three-Phase Converters- Current Source/Stiff Inverters- Three-Level Inverters- Multilevel Inverter Topologies- Harmonic Distortion Factors for Three-Phase Inverter- WTHD of Three-Level Inverter

UNIT II MODULATION OF VOLTAGE SOURCE INVERTERS 9

Fundamental Concepts of PWM- Naturally Sampled Pulse Width Modulation- PWM Analysis by Duty Cycle Variation- Regular Sampled Pulse Width Modulation- Topology of a Single-Phase and three phase Inverter- Three-Level Modulation of a Single-Phase Inverter- Switched Pulse Position- Switched Pulse Sequence.

UNIT III OVERMODULATION OF AN INVERTER 9

Naturally Sampled Overmodulation of One Phase Leg of an Inverter- Regular Sampled Overmodulation of One Phase Leg of an Inverter- Naturally Sampled Overmodulation of Single- and Three-Phase Inverters- PWM Controller Gain during Overmodulation- Space Vector Approach to Overmodulation

UNIT IV PROGRAMMED MODULATION OF MULTILEVEL CONVERTERS 9

Optimized Space Vector Modulation- Harmonic Elimination PWM- Performance Index for Optimality- Optimum PWM- Minimum-Loss PWM- Multilevel Converter Alternatives- Block Switching Approaches to Voltage Control- Harmonic Elimination Applied to Multilevel Inverters- Minimum Harmonic Distortion

UNIT V CARRIER-BASED PWM OF MULTILEVEL INVERTERS 9

PWM of Cascaded Single-Phase H- Overmodulation of Cascaded H-Bridges- PWM Alternatives for Diode-Clamped Multilevel Inverters- Three-Level Naturally Sampled PO PWM- Three-Level Naturally Sampled APOD or POD PWM- Overmodulation of Three-Level Inverters- PWM of Higher-Level Inverters-

Equivalent PD PWM for Cascaded Inverters- Hybrid Multilevel Inverter- Equivalent PO PWM for a Hybrid Inverter- Third-Harmonic Injection for Multilevel Inverters

TOTAL HOURS: 45

SUGGESTED READINGS:

1. Holmes, D. G., and Lipo, T. A., Pulse Width Modulation for Power Converters: Principles and Practice (Vol. 18). John Wiley and Sons, 2003.
2. Rodriguez, Jose, and Patricio Cortes, " Predictive control of power converters and electrical drives", Vol. 40. John Wiley & Sons, 2012
3. Ned Mohan, Tore M. Undeland and William P.Robbins, "Power Electronics, Converters, Applications and Design", Third Edition, John Wiley and Sons Inc., 2006.

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	2	1	1	1	-	-	2	2
CO2	3	3	2	1	-	-	2	2
CO3	3	2	1	1	-	-	2	2
CO4	3	2	1	1	-	-	2	2
CO5	3	3	2	1	-	-	2	2
Average	**2.8**	**1.8**	**1**	**1**	**-**	**-**	**2**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER I

24MEPS104C ELECTRIC AND HYBRID VEHICLES 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Discuss about the hybrid vehicle architecture
- Learn the power electronics-based drive control systems
- Understand battery management systems and grid integration issues of Electric and Hybrid vehicles

COURSE OUTCOMES: -

Upon completion of this course, the student will be able to:

- Understand the History of hybrid and electric vehicles K2
- Analyze the various hybrid drive-train topologies K3
- Devise the components used in hybrid and electric vehicles K3
- Analyze and design various components of electric and hybrid vehicles K3
- Investigate and model the energy management system K3

UNIT I HISTORY OF HYBRID AND ELECTRIC VEHICLES 9

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

UNIT II TRACTION SYSTEM 9

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

UNIT III DRIVE SYSTEMS 9

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

UNIT IV SUBSYSTEMS 9

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

UNIT V BATTERY MANAGEMENT SYSTEM 9

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

SUGGESTED READING

1. Sira -Ramirez, R. Silva Ortigoza, “Control Design Techniques in Power Electronics Devices”, Springer.
2. Siew-Chong Tan, Yuk-Ming Lai, Chi Kong Tse, “Sliding mode control of switching Power Converters”

CO, PO, PSO MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	2	1	1	1	1	1	1	2
CO2	3	3	1	1	1	3	1	2
CO3	3	3	1	1	1	3	1	2
CO4	3	3	1	1	1	3	1	2
CO5	3	3	1	1	1	3	1	2
Average	**2.8**	**2.6**	**1**	**1**	**1**	**2.6**	**1**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER I

24MEPS105 RESEARCH METHODOLOGY AND IPR 3H-2C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Understand research problem formulation.
- Analyze research related information
- Follow research ethics

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity. K2
- Understand the importance of IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular. K2
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and betterproducts, and in turn brings about, economic growth and social benefits. K2
- Understand the concept of effective technical writing K2
- Understand the nature of Patent Rights and Scope of Patent Rights K2

UNIT I

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

UNIT II

Effective literature studies approaches, analysis Plagiarism, Research ethics,

UNIT III

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

UNIT IV

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

UNIT V

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TOTAL HOURS : 45

SUGGESTED READING

1. Stuart Melville and Wayne Goddard, "Research methodology: an introductionfor science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guidefor beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd,2007.
5. Mayall , "Industrial Design", McGraw Hill,1992.
6. Niebel , "Product Design", McGraw Hill,1974.
7. Asimov , "Introduction to Design", Prentice Hall,1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property inNew Technological Age",2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	2	1	1	1	-	-	2	2
CO2	3	2	1	1	-	-	2	2
CO3	3	2	1	1	-	-	2	2
CO4	3	2	1	1	-	-	2	2
CO5	3	2	1	1	-	-	2	2
Average	**2.8**	**1.8**	**1**	**1**	**-**	**-**	**2**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER I

24MEPS111 POWER SYSTEM STEADY STATE ANALYSIS LAB 3H-2C

Instruction Hours/week: L:0 T:0 P:3 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Illustrate the power system issues under normal and abnormal conditions
- Analyze the performance of power system under normal and abnormal conditions using simulation software
- Evaluate the existing system and system under smart environment

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

• Acquire expertise in usage of simulation software as applied to power system	K2
• Apply tools to simulate the mathematical model for analyzing power system	K3
• Analyze the power system through various numerical methods under normal and abnormal conditions	K4
• Calculate the steady-state power flow in a power system.	K3
• Develop a program for fault analysis.	K4

LIST OF EXPERIMENTS

1. Economic load dispatch using lambda-iteration method
2. Unit commitment: Priority-list scheme and dynamic programming.
3. Load flow analysis of two-bus system with STATCOM
4. Available Transfer Capability (ATC) calculation using an existing load flow program in deregulated environment.
5. Harmonic Analysis of Power system with nonlinear load
6. Study of protective relaying schemes of Power Apparatus
7. Demand Side Management in Smart Power Grid environment
8. Determination of Sequence Impedances of Power Network

TOTAL HOURS : 30

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	2	1	1	-	-	-	2
CO2	3	2	1	1	-	-	-	2
CO3	3	3	2	1	-	-	-	2
CO4	3	3	2	1	-	-	-	2
CO5	3	2	1	1	-	-	-	2
Average	**3**	**2.4**	**1.4**	**1**	**-**	**-**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER I

24MEPS112A **POWER SYSTEM DYNAMICS LAB** **3H-2C**

Instruction Hours/week: L:0 T:0 P:3 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Perform Load flow analysis of power system for planning and operation.
- Estimate the states of power system for monitoring, control and contingency evaluation.
- Analyze the performance of power system under normal and abnormal conditions.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

• Apply tools to simulate the mathematical model for power system analysis	K3
• Make use of simulation tools for Harmonic analysis.	K3
• Identify the symmetrical and unsymmetrical faults .	K3
• Analyze the power system through various numerical methods under fault condition.	K4
• Suggest methods for economic operation of power system.	K3

LIST OF EXPERIMENTS

1. Formulation of Y_{BUS} and Z_{BUS} of power network
2. Power flow analysis by Gauss Seidel/Newton-Raphson/ Fast decoupled method
3. Transient stability analysis of single machine-infinite bus system using classical machine model
4. State estimation of Power System
5. Contingency analysis: Generator shift factors and line outage distribution factors
6. Simulations of various types of faults.
7. Harmonic Analysis and Simulation of transmission system
8. Load Frequency Control of Single and Two area power system

TOTAL HOURS : 30

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	2	1	1	-	-	-	2
CO2	3	2	1	1	-	-	-	2
CO3	3	2	1	1	-	-	-	2
CO4	3	3	2	1	-	-	-	2
CO5	3	2	1	1	-	-	-	2
Average	**3**	**2.2**	**1.2**	**1**	**-**	**-**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER I

24MEPS112B **RENEWABLE ENERGY LAB** **3H-2C**

Instruction Hours/week: L:0 T:0 P:3 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Provide exposure on various aspects of renewable energy sources and technology.
- Get detailed insights into the design and operational aspects of renewable energy devices.
- Measure Solar radiation and Wind velocity.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

• Infer about the temperature variation on Solar panel output.	K2
• Identify the effect of load on Solar panel output.	K3
• Utilize Anemometer to measure wind velocity.	K3
• Make use of Pyranometer to measure solar radiation.	K3
• Interpret the different types of renewable energy gadgets.	K2

LIST OF EXPERIMENTS

1. Effect of temperature variation on Solar panel output.
2. Effect of load on Solar panel output.
3. Measurement of Wind velocity using Anemometer.
4. Measurement of Solar radiation using Pyranometer.
5. Study of solar water pumping
6. Study of Biogas Plants
7. Study the production process of Bio-Fuels
8. Study of Briquetting machine.

TOTAL HOURS : 30

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	2	1	1	1	-	-	-	2
CO2	3	2	1	1	-	-	-	2
CO3	3	2	1	1	-	-	-	2
CO4	3	2	1	1	-	-	-	2
CO5	2	1	1	1	-	-	-	2
Average	**2.6**	**1.6**	**1**	**1**	**-**	**-**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER I

24MEPS151A ENGLISH FOR RESEARCH PAPER WRITING 3H-2C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Understand that how to improve your writing skills and level of readability.
- Learn about what to write in each section.
- Understand the skills needed when writing a Title.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Recall their previous writing experiences and enhance their current and future learning K1
- Interpret, summarize and critique academic texts. K2
- Evaluate and synthesize information from different academic sources K4
- Develop a process writing approach: from planning to drafting and revising, to create different genres of academic texts K3
- Identify good academic writing practices and adopt such practices to maintain academic honesty and avoid plagiarism during the writing process K3

UNIT I PLANNING AND PREPARATION 6

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

UNIT II STRUTURE OF THE PAPER 6

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT III KEY SKILLS 6

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

UNIT IV RESULTS AND DISCUSSION 6

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V SUBMISSION 6

Useful phrases, how to ensure paper is as good as it could possibly be the first - time submission

TOTAL HOURS : 30

SUGGESTED READINGS:

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

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	1	1	-	-	-	-	-	-
CO2	2	1	-	-	-	-	-	-
CO3	3	2	2	1	-	-	-	-
CO4	3	2	1	-	-	-	-	-
CO5	3	2	1	-	-	-	-	-
Average	2.4	1.6	1.3	1	-	-	-	-

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER I

24MEPS151B	DISASTER MANAGEMENT	3H-2C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Summarize basics of disaster K2
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response. K2
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives K3
- Demonstrate how to use data from remote sensing and meteorological agencies to assess disaster risks. K3
- Develop the strengths and weaknesses of disaster management approaches. K3

UNIT I INTRODUCTION **6**

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS **6**

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III DISASTER PRONE AREAS IN INDIA **6**

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT **6**

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT **6**

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

TOTAL HOURS: 30

SUGGESTED READINGS:

1. Goel S. L., "Disaster Administration And Management Text And Case Studies", Deep& Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies" New Royal book Company,2007.
3. Sahni, Pardeep Et.Al, "Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi,2001.

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	2	1	1	1	-	-	-	-
CO2	2	1	1	1	-	-	-	-
CO3	3	2	1	1	-	-	-	-
CO4	3	2	1	1	-	-	-	-
CO5	3	2	1	1	-	-	-	-
Average	**2.6**	**1.6**	**1**	**1**	**-**	**-**	**-**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER I

24MEPS151C	VALUE EDUCATION	3H-2C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Introduce students to the concept of values and their importance in personal and social life.
- Help students recognize and understand various types of values, including moral, cultural, social, and ethical values.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Identify and recall key moral values like honesty, integrity, and empathy. K3
- Describe how values like respect and empathy contribute to positive social interactions. K2
- Explain the concept of human rights and differentiate between civil, political, social, economic, and cultural rights. K2
- Interpret the role of empathy in resolving conflicts and promoting understanding among diverse groups. K2
- Summarize human rights and list key human rights documents. K2

UNIT I : CONCEPT OF HUMAN VALUES, VALUE EDUCATION TOWARDS PERSONAL DEVELOPMENT **6**

Aim of education and value education; Evolution of value-oriented education; Concept of Human values; types of values; Components of value education- Personal Development, Self-analysis and introspection; sensitization towards gender equality, physically challenged, intellectually challenged. Respect to - age, experience, maturity, family members, neighbours, co-workers.

UNIT II : VALUE EDUCATION TOWARDS NATIONAL AND GLOBAL DEVELOPMENT **6**

National and International Values: Constitutional or national values - Democracy, socialism, secularism, equality, justice, liberty, freedom and fraternity. Social Values - Pity and probity, self-control, universal brotherhood. Professional Values - Knowledge thirst, sincerity in profession, regularity, punctuality and faith.

UNIT III: IMPACT OF GLOBAL DEVELOPMENT ON ETHICS AND VALUES **6**

Conflict of cross-cultural influences, mass media, cross-border education, materialistic values, professional challenges and compromise-Modern Challenges of Adolescent Emotions and behaviour; Sex and spirituality: Comparison and competition; positive and negative thoughts.

UNIT IV: HUMAN RIGHTS **6**

Concept of Human Rights – Indian and International Perspectives- Evolution of Human Rights- Right to Life, Liberty and Dignity- Human Rights of Women and Children-Social Practice and Constitutional Safeguards-Institutions for Implementation-Human Rights Commission

UNIT V: THERAUPATIC MEASURES **6**

Control of the mind through simplified physical exercise - Meditation: Objectives, types, effect on body, mind and soul - Yoga: Objectives, Types, Asanas -Activities: Moralisation of Desires - Neutralisation of Anger - Eradication of Worries Commission

TOTAL HOURS: 30

SUGGESTED READINGS:

1. Dr Kiruba Charles and V Arul Selvi." The Education of a Value Investor: My Transformative Quest for Wealth, Wisdom, and Enlightenment" by Guy Spier.
2. Education For Values, Environment And Human Rights, Kuldeep S. Katoch Y. K. Sharma , Jan 2007.

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-
CO2	3	2	1	1	-	-	-	-
CO3	3	2	1	1	-	-	-	-
CO4	3	3	2	1	-	-	-	-
CO5	3	2	1	1	-	-	-	-
Average	**3**	**2.2**	**1.2**	**1**	**-**	**-**	**-**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER II

24MEPS201 DIGITAL PROTECTION OF POWER SYSTEM 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Demonstrate the basic concepts and recent trends in power system protection.
- Design and work with the concepts of digital and numerical relaying of various power apparatuses Study the fundamentals genetic algorithm and it applications.
- Train up with the relay coordination for the transmission line protection schemes
- Expose PC applications for designing protective relaying schemes

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

• Outline the underlying principle of digital techniques for power system protection	K2
• Apply the concepts of digital protection schemes based on fundamental signals to design basic hardware and software for transmission line protection.	K3
• Design and implement numerical relays to improve over-current protection systems	K3
• Apply relay coordination techniques to ensure effective protection in multi-zone power networks.	K3
• Develop PC based algorithm for short circuit studies	K3

UNIT I NUMERICAL PROTECTION 9

Introduction - Block diagram of numerical relay - Sampling theorem - Correlation with a reference wave - Least Error Squared (LES) technique - Digital filtering and numerical over- Current protection.

UNIT II DIGITAL PROTECTION OF TRANSMISSION LINE 9

Introduction - Protection scheme of transmission line – Distance relays - Traveling wave relays - Digital protection scheme based upon fundamental signal - Hardware design - Software design - Digital protection of EHV/UHV transmission line based upon traveling wave phenomenon - New relaying scheme using amplitude comparison.

UNIT III DIGITAL PROTECTION OF SYNCHRONOUS GENERATOR & TRANSFORMER 9

Introduction - Faults in synchronous generator - Protection schemes for Synchronous Generator - Digital protection of Synchronous Generator - Faults in a Transformer - Schemes used for Transformer Protection - Digital Protection of Transformer.

UNIT IV DISTANCE AND OVERCURRENT RELAY SETTING AND CO-ORDINATION 9

Directional instantaneous IDMT over current relay - Directional multi-Zone distance relay - Distance relay setting - Co-ordination of distance relays - Co-ordination of over current relays - Computer graphics display - Man-machine interface subsystem - Integrated operation of national power system - Application of computer graphics.

UNIT V PC APPLICATIONS FOR DESIGNING PROTECTIVE RELAYING SCHEME 9

Types of faults – Assumptions - Development of algorithm for SC studies - PC based integrated software for SC studies - Transformation to component quantities - SC studies of multiphase systems - Ultra high speed protective relays for high voltage long transmission line.

TOTAL HOURS: 45

SUGGESTED READINGS:

1. L. P. Singh, "Digital Protection - Protective Relaying from Electromechanical to Microprocessor", New Age International Ltd., New Delhi, Second Edition, 2006
2. S. R. Bhide, “Digital Power System Protection”, Prentice Hall of India Pvt. Ltd., New Delhi, 2014
3. Paithankar and Bhide, “Fundamentals of Power System Protection”, Prentice Hall of India Pvt. Ltd., New Delhi, second edition, 2010.
4. Paithankar, “Transmission Network Protection”, Marcel & Dekker, New York, 1998.
5. Stanley Horowitz, “Protective Relaying for Power System II”, John Wiley & Sons, 2008.
6. T. S. M. Rao, “Digital / Numerical relays”, Tata McGraw Hill, New Delhi, 2005.

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	2	-	3	-	3	-	2	2
CO2	3	-	3	-	3	3	2	2
CO3	3	1	3	2	2	2	2	2
CO4	3	-	3	-	-	3	2	2
CO5	3	1	3	3	3	2	2	2
Average	**2.8**	**1**	**3**	**2.5**	**2.75**	**2.5**	**2**	**2**

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

SEMESTER I

24MEPS202	POWER SYSTEM DYNAMICS-II	3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Fundamentals of Electrical Circuits, Electrical Machines, Power Systems, Control Systems

COURSE OBJECTIVES:

The goal of this course is for students to:

- Understand the various dynamic phenomena and their impacts in power systems.
- Explain the principles and operation of Automatic Generation Control (AGC) in power systems and apply AGC techniques to maintain system performance.
- Describe the roles of primary and secondary control in power systems

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

• Interpret the dynamic phenomena in power systems	K2
• Classify various types of stability and differentiate their characteristics and impact on power system operations.	K2
• Examine the stability of multi-machine power and recommend appropriate measures to mitigate these issues.	K4
• Apply AGC techniques to regulate system frequency and maintain power balance.	K3
• Illustrate the functions and importance of primary and secondary control mechanisms in power systems	K2

Unit I **9**

Basic Concepts of Dynamic Systems and Stability Definition - Small Signal Stability (Low Frequency Oscillations) of Unregulated and Regulated System

Unit II **9**

Effect of Damper, Flux Linkage Variation and AVR - Large Signal Rotor Angle Stability - Dynamic Equivalents and Coherency-Direct Method of Stability Assessment StabilityEnhancing Techniques - Mitigation using Power System Stabilizer

Unit III **9**

Asynchronous Operation and Resynchronization - Multi-Machine Stability - DynamicAnalysis of Voltage Stability

Unit IV **9**

Voltage Collapse - Frequency Stability - Automatic Generation Control.

Unit V **9**

Primary and Secondary Control - Sub-Synchronous Resonance and Counter Measures

TOTAL HOURS: 45

SUGGESTED READING:

- P. Kundur, "Power System Stability and Control", McGraw Hill Inc, 1994
- J. Machowski, Bialek, Bumby, "Power System Dynamics and Stability", John Wiley & Sons, 1997
- L. Leonard Grigsby (Ed.); "Power System Stability and Control", Second edition, CRC Press, 2007
- V. Ajjarapu, "Computational Techniques for voltage stability assessment & control"; Springer, 2006

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	2	1	-	-	1	1	2	1
CO2	2	1	-	-	1	1	2	1
CO3	3	2	2	1	1	1	2	1
CO4	3	2	1	-	1	1	2	1
CO5	2	1	-	-	1	1	2	1
Average	**2.4**	**1.4**	**0.6**	**0.2**	**1**	**1**	**2**	**1**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER II

24MEPS203A RESTRUCTURED POWER SYSTEMS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Describe the behavior of deregulated markets in power system.
- Describe the technical and non-technical issues in deregulated power industry.
- Identify the methods of Local Marginal prices calculation in transmission and the function of financial transmission rights.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Demonstrate the requirement for deregulation of the electricity market and the principles of market models in power systems. K2
- Identify the methods of congestion management in deregulated power system K3
- Illustrate the locational marginal pricing and financial transmission rights K2
- Analyze the ancillary services management K4
- Explain the framework of US and Indian power sectors K2

UNIT I INTRODUCTION 9

Reasons for restructuring - Understanding the restructuring process - objectives of deregulation of various power systems across the world - Consumer behavior - Supplier behavior - Market equilibrium - Short-run and Long-run costs - Various costs of production. The Philosophy of Market Models:Market models based on contractual arrangements - Market architecture

UNIT II TRANSMISSION CONGESTION MANAGEMENT 9

Importance of congestion management in deregulated environment - Classification of congestion management methods - Calculation of ATC - Non-market methods - Market based methods – Nodal pricing - Inter-zonal Intra-zonal congestion management - Price area congestion management - Capacity alleviation method.

UNIT III LOCATIONAL MARGINAL PRICES AND FINANCIAL TRANSMISSION RIGHTS 9

Fundamentals of locational marginal pricing - Lossless DCOPF model for LMP calculation – Loss compensated DCOPF model for LMP calculation - ACOPF model for LMP calculation - Risk Hedging Functionality Of financial Transmission Rights - FTR issuance process - Treatment of revenue shortfall - Secondary trading of FTRs - Flow Gate rights - FTR and market power

UNIT IV ANCILLARY SERVICE MANAGEMENT AND PRICING OF TRANSMISSION NETWORK 9

Types of ancillary services -Load-generation balancing related services - Voltage control and reactive power support services - Black start capability service - Mandatory provision of ancillary services - Markets for ancillary services - Co-optimization of energy and reserve services – International comparison. Pricing of transmission network: wheeling - principles of transmission pricing - transmission pricing methods - Marginal transmission pricing paradigm - Composite pricing paradigm - loss allocation methods.

UNIT V MARKET EVOLUTION 9

US markets: PJM market - The Nordic power market - Reforms in Indian power sector: Framework of Indian power sector - Reform initiatives - availability based tariff (ABT) - The Electricity Act 2012 - Open Access issues - Power exchange

TOTAL HOURS : 45

SUGGESTED READINGS:

1. Mohammad Shahidehpour, MuwaffaqAlomoush, “Restructured electrical power systems: operation, trading and volatility” Marcel Dekker Pub.,2001.
2. Kankar Bhattacharya, Math H.J.Boolen, and JaapE. Daadler, "Operation of restructured power systems”, Kluwer AcademicPub.,2001.
3. Paranjothi, S.R., “Modern Power Systems The Economics of Restructuring”, New Age International Publishers, First Edition: 2017.
4. Sally Hunt, "Making competition work In electricity”,John Willey and Sons Inc.2002.
5. Steven Stoft," Power System Economics: Designing Markets for Electricity”,Wiley-IEEE Press, 2002.
6. A. Khaparde, A. R. Abhyankar, "Restructured Power Systems", NPTEL Course, https://nptel.ac.in/courses/108101005/.

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	2	1	1	1	1	1	2	2
CO2	3	2	1	1	1	1	2	2
CO3	2	1	1	1	1	1	2	2
CO4	3	3	2	1	1	1	2	2
CO5	2	1	1	1	1	1	2	2
Average	**2.4**	**1.6**	**1.2**	**1**	**1**	**1**	**2**	**2**

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

SEMESTER II

24MEPS203B	DYNAMICS OF ELECTRICAL MACHINES	3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Electrical Machines

COURSEOBJECTIVES:

The goal of this course is for students to:

- Be familiar with dynamic modeling, simulation of electric machinery
- Acquire knowledge of control theory of electric machinery.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Design Kron's Primitive machine as a unified electrical machine model. K3
- Develop the mathematical model and control a 3- phase Induction motor. K3
- Analyze asymmetrical 2-phase induction motor. K4
- Construct the mathematical model of a separately excited DC motor K3
- Analyze a three-phase synchronous machine under transient conditions. K4

UNIT-I: MODELING CONCEPTS **9**

Basic Two-pole machine representation of commutator machines, 3-phsynchronous machine with and without damper bars and 3-ph induction machine, Kron's primitive machine-voltage, current and torque equations. Real time model of a two-phase induction machine transformation to obtain constant matrices-three phase to two phase transformation- power equivalence.

UNIT-II MODELING OF THREE PHASE INDUCTION MACHINE **9**

Generalized model in arbitrary reference frame- Electromagnetic torque– Derivation of commonly used induction machine models- Stator reference frame model- Rotor reference frame model- Synchronously rotating frame model- Equations in flux linkages – per unit model-Dynamic Simulation- Small signal equations of induction machine –

UNIT-III SYMMETRICAL AND UNSYMMETRICAL 2 PHASE INDUCTION MACHINE **9**

Analysis of symmetrical 2 phase induction machine-voltage and torque equations for un symmetrical 2 phase induction machine voltage and torque equations in stationary reference frame variables for unsymmetrical 2 phase induction machine-analysis of steady state operation of unsymmetrical 2 phase induction machine-single phase induction motor - Cross field theory of single-phase induction machine.

UNIT-IV SYNCHRONOUS MACHINE MODELING **9**

Mathematical model of a separately excited DC motor- steady state and transient analysis – Transfer function of a separately excited DC motor – Mathematical model of a DC series motor, shunt motor-linearization techniques for small perturbations. Synchronous machine inductances – voltage equations in the rotor's DQ0 reference frame- electromagnetic torque-current in terms of linkages.

UNIT-V DYNAMIC ANALYSIS OF SYNCHRONOUS MACHINE **9**

Dynamic performance of synchronous machine, three-phase fault, comparison of actual and approximate transient torque characteristics, Equal area criteria- simulation of three phase synchronous machine – modeling of PMSM.

TOTAL HOURS: 45

TEXT BOOKS:

1. R.Krishnan "Electric Motor Drives - Modeling, Analysis& control"- PearsonPublications-1st edition -2002
2. P.C.Krause, Oleg Wasynczuk, Scott D. Sudhoff " Analysis of Electrical Machinery and Drive systems", IEEE Press, 2nd Edition
3. Chee Mun Ong " Dynamic simulation of Electric machinery using Matlab / Simulink " –Prentice Hall,2000

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	2	1	1	-	-	2	2
CO2	3	2	1	1	-	-	2	2
CO3	3	2	2	1	-	-	2	2
CO4	3	2	1	1	-	-	2	2
CO5	3	2	2	1	-	-	2	2
Average	**3**	**2**	**1.4**	**1**	**-**	**-**	**2**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER II

24MEPS203C	POWER APPARATUS DESIGN	3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Electrical Machines

COURSE OBJECTIVES:

The goal of this course is for students to:

- Study the modelling analysis of rotating machine.
- To introduce students to the selection of specific electric and magnetic loadings for different machines.
- To develop knowledge of designing the main dimensions, temperature rise calculation and ventilation types in electrical machines.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Understand the fundamental principles of machine design, including specific loadings K2
- Identify the main dimensions and materials used for DC and AC machines K3
- Apply the knowledge of magnetic and electric loadings in calculating real and apparent flux densities K3
- Design various types of electrical machines and transformers, considering factors like leakage reactance, conductor size, and cooling methods. K3
- Evaluate the efficiency, losses, and regulation of electrical machines through design data. K3

UNIT I **9**

Principles of Design of Machines -Specific loadings, choice of magnetic and electric loadings, Real and apparent flux densities, temperature rise calculation, Separation of main dimension for DC machines, Induction machines and synchronous machines, Design of Transformers-General considerations, output equation, emf per turn, choice of flux density and current density, main dimensions, leakage reactance and conductor size, design of tank and cooling

UNIT II **9**

Specific loadings, choice of magnetic and electric loadings Real and apparent flux -densities, temperature rise calculation, Separation of main dimension for DC machines, Induction machines and synchronous machines, Heating and cooling of machines, types of ventilation, continuous and intermittent rating

UNIT III **9**

General considerations, output equation, emf per turn, choice of flux density and current density, main dimensions, leakage reactance and conductor size, design of tank and cooling tubes, Calculation of losses, efficiency and regulation, Forces winding during short circuit

UNIT IV **9**

General considerations, output equation, Choice of specific electric and magnetic loadings, efficiency, power factor, Number of slots in stator and rotor, Elimination of harmonic torques

UNIT V **9**

Design of stator and rotor winding, slot leakage flux, Leakage reactance, equivalent resistance of Magnetizing current, efficiency from design data , squirrel cage rotor design of main dimensions - Introduction to Computer Aided Electrical Machine Design Energy efficient machines

SUGGESTED READING

1. Clayton A.E, "The Performance and Design of D.C. Machines", Sir I. Pitman & sons,Ltd.
2. M.G. Say, "The Performance and Design of A.C. Machines ", Pitman
3. Sawhney A.K, "A course in Electrical Machine Design", DhanpatRai& Sons, 5thEdition

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	2	1	1	-	-	2	1
CO2	3	2	1	1	-	-	2	1
CO3	3	2	1	1	-	-	2	1
CO4	3	2	1	1	-	-	2	1
CO5	3	2	1	1	-	-	2	1
Average	**3**	**2**	**1**	**1**	-	-	**2**	**1**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER II

24MEPS204A SCADA SYSTEMS AND APPLICATIONS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Design the structural framework for a SCADA system that meets the specific needs of an industrial or utility application
- Implement and utilize communication protocols that are suitable for SCADA systems.
- Establish methods for managing SCADA-related knowledge and performance metrics.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Develop architecture of SCADA K3
- Make use of the SCADA protocols K3
- Develop the knowledge management and framework metrics of SCADA. K3
- Interpret the commissioning and operations. K3
- Analyze the challenges and issues in SCADA systems K4

UNIT I SCADA SYSTEMS 9

Introduction, definitions and history of Supervisory Control and Data Acquisition, typical SCADA system Architecture, Communication requirements, Desirable Properties of SCADA system, features, advantages, disadvantages and applications of SCADA. SCADA Architectures (First generation - Monolithic, Second generation - Distributed, Third generation – Networked Architecture), SCADA systems in operation and control of interconnected power system, Power System Automation (Automatic substation control and power distribution), Petroleum Refining Process, Water Purification System, Chemical Plant.

UNIT II SCADA PROTOCOLS 9

Open systems interconnection (OSI) models, TCP/IP protocol, DNP3 protocol, IEC61850 layered architecture, Control and Information Protocol (CIP), Device Net, Control Net, Ether Net/IP, Flexible Function Block process (FFB), Process Field bus (Profibus). Interfacing of SCADA with PLC.

UNIT III MANAGEMENT AND MODELLING 9

Disaster recovery and business continuity of SCADA, Forensic management, Governance and compliance, Communications and Engineering systems, Metrics framework for a SCADA systems, Network topology and Implementation.

UNIT IV COMMISSIONING AND OPERATIONS 9

Obsolescence and procurement of SCADA, Patching and change management, physical security management, Integrity monitoring

UNIT V ISSUES IN SCADA SYSTEMS 9

Introduction, SCADA Alarm management, Human Management Interface (HMI), SCADA Network security, SCADA historian, Troubleshooting issues, SCADA System maintenance, SCADA system specification.

TOTAL HOURS: 45

SUGGESTED READINGS:

1. Bennett Stuart, “Real Time Computer Control”, Prentice Hall, 1988
2. Doebelin E. O., “Measurement Systems”, McGraw-Hill International Editions, Fourth Edition, 1990
3. Gordan Clark, Deem Reynders, “Practical Modern SCADA Protocols”, ELSEVIER
4. Krishna Kant, “Computer Based Industrial Control”, PHI
5. M. Chidambaram, “Computer Control of Process”, Narosha Publishing
6. Poppovik, Bhatkar, “Distributed Computer Control for Industrial Automation”, Dekkar Publications
7. S. K. Singh, “Computer Aided Process Control”, PHI

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	2	1	1	1	1	1	1
CO2	3	2	1	1	1	1	1	1
CO3	3	2	1	1	1	1	1	1
CO4	2	1	-	1	1	-	1	1
CO5	3	3	2	1	1	-	1	1
Average	**2.8**	**2**	**1.3**	**1**	**1**	**1**	**1**	**1**

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

SEMESTER II

24MEPS204B POWER QUALITY 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Understand the different power quality issues.
- Understand the recommended practices by various international and national standard bodies.
- Understanding the concept of STATIC VAR Compensators.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Acquire knowledge about the harmonics and effect of harmonics. K2
- Apply the analytical modeling skills for modeling and analysis of harmonics. K3
- Understand the active power factor correction based on staticVAR compensators and its control techniques K2
- To Remember the series and shunt active power filteringtechniques. K1
- Understand the concept of Static VAR compensators and UPS. K2

UNIT I INTRODUCTION 8

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

UNIT II HARMONICS 9

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

UNIT III MODELLING OF NETWORKS 9

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

UNIT IV POWER FACTOR IMPROVEMENT 9

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

UNIT V STATIC VAR COMPENSATORS 10

Static VAR compensators-SVC and STATCOM Active Harmonic Filtering- Shunt Injection, Filter for single phase, three-phase three-wire and three-phasefour- wire systems, d-q domain control of three phase shunt active filters uninterruptible power supplies constant voltage - transformers - series active power filtering techniques for harmonic cancellation and isolation, Dynamic Voltage Restorers for sag, swell and flicker problems. Grounding and wiring introduction - NEC grounding requirements-reasons for grounding - typical grounding and wiring problems solutions to grounding and wiring problems

TOTAL HOURS: 45

SUGGESTED READING

1. G.T. Heydt, “Electric power quality”, McGraw-Hill Professional, 2007
2. Math H. Bollen, “Understanding Power Quality Problems”, IEEE Press, 2000
3. J. Arrillaga, “Power System Quality Assessment”, John wiley, 2000
4. J. Arrillaga, B.C. Smith, N.R. Watson & A. R.Wood ,”Power systemHarmonic Analysis”, Wiley, 1997.

CO, PO, PSO MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
1	2	2	2	2	-	-	2	2
2	3	3	3	3	-	-	3	3
3	3	3	3	3	-	-	3	3
4	3	3	3	3	-	-	3	3
5	3	3	3	3	-	-	3	3
Avg.	**2.8**	**2.8**	**2.8**	**2.8**	**-**	**-**	**2.8**	**2.8**

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

SEMESTER II

24MEPS204C ARTIFICIAL INTELLIGENCE TECHNIQUES 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Know the fundamentals of intelligent systems and their applications in Power systems.
- Provide knowledge on Neural Networks and Fuzzy Logic Control and understand the use of these for controlling real time systems.
- Study the fundamentals genetic algorithm and it applications.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

• Explain the fundamental concepts and methodologies of intelligent systems.	K2
• Identify and work with different operations on the fuzzy sets.	K3
• Design and implement ANN architectures.	K3
• Make use of Genetic Algorithm to solve Power system problems.	K3
• Apply hybrid control schemes and PSO for real time problems.	K3

UNIT I KNOWLEDGE-BASED INTELLIGENT SYSTEMS 9

Concepts and theory - Knowledge representation techniques - Structure of a rule-based expert system - Forward and backward chaining inference techniques.

UNIT II FUZZY SYSTEMS 9

Concepts of Fuzzy reasoning - Membership Functions and Fuzzy sets - Fuzzy rules - Defuzzification methods - Fuzzy inference - Building a fuzzy expert system.

UNIT III ARTIFICIAL NEURAL NETWORKS 9

Counter propagation network- architecture- functioning & characteristics of counter Propagation network- Hopfield/ Recurrent network configuration - stability constraints - associative memory and characteristics - Hopfield v/s Boltzman machine- Adaptive Resonance Theory.

UNIT IV GENETIC ALGORITHM 9

Genetic Algorithm versus Conventional Optimization Techniques - Genetic representations and selection mechanisms; Genetic operators- different types of crossover and mutation operators - Optimization problems using GA-discrete and continuous - Single objective and multi-objective problems - Procedures in evolutionary programming.

UNIT V HYBRID CONTROL SCHEMES 9

Fuzzification and rule base using ANN–Neuro fuzzy systems-ANFIS – Fuzzy Neuron - Optimization of membership function and rule base using Genetic Algorithm –Introduction to Support Vector Machine - Particle Swarm Optimization.

TOTAL HOURS : 45

SUGGESTED READINGS:

8. Laurene V. Fausett, “Fundamentals of Neural Networks: Architectures, Algorithms and Applications”, Pearson Education.
9. Timothy J. Ross, “Fuzzy Logic with Engineering Applications” Wiley India, 2008.
10. Zimmermann H.J. "Fuzzy set theory and its Applications" Springer international edition, 2011.
11. David E.Goldberg, “Genetic Algorithms in Search, Optimization, and Machine Learning”, Pearson Education, 2009.
12. W.T.Miller, R.S.Sutton and P.J.Webrose, “Neural Networks for Control” MIT Press”, 1996.
13. T. Ross, “Fuzzy Logic with Engineering Applications”, Tata McGraw Hill, New Delhi, 1995.
14. Ethem Alpaydin, “Introduction to Machine Learning (Adaptive Computation and Machine Learning Series)”, MIT Press, 2004.
15. Corinna Cortes and V. Vapnik, " Support - Vector Networks, Machine Learning” 1995.

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	2	1	1	1	-	-	2	2
CO2	3	2	1	1	-	-	2	2
CO3	3	2	1	1	-	-	2	2
CO4	3	2	1	1	-	-	2	2
CO5	3	2	1	1	-	-	2	2
Average	**2.8**	**1.8**	**1**	**1**	**-**	**-**	**2**	**2**

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

SEMESTER II

24MEPS211A POWER SYSTEM PROTECTION LAB 3H-2C

Instruction Hours/week: L:0 T:0 P:3 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Provide knowledge on power system protection through feeders.
- Understand the transformer protection.
- Know the working of reverse power and induction relay.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

• Analyze the performance of protection relays with feeders	K4
• Infer the impact of induction motor on power system	K3
• Design of relay and understand principle of different relays	K3
• Explain the radial, parallel feeder and reverse power protection system	K2
• Illustrate the differential protection scheme of transformer.	K3

LIST OF EXPERIMENTS:

1. Study of Power System Protection devices
2. Impact of Induction Motor Starting on Power System
3. Modelling of Differential Relay
4. Radial Feeder Protection
5. Parallel Feeder Protection
6. Principle of Reverse Power Protection
7. Differential Protection of Transformer
8. Study of time Vs. voltage characteristics of over voltage induction relay

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	2	1	1	3	3	2	3
CO2	3	2	1	1	3	3	2	3
CO3	3	2	1	1	3	3	2	3
CO4	3	2	1	1	3	3	2	3
CO5	2	2	1	1	2	2	2	2
Average	**2.8**	**2**	**1**	**1**	**2.8**	**2.8**	**2**	**2.8**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER II

24MEPS211B **POWER QUALITY LAB** **3H-3C**

Instruction Hours/week: L:0 T:0 P:3 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Identify and understand common power quality problems such as voltage sags, swells, harmonics, transients and their causes.
- Develop skills in using power quality analyzers and other instruments to measure and monitor power quality in electrical systems.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

• Identify the effect of Nonlinear Loads on Power Quality	K3
• Demonstrate the Voltage & Current Distortions with LED loads	K2
• Make use of filters to reduce current harmonics	K3
• Analysis of harmonics using Power Quality Analyzer	K3
• Illustrate the Voltage Sag and Swell Problem in Distribution System.	K2

LIST OF EXPERIMENTS:

1. The Effect of Nonlinear Loads on Power Quality
2. Study of the Voltage Sag and Voltage Swell with Passive Load
3. Demonstration of the Voltage & Current Distortions with LED load
4. Reduction the Current Harmonics with Filters
5. Study the Current Harmonics in BLDC Motor
6. Study the Effect of Voltage Flicker
7. Analysis of harmonics for various residential loads using Power Quality Analyzer
8. Reducing the Voltage Sag and Swell Problem in Distribution System Using DVR with PI Controller

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	2	1	1	1	1	2	1
CO2	2	2	1	1	1	1	2	1
CO3	3	2	1	1	1	1	2	1
CO4	3	2	1	1	1	1	2	1
CO5	2	2	1	1	1	1	2	1
Average	**2.6**	**2**	**1**	**1**	**1**	**1**	**2**	**1**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER II

24MEPS211C ARTIFICIAL INTELLIGENCE LAB 3H-2C

Instruction Hours/week: L:0 T:0 P:3 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Emphasis the need of soft computing techniques.
- Get exposure to modern techniques for solving Power System Problems.
- Suggest suitable technique as applicable to power system problem.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Solve the power system problems using computational intelligent techniques. K3
- Identify and work with different operations on the fuzzy sets. K3
- Design and implement ANN architectures. K3
- Analyze the solution obtained through soft computing techniques. K4
- Make use of Genetic Algorithm to solve Power system problems. K3

LIST OF EXPERIMENTS

1. Write a program to solve a XOR function using feed-forward neural network trained using back-propagation algorithm.
2. Write a program to simulate a perceptron network for pattern classification and function approximation.
3. Write a program to implement adaptive noise cancellation using ADALINE neural network.
4. Given the region to be de-fuzzified, write programs to discuss the various methods that might be chosen.
5. Implementation of simple Over Current Relay using fuzzy logic.
6. Simulation and comparison of fuzzy PID controller with conventional PID controller for a given plant.
7. Solve optimal relay coordination as a linear programming problem using Genetic Algorithm.
8. Solve economic load dispatch problem using Genetic algorithm.

TOTAL HOURS : 30

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	2	1	1	-	-	2	2
CO2	3	2	1	1	-	-	2	2
CO3	3	2	1	1	-	-	2	2
CO4	3	3	2	1	-	-	2	2
CO5	3	2	1	1	-	-	2	2
Average	**3**	**2.2**	**1.2**	**1**	**-**	**-**	**2**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER II

24MEPS251A	CONSTITUTION OF INDIA	3H-2C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:100** External**:0** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Understand the historical background and key features of the Indian Constitution.
- Analyze the structure and functioning of various government bodies and constitutional institutions.
- Assess recent developments and amendments to the Constitution

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Understand and abide the rules of the Indian constitution K2
- Identify the roles and responsibilities of the President, Vice President, Prime Minister and the Cabinet. K2
- Interpret the key positions and their roles within the State Government, such as the Governor and Chief Minister. K3
- Make use of Genetic Algorithm to solve Power system problems. K3
- Illustrate the roles and responsibilities of local bodies' administration, including the role of the Mayor, CEO, and elected representatives in Municipal Corporations K3

UNIT I HISTORY OF THE INDIAN CONSTITUTION **6**

Meaning and importance of Constitution, Role of Dr.BR Ambedkar in making of the Indian Constitution, Philosophical foundations of the Indian Constitution – Preamble, Salient Features of Indian Constitution

UNIT II FUNCTION OF CENTRAL GOVERNMENT **6**

Union Government – Structures of the Union Government and Functions – President – Vice President– Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review.

UNIT III STRUCTURE AND FUNCTION OF STATE GOVERNMENT **6**

State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts.

UNIT IV CONSTITUTION FUNCTIONS **6**

Indian Federal System–Center–State Relations–Presidents Rule–Constitutional Amendments–Constitutional Functionaries - Assessment of working of the Parliamentary System in India

UNIT V LOCAL BODIES ADMINISTRATION **6**

District's Administration head: Role and Importance, Introduction, Mayor and role Of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, Position and role. Block level Organizational Hierarchy (Different departments).

TOTAL HOURS : 30

SUGGESTED READINGS:

1. Durga Das Basu, Introduction to the Constitution of India, Prentice Hall of India, New Delhi 2008
2. R.C.Agarwal, (1997).Indian Political System ,S.Chand and Company, New Delhi,
3. Maciver and Page, Society: An Introduction Analysis, Mac Milan India Ltd, New Delhi
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-
CO2	3	2	1	1	-	-	-	-
CO3	3	2	1	1	-	-	-	-
CO4	3	2	1	1	-	-	-	-
CO5	3	2	1	1	-	-	-	-
Average	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER II

24MEPS251B	PEDAGOGY STUDIES	3H-2C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:100** External**:0** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Understand the concepts of pedagogy and the improvement of teaching methods
- Understand the pedagogical practices employed by teachers in both formal and informal educational settings

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

• Understand the basics of pedagogy.	K2
• Utilize the effectiveness of various pedagogical practices in developing countries.	K2
• Outline the effectiveness of pedagogical practices.	K2
• Develop and implement strategies that enhance classroom practices	K3
• Summarize the methods for improving teaching methodologies	K2

UNIT I INTRODUCTION AND METHODOLOGY **6**

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

UNIT II THEMATIC OVERVIEW **6**

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

UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES **6**

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

UNIT IV PROFESSIONAL DEVELOPMENT **6**

Alignment with classroom practices and followup support - Peer support - Support from the head teacher and the community – Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS **6**

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

TOTAL HOURS : 30

SUGGESTED READINGS:

1. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
2. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
3. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
4. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
5. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	2	2	1	-	-	-	-	-
CO2	2	2	1	-	-	-	-	-
CO3	2	2	1	-	-	-	-	-
CO4	3	2	1	-	-	-	-	-
CO5	2	2	1	-	-	-	-	-
Average	**2.2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER II

24MEPS251C	**STRESS MANAGEMENT BY YOGA**	**3H-2C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:100** External**:0** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Know ways to achieve overall Good Health of Body and Mind.
- Do Yoga to lower blood pressure and improve heart health.
- To become non-violent and truthfulness.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Develop healthy mind in a healthy body thus improving social health also improve efficiently. K3
- Learn how to use their bodies in a healthy way. K2
- Strengthen muscles and connective tissues enabling good posture. K2
- Manage stress through breathing, awareness, meditation and healthy movement. K3
- Build concentration, confidence and positive self-image. K3

UNIT I INTRODUCTION **6**

Definitions of Eight parts of yog. (Ashtanga)

UNIT II IMPORTANCE OF YOGA **6**

Yam and Niyam. Do's and don'ts in life, Satya, astheya, Bram Acharya and aparigraha Shaucha, Santosh, tapa, swadhyay, Ishwar pranidhan

UNIT III IMPACT OF YOGA ON STRESS MANAGEMENT **6**

Asanand Pranayam, Various yog poses and their benefits for mind & body. Regularization of breathing techniques and its effects-Types of pranayama

UNIT IV EFFECT OF YOGA ON BODY PARTS **6**

Impact of Yoga on Muscular system, Respiratory System, Circulatory system, Nervous system, Digestive system and Endocrine system

UNIT V PERSONALITY DEVELOPMENT **6**

Yoga and development of Social qualities of personality – Co-operation – Simplicity – Tolerance – Social adjustments – Yoga and personal efficiency. Improvement of personal efficiency through yoga

TOTAL HOURS : 30

SUGGESTED READINGS:

1. Yogic asanas for group training -Part 1-Janardan Swami yogabhyasi Mandal Quest, Nagpur
2. Raja yoga or conquer the Internal nature AdvaitaAshrama (Publication Department), Kolkata.

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	2	2	1	-	-	-	-	-
CO2	2	2	1	-	-	-	-	-
CO3	2	2	1	-	-	-	-	-
CO4	3	2	1	-	-	-	-	-
CO5	2	2	1	-	-	-	-	-
Average	**2.2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER III

24MEPS301A POWER SYSTEM TRANSIENTS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSEOBJECTIVES:

The goal of this course is for students to:

- Gain knowledge in sources of transients like lightning, switching and temporary over voltages.
- Model power system components and estimate the over voltages in power system
- Analyze travelling wave phenomena against different over voltages

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Summarize the various sources of transients K2
- Identify the possible over voltages in power systems K3
- Design over voltages in power system using travelling wave theory K3
- Model over voltages using EMTP with multiple sources K3
- Illustrate the insulation level of the power system K2

UNIT I LIGHTNING OVERVOLTAGES 9

Classification of over voltages- Mechanism and parameters of lightning flash, protective shadow, striking distance, electro geometric model for lightning strike, Grounding for protection against lightning – Steady state and dynamic tower-footing resistance, substation grounding Grid, Direct lightning strokes to overhead lines, without and with shield Wires

UNIT II SWITCHING AND TEMPORARY OVERVOLTAGES 9

Switching transients – concept – phenomenon – system performance under switching surges- Ferranti Effect, Temporary over voltages – load rejection – line faults – ferro resonance, VFTO

UNIT III TRAVELLING WAVES ON TRANSMISSION LINE 9

Circuits and distributed constants, wave equation, reflection and refraction – behavior of travelling waves at the line terminations – Lattice Diagrams – attenuation and distortion – multiconductor system and multi velocity waves

UNIT IV INSULATION CO-ORDINATION 9

insulation co-ordination –volt –time characteristics, Insulation strength and their selection Evaluation of insulation strength standard BILs-Characteristics of protective devices, applications, location of arresters – insulation co-ordination in AIS and GIS

UNIT V COMPUTATION OF POWER SYSTEM TRANSIENTS 9

Computation of transients using electromagnetic transient program-Modelling of power system components-Simple case studies - Application of simplified method: single line station, two line station, gas insulated substations, comparison with IEEE and IEC guides

TOTAL HOURS: 45

SUGGESTED READINGS:

1. Pritindra Chowdhari, “Electromagnetic transients in Power System”, John Wiley and Sons Inc., Second Edition, 2009.
2. Allan Greenwood, “Electrical Transients in Power System”, Wiley & Sons Inc. New York, 2012.
3. Andrew R. Hileman, “Insulation Coordination for Power Systems”, CRC press, Taylor & Francis Group, New York, 1999.

4. Klaus Ragaller, “Surges in High Voltage Networks”, Plenum Press, New York, 1980.
5. Rakosh Das Begamudre, “Extra High Voltage AC Transmission Engineering”, (Second edition) Newage International (P) Ltd., New Delhi, 2006.
6. Naidu M S and Kamaraju V, “High Voltage Engineering”, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.
7. IEEE Guide for safety in AC substation grounding IEEE Standard 80-2000.
8. Working Group 33/13-09 (1988), ‘Very fast transient phenomena associated with Gas Insulated System’, CIGRE, 33-13, pp. 1-20.
9. R. Ramanujam, “Computational Electromagnetic Transients: Modeling, Solution Methods and Simulation”, I.K. International Publishing House Pvt. Ltd, New Delhi -110 016, 2014

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	2	1	1	1	1	2	2
CO2	3	2	1	1	1	1	2	2
CO3	3	2	1	1	1	1	2	2
CO4	3	2	1	1	1	1	2	2
CO5	3	2	1	1	1	1	2	2
Average	**3**	**2**	**1**	**1**	**1**	**1**	**2**	**2**

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

SEMESTER III

24MEPS301B FACTS AND CUSTOM POWER DEVICES 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSEOBJECTIVES:

The goal of this course is for students to:

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

COURSE OUTCOMES:

- Analyze the performance of compensated transmission line using a FACTS device K4
- Understand the operation of Static Synchronous Compensator (STATCOM) and SVC K2
- Compare the control schemes of the GCSC, TSSC and TCSC K2
- Analyze the Real and reactive power control of UPFC K4
- Understand the operation of Interline power flow controller K2

UNIT I **9**

Reactive power flow control in Power Systems - Control of dynamic power unbalances in Power System - Power flow control - Constraints of maximum transmission line loading - Benefits of FACTS Transmission line compensation - Uncompensated line -Shunt compensation, Series compensation Phase angle control - Reactive power

Compensation Shunt and Series compensation principles - Reactive compensation at transmission and distribution level

UNIT II **9**

Static versus passive VAR compensator, Static shunt compensators: SVC and STATCOM Operation and control of TSC, TCR and STATCOM -Compensator control Comparison between SVC and STATCOM

UNIT III **9**

Static series compensation: TSSC, SSSC -Static voltage and phase angle regulators - TCVR and TCPAR Operation and Control - Applications, Static series compensation - GCSC,TSSC,TCSC and Static synchronous series compensators and their Control

UNIT IV **9**

SSR and its damping Unified Power Flow Controller - Circuit Arrangement, Operation - and control of UPFC - Basic Principle of P and Q control - Independent real and reactive power flow control- Applications

UNIT V **9**

Introduction to interline power flow controller. Modeling and analysis of FACTS Controllers – Simulation of FACTS controllers Power quality problems in distribution systems, harmonics. Loads that create harmonics, modeling, harmonic propagation, series and parallel resonances, mitigation of harmonics, passive filters, active filtering– shunt, series and hybrid and their control.

TOTAL HOURS :45

SUGGESTED READING

1. K R Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age InternationalPublishers,2007
2. X P Zhang, C Rehtanz, B Pal, "Flexible AC Transmission Systems- Modelling andControl", SpringerVerlag, Berlin,2006
3. N.G. Hingorani, L. Gyugyi, "Understanding FACTS: Concepts and Technologyof Flexible ACTransmission Systems", IEEE Press Book, Standard Publishers and Distributors,Delhi, 2001.
4. K.S.Sureshkumar,S.Ashok , "FACTS Controllers & Applications", E-book edition, Nalanda DigitalLibrary, NITCalicut,2003
5. G T Heydt, "Power Quality", McGraw-Hill Professional,2007
6. T J E Miller, "Static Reactive Power Compensation", John Wiley and Sons, Newyork,1982.

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	2	1	-	-	-	2	1
CO2	3	2	-	-	-	-	2	1
CO3	3	2	-	-	-	-	2	1
CO4	3	2	1	-	-	-	2	1
CO5	3	2	-	-	-	-	2	1
Average	**3**	**2**	**1**	**-**	**-**	**-**	**2**	**1**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER III

24MEPS301C INDUSTRIAL LOAD MODELING AND CONTROL 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Understand the modeling of load and its ease to study load demand industrially
- Know electricity pricing models
- Study Reactive power management and saving in Industries

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Apply load management to reduce demand of electricity during peak time K3
- Analyze the load control techniques in industries and its application K4
- Illustrate different types of industrial processes and reactive power management K2
- Compare different energy saving opportunities in industries K2
- Explain the selection of schemes optimal operating strategies K2

UNIT I LOAD MANAGEMENT IN INDUSTRIES 9

Electric Energy Scenario-Demand Side Management-Industrial Load Management - Load Curves-Load Shaping Objectives - Methodologies-Barriers - Classification of Industrial – Loads - Continuous and Batch processes -Load Modeling

UNIT II INDUSTRIAL LOAD CONTROL TECHNIQUES 9

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

UNIT III REACTIVE POWER MANAGEMENT TECHNIQUES 9

Reactive power management in industries - controls-power quality impacts - application offilters Energy saving in industries

UNIT IV ENERGY MANAGEMNET TECHNIQUES 9

Cooling and heating loads - Captive power units - Operating and control strategies - PowerPooling-Operation models - Energy banking - Industrial Cogeneration

UNIT V ENERGY SAVING TECHNIQUES 9

Selection of Schemes Optimal Operating Strategies - Peak load saving - Constraints Problem formulation- Case study - Integrated Load management for Industries

SUGGESTED READINGS:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	2	1	2	2	-	-	2	2
CO2	3	2	2	2	-	-	2	2
CO3	2	2	2	2	-	-	2	2
CO4	3	2	2	2	-	-	2	2
CO5	3	2	2	2	-	-	2	2
Average	**2.6**	**1.8**	**2**	**2**	**-**	**-**	**2**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER III

24MEPS302A	INDUSTRIAL SAFETY	3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSEOBJECTIVES:

The goal of this course is for students to:

- To be familiar with industrial safety equipment and techniques.
- To acquire practical knowledge of maintenance techniques available in industry.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Understand the fundamental principles of industrial safety and their application. K2
- Analyze and evaluate workplace hazards and risks K4
- Implement and manage safety programs and policies K3
- Apply safety management techniques to enhance the safety culture within organizations. K3
- Utilize tools and technologies for monitoring and improving industrial safety. K2

UNIT –I INDUSTRIAL SAFETY **9**

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

UNIT –II FUNDAMENTALS OF MAINTENANCE ENGINEERING **9**

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

UNIT –III WEAR AND CORROSION **9**

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

UNIT –IV FAULT TRACING **9**

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

UNIT –V PERIODIC AND PREVENTIVE MAINTENANCE 9

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

TOTAL HOURS: 45

SUGGESTED READINGS:

1. Higgins & Morrow “Maintenance Engineering Handbook”, Da Information Services, 2008
2. H.P.Garg “Maintenance Engineering”, S. Chand and Company, 2010.
3. Audels “Pump-hydraulic Compressors”, Mcgrew Hill Publication, 1943.
4. Winterkorn, Hans “Foundation Engineering Handbook”, Chapman & Hall London, 1975.

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	2	1	1	-	-	2	2
CO2	3	2	1	1	-	-	2	2
CO3	3	2	1	1	-	-	2	2
CO4	3	2	1	1	-	-	2	2
CO5	3	2	1	1	-	-	2	2
Average	**3**	**2**	**1**	**1**	**-**	**-**	**2**	**2**

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

SEMESTER III

24MEPS302B COST MANAGEMENT OF ENGINEERING PROJECTS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Acquire and fine-tune the skills and techniques for 4 phases in the life cycle of a typical project: initiating, planning, executing, and closing.
- Familiarize yourself with commonly available computer software tools
- Understand and apply methods for solving and avoiding common difficulties associated with project management.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Determine and document project goals and performance requirements by working closely with project stakeholders. K2
- Define and document product or service deliverables. K2
- Select appropriate project management practices, tools, and methodologies. K3
- Define, analyze, refine, and document project requirements, assumptions, and constraints. K4
- Apply project selection methods to evaluate the feasibility and assessment of projects. K3

UNIT I **9**

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

UNIT II **9**

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

UNIT III **9**

Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis.

UNIT IV **9**

Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-

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

UNIT V **9**

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

TOTAL HOURS: 45

SUGGESTED READINGS:

- Cost Accounting a Managerial Emphasis, Prentice Hall of India, New Delhi
- Charles T. Horngren and George Foster, Advanced Management Accounting
- Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
- Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
- N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	2	1	-	-	1	-	2	1
CO2	2	1	-	-	1	-	2	1
CO3	3	2	1	-	1	-	2	1
CO4	3	3	2	1	1	-	2	1
CO5	3	2	1	-	1	-	2	1
Average	**2.6**	**1.8**	**1.3**	**1.0**	**1.0**	**-**	**2.0**	**1.0**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER III

24MEPS302C	WASTE TO ENERGY	3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Understand the concept of Waste Management, Minimization and Utilization.
- learn about the best available technologies for waste to energy.
- link legal, technical & management principles for production of energy from waste.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

•	Explain the various aspects of energy from waste.	K2
•	Apply the knowledge about the operation of waste treatment and disposal.	K3
•	Compare the different techniques of waste to energy generation.	K3
•	Analyze the various aspects of waste to energy plant.	K4
•	Apply the knowledge in planning & operation of waste to energy plants.	K3

UNIT I INTRODUCTION TO ENERGY FROM WASTE **9**

Introduction to energy from waste: characterization and classification of waste as fuel; agro-based, forest residues, industrial waste, Solid Waste Sources: Types compositions and Properties, Municipal Solid Waste: Physical, chemical and biological properties, Waste Collection and transfer stations, Waste minimization and recycling of municipal waste, Segregation of waste, Size Reduction, Managing Waste, Status of technologies for generation of Energy from Waste.

UNIT 2 WASTE TREATMENT AND DISPOSAL **9**

Aerobic composting, Furnace types and designs, Medical waste /Pharmaceutical waste treatment Technologies, concept of Bioremediation, Incineration, Environmental impacts, Measures to mitigate environmental effects due to incineration. Land fill classifications, Types, methods and Siting consideration, Layout and preliminary design of landfills: Composition, characteristics, generation, movement and control of landfill leachate and gases.

UNIT 3 WASTE TO ENERGY CONVERSATION **9**

Biochemical and Thermochemical routes; Biochemical Options – Anaerobic Digestion, Fermentation; Thermochemical Options – Pyrolysis, Gasification and Incineration; Other options – Biodiesel synthesis, Briquetting and Torrefaction, Hazardous waste management.

UNIT 4 ENERGY GENERATION FROM BIOCHEMICAL CONVERSION **9**

Biochemical Conversion: Sources of energy generation, Anaerobic digestion of sewage and municipal wastes, Direct combustion of MSW-refuse derived solid fuel, Industrial waste, Agro residues, Anaerobic Digestion: Biogas production, Land fill gas generation and utilization.

UNIT 5 ENERGY GENERATION FROM THERMOCHEMICAL CONVERSION 9

Thermochemical conversion: Sources of energy generation, Gasification of waste using gasifiers, Briquetting, Utilization and advantages of briquetting, Case studies of Commercial Waste to Energy Plants, Present status (National and International) of Technologies for Conversion of Waste into Energy, Design of Waste to Energy Plants for Cities, small townships and villages. Environmental impact and benefits of Biochemical and Thermochemical conversions.

TOTAL HOURS: 45

SUGGESTED READINGS:

1. Energy from Waste - An Evaluation of Conversion Technologies by C Parker and T Roberts (Ed),
2. Parker, C., & Roberts, T. (1985). Energy from waste: an evaluation of conversion technologies. Elsevier Applied Science, London.
3. Shah, K. L. (2000). Basics of solid and hazardous waste management technology, Prentice Hall.
4. Christensen, T. H., Cossu, R., & Stegmann, R. (Eds.). (2005). Landfilling of waste: leachate. CRC Press.
5. White, P., Dranke, M., & Hindle, P. (2012). Integrated solid waste management: a lifecycle inventory. Springer Science & Business Media.
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7. Kalogirou, E. N. (2017). Waste-to-Energy technologies and global applications. CRC Press

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	2	1	1	1	-	-	2	2
CO2	3	2	1	1	-	-	2	2
CO3	3	2	1	1	-	-	2	2
CO4	3	2	1	1	-	-	2	2
CO5	3	2	1	1	-	-	2	2
Average	**2.8**	**1.8**	**1**	**1**	**-**	**-**	**2**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER III

24MEPS391	PHASE – I DISSERTATION	9H-10C
Instruction Hours/week: L:0 T:0 P:9	**Marks:** Internal:**40** External:**60** Total:**100**	

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Developing analytical skills of the students to address any specific power system related problems.
- Select suitable experimental method to solve the power system engineering problems.
- Execution of the project using suitable techniques

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

• Identify the problem by analyzing the gap through literature survey	K3
• Conduct the experimental work to solve power engineering problems.	K3
• Validate the experimental results using simulation models.	K4
• Write a technical report related to selected topic	K3
• Present outcome of the study with the help of ppt.	K3

The student individually works on a specific topic approved by faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	2	1	2	2	2	2	2
CO2	3	2	1	2	2	3	2	2
CO3	3	2	1	2	2	3	2	3
CO4	3	3	1	2	2	2	2	2
CO5	3	2	1	2	2	2	2	2
Average	**2.8**	**2.2**	**1**	**2**	**2**	**2.4**	**2**	**2.2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER IV

24MEPS491	PHASE – II DISSERTATION	18H-12C
Instruction Hours/week: L:0 T:0 P:18	**Marks:** Internal:**120** External:**180** Total:**300**	

PREREQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Developing analytical skills of the students to address any specific power system related problems.
- Select suitable experimental method to solve the power system engineering problems.
- Execution of the project using suitable techniques

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

• Identify the problem by analyzing the gap through literature survey	K3
• Conduct the experimental work to solve power engineering problems.	K3
• Validate the experimental results using simulation models.	K4
• Write a technical report related to selected topic	K3
• Present outcome of the study with the help of ppt.	K3

The student should continue the phase I work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated through based on the report and the viva-voce examination by a panel of examiners including one external examiner.

CO, PO, PSO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	2	2	2	2	2	2	2
CO2	3	2	2	2	2	3	2	2
CO3	3	2	2	2	2	3	2	3
CO4	3	3	2	2	2	2	2	2
CO5	3	2	2	2	2	2	2	2
Average	**2.8**	**2.2**	**2**	**2**	**2**	**2.4**	**2**	**2.2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation