Ordinances

For

M. Tech. (Electrical Engineering)

(Under Choice Based Credit System)
Syllabus and Scheme 2019-20

DESH BHAGAT UNIVERSITY, MANDI GOBINDGARH

Faculty of Engineering and Applied Sciences

Department of Electrical Engineering

Ordinances of M. Tech (EE)

1. Duration of Course:

The duration of course for regular candidates shall be two (2) academic years consisting of four (4) semesters i.e. two semesters in each year and for part time candidates shall be three (3) academic years consisting of six (6) semesters i.e. two semesters in each year. The duration of each semester will be 18-20 weeks with ninety (90) teaching days.

2. Maximum period for passing M. Tech. (Electrical Engineering)

2.1 The maximum period for passing all the subjects of all the semesters in M. Tech. (Electrical Engineering) course for regular candidates shall be four (4) years and for part time candidate shall be six (6) years, failing which the candidate shall not be allowed to continue his/her studies in the programme.

2.2 The conditions for completion and submission of dissertation shall be as specified in Ordinances 20.

3. Eligibility for admission

A candidate seeking admission to M. Tech. (Electrical Engineering) course

a) must have passed B. Tech. (Electrical Engineering) or any equivalent degree from any recognized University with at least 50% marks in aggregate, on the basis of merit.

OR

b) must have passed A and B Section of Institute of Engineering (India), Calcutta examination or I.E.T.E. Graduate Examination with at least 50% marks after having passed the Diploma Examination and has at least 5 years professional experience with a valid GATE score may be admitted to M. Tech. programme of the University.

c) Five (5) percent relaxation in marks shall be given to Schedule Caste/ Schedule Tribe or any rural and under privileged candidates.

4. Medium of Instructions

The medium of instruction during the course and examinations shall be English.

5. Examination Schedule, examination fee and examination forms:

5.1 The examination of Odd semesters shall ordinarily be held in the month of December and that of Even semesters in the month of May, or on such other dates as may be fixed by the competent authority.

5.2 The candidates will be required to pay examination fees as prescribed by the University from time to time.

5.3 The Examination Form must reach in the office of the Controller of Examinations as per the schedule notified, from time to time.

5.4 The Examination Forms must be countersigned by the Director/Head of the Department along with the following certificate :--

(i) that he/she has been on the rolls of the University Teaching Department during the academic term preceding the end semester examination;
(ii) that he/she has attended not less than 75% lectures delivered to that class in each paper; and
(iii) that he/she has a good moral character.

5.5 The shortage in the attendance of lectures of the candidate may be condoned by the Vice-Chancellor, on the recommendations of Head of the Department, as per rules.

6. Re-admission

In case name of a student is struck off from the rolls due to non-payment of fee or continued absence from classes in any subject for one month and he/she will be re-admitted after payment of re-admission fee as prescribed by the University from time to time. However, the student will be allowed to appear in the end semester examination of that paper (s) only after attending the required lectures/practicals delivered to that paper(s). However, if a student falls short of attendance in all courses offered in a semester he/she shall be required to repeat the semester, along with the next batch of students.

7. Scheme of Examinations

The examination in each semester shall be conducted according to the syllabus prescribed for the semester. The end semester examination for each paper shall be of three hours duration. There will be 50 internal marks and 100 external marks in paper.

8. Minimum pass marks

The minimum number of marks required to pass in each semester shall be 40% marks in each in Theory and Practical/Laboratory/Seminar/Viva-Voce paper and in Internal Assessment, separately.

9. Grading of performances

9.1 Letter grades and grade points allocations:

Based on the performances, each student shall be awarded a final letter grade at the end of the semester for each course. The letter grades and their corresponding grade points are given hereunder:-

Percentage of marks obtained	Letter Grade	Grade Point	Performance
90.00 – 100	O	10	Outstanding
80.00 – 89.99	A+	9	Excellent
70.00 – 79.99	A	8	Very Good
60.00 – 69.99	B+	7	Good
50.00 – 59.99	B	6	Average
40.00 – 49.99	C	5	Pass
Less than 40.00	F	0	Fail
Absent	AB	0	Fail

9.2 Grades from O to C are pass grades.

9.3 A student who fails in any end semester shall be assigned a letter grade 'F' and a corresponding grade point of zero. He/she should reappear for the said evaluation/examination in due course

9.4 A student who remains absent for any end semester examination shall be assigned a letter grade of 'AB' and a corresponding grade point of zero.

Semester Grade Point Average (SGPA) = $(\sum C_i G_i) / (\sum C_i)$

Where C i = No. of credits assigned to ith semester

G i = No. of Grade equivalent point assigned to ith semester.

Cumulative Grade Point Average (CGPA) = $\dfrac{\sum (SGPA_j \times C_j)}{\sum C_j}$

Where $SGPA_j$ = SGPA score of jth semester

C_j = Total no. of credits in the jth Semester

9.5 Percentage can be calculated as CGPA *10

10. Declaration of class and Division

The class shall be awarded on the basis of CGPA as follows:

CGPA: ≥7.5 provided that the candidate must have passed all the Semester Examinations in the first available attempt.	First Division with Distinction
CGPA: 6.0 to 7.49	First Division
CGPA: 5.0 to 5.99	Second Division
CGPA: 4.0 to 4.99	Third Division

11. Internal Assessment of failed candidate

The internal assessment award of a candidate who fails in the external examination shall be carried forward to the next Examination, if passed in Internal Assessment.

12. Grace Marks

12.1 The grace marks of 1% of total marks of the semester shall be given to a candidate to his best advantage so as to enable him to pass in one or more written papers, to make up aggregate to pass the examination/paper or for changing the result from FAIL to COMPARTMENT/PASS. If a fraction works out to be half or more, it shall be counted as one mark and fraction less than half shall be ignored

12.2 If a candidate appears in an examination to clear re-appear/compartment paper, the grace marks of 1% will be given only on the total marks of that particular paper.

13. Re-evaluation

A candidate who is not satisfied with his result may apply to the Examination Branch for re-evaluation in a subject/paper within 15 days of declaration of result along with a fee as prescribed by the university from time to time.

14. Re-checking

A candidate who is not satisfied with his result may apply to the Examination Branch for re-evaluation in a subject/paper within 15 days of declaration of result along with a fee as prescribed by the university from time to time.

15. Special examination

A Special Examination will be conducted for those students who are passing out but having re-appear(s) in the last semester and/or in the lower semesters. The special examination will be conducted within one month of the declaration of final semester result. The student shall have to pay prescribed fee for Special Examination.

16. Re-appear/Supplementary examination

In case of re-appear examination, the University will adopt even/odd semester examination or open semester system. The student will be eligible to appear in the re-appear papers of odd semester along with the odd semester regular examinations of subsequent batches and re-appear of even semester's paper of the even semester regular examinations in the case of even/odd semester examination. The student will be eligible to appear in the re-appear papers of all semesters (even/odd) along with regular examinations of open semester examinations. Controller of Examination will implement any of the above examination system with the approval of the Vice-Chancellor.

17. Mercy Chance

The candidate will be given maximum two changes to appear in the supplementary examinations. After that, mercy chance may be given by the Vice-Chancellor on the recommendations of the Director of the concerned school on payment of a special fee.

18. Syllabus for re-appear candidates

A student who obtains re-appear(s) in a subject will be examined from the same syllabus which he/she studied as a regular student.

19. Promotion Criteria

19.1 A candidate who joins First Semester of M. Tech. (Electrical Engineering) may on completing attendance requirements appear in 1st semester examination. He/she shall be allowed to continue his/her studies in the 2nd Semester even if he/she does not clear any paper of the 1st semester and on completing attendance requirements may appear in the 2nd Semester examination.

19.2 A candidate shall not be eligible to join 3rd Semester of M. Tech (Electrical Engineering) if he/she has yet to clear more than 50% papers of First and Second Semesters taken together. A candidate who has cleared 50% or more papers of M. Tech. (Electrical Engineering) 1st and 2nd Semesters taken together may join 3rd Semester and on completing attendance requirements may take 3rd Semester Examination. He/she shall be allowed to continue his/her studies in the 4th Semester even if he/she does not clear any paper of the 3rd Semester and on completing attendance requirements may appear in 4th Semester examination.

19.3 A candidate shall not be eligible to join 5th Semester of M. Tech. (Electrical Engineering) if he/she has yet to clear more than 50% papers of 3rd and 4th Semesters taken together. A candidate who has cleared

50% or more papers of M. Tech. (Electrical Engineering) 3rd and 4th Semesters taken together may join 5th Semester and on completing attendance requirements may take 5th Semester Examination. He/she shall be allowed to continue his/her studies in the 6th Semester even if he/she does not clear any paper of the 5th Semester and on completing attendance requirements may appear in 6th Semester examination.

20. Division Improvement

A candidate who has passed M. Tech examination from this University may re-appear for improvement of division in one or more subjects in the succeeding semesters with regular candidates in order to increase the percentage for obtaining higher division. However, final year candidates who have passed an examination of the University may re-appear for improvement of performance under special examination as per rules of the university.

21. Dissertation

21.1 A regular candidate**,** shall submit dissertation before appearing in the 4th Semester examination provided that he/she has appeared in all the papers of 3rd Semester and a part time candidate shall submit dissertation before appearing in 6th Semester examination provided that he/she has appeared in all the papers of 5th Semester.

Provided further that the Head of the Department may give extension up to three months for submission of dissertation, keeping in view the reasons for delay, on the request of the candidate made through his/her Supervisor.

Provided further that the Vice-Chancellor may extend the period of submission of dissertation for another three months, on the recommendation of the Head of the Department.

Provided further that Vice-Chancellor may give another extension up to one year, under exceptional circumstances, with a late fee as prescribed by the University from time to time.

21.2 The candidate shall prepare his/her dissertation under the supervision of the teacher concerned in the University Department/School. If, however, the Head of the Department/Director is satisfied that facilities for preparing the dissertation exist elsewhere, the candidate may be allowed to prepare the dissertation there but the period shall count towards the requirement for the Master's Degree Programme and candidate shall spend a minimum of four weeks for completing the dissertation, under the direct supervision of his/her teacher. In such a case, the

candidate will be allowed to have supervisor from the concerned institution.

21.3 The Supervisor of the dissertation may be changed with prior approval of the Vice-Chancellor, on the recommendation of Head of the Department.

21.4 In case the supervisor of the dissertation leaves the University Department and joins some other recognized institution/university or some R & D Organizations within the State of Punjab, he/she may continue to guide the dissertation work of the candidates registered with him/her.

21.5 In case the Supervisor after leaving this University is not willing to guide the dissertation, the Vice-Chancellor, on the recommendation of the concerned Director/HOD, may change the Supervisor.

21.6 The dissertation shall present an orderly and critical exposition of the existing knowledge of the subject or shall embody results of original investigation and shall demonstrate the capability of the candidate to do independent research work. While writing the dissertation the candidate shall lay out clearly the work done by him/her independently and the sources from which he/she has obtained other information contained in his/her dissertation.

21.7 Four typed copies (along with a soft copy in CD) of the Dissertation shall be submitted to the Head of the Department along with a certificate of approval by the Supervisor.

21.8 The Head of the Department, through its Director, will submit the dissertation to the Research Cell along with a list of five External Examiners, after getting their consent, for evaluation of dissertation.

21.9 The Director Research will get approval of two external examiners from the Vice-Chancellor and Examination Branch will dispatch the dissertation to the concerned external examiners, with all the detail in a covering letter like report format, honorarium and time allocated for evaluation etc. A maximum of 20 days will be given to the concerned evaluator for evaluation.

21.10 The external examiner will send the report & dissertation to the Controller of Examinations, which will further be forwarded to the Research Cell. A panel of experts for conduct of final Viva-Voce will be got approved from the Vice-Chancellor by the concerned Research Cell.

21.11 In case the candidate has not passed all the papers of 3rd Semester or 6th Semester, as the case may be for Regular and Part Time candidate,

Viva-Voce may be conducted but the report shall be kept pending by the HOD concerned, in a sealed cover till the candidate has passed all the papers of previous semesters.

21.12 A candidate who fails to secure pass marks in the Dissertation may be allowed by the Vice-Chancellor to submit a revised Dissertation on the same topic, but he/she shall have to secure pass marks in the Dissertation within a period of three years from the date of admission to 3rd semester or 5th semester, as the case may be, for regular and part time candidates.

21.13 The concerned Director/HOD will submit the report of Viva-Voce to the Controller of Examinations with a certificate that the candidate has passed all the papers of previous semesters.

21.14 The result of the dissertation shall be declared only after the candidate has passed in viva-voce, labs/projects, seminar and all the theory papers of all the semesters.

22. Migration to this University

22.1 Migration to this University will be allowed only after completion of the 1st year and is applicable only to those students who are eligible to register for 3rd semester.

22.2 Migration shall be allowed after completion of the second semester but before start of the 3rd semester.

22.3 The candidates shall not be allowed to change his/ her discipline of study in the process of migration.

22.4 Migration to an affiliated College /Institute of the University from other recognized universities will be allowed 15 days prior to of the start of the 3rd semester. The following conditions shall be apply:-

i) The candidate should have passed all the courses of the first year of the University from where he/she wants to migrate.
ii) The courses studied by the candidate in first year must be equivalent to the courses offered in this University. Deficiency, if any, should not be of more than two subjects. The candidate would be required to furnish an undertaking that he/she will attend classes and pass these courses (found deficient). The institute and the University where the student is studying and the Institute, to which migration is sought, have no objection to the migration.
iii) There is a vacant seat available in the discipline in the college in

which migration is sought.

22.5 **Power of Relaxatio**n: Notwithstanding the existing Migration Rules, the Vice-Chancellor, after obtaining an undertaking/affidavit from the candidate, to his satisfaction, to be recorded in writing, shall be authorized to consider the migration for the cases that are not otherwise covered under the above Migration Rules, with the approval of the Chancellor.

23. Migration to any other University

23.1 Migration to any other University will be allowed 15 days prior to of the start of the 3rd semester.

23.2 The candidate seeking migration from this University shall be apply for the approval of his migration to the University within 15 working days after passing the 2nd Semester/First Year Examination.

23.3 The Director/Head of the department concerned of the University will issue "No Objection Certificate" after the candidate has paid all the fees due for the remaining period of the full session as well as the annual dues as per rules. In addition to the above, Migration fee as prescribed by the University shall be charged from such candidates.

23.4 If a candidate, on completion of any course, applies for Migration Certificate, the same shall be issued on receipt of fee prescribed for Migration Certificate and on completion of other formalities etc.

24. Award of Detail Marks Card

Each candidate of First Year M. Tech. (Electrical Engineering) (i.e. Semester-I & Semester-II), Second Year (i.e. Semester-III & Semester-IV) and Third Year M.Tech. (i.e. Semester –V and Semester – VI), on successfully completion of course and passing all the papers of each semester, shall be supplied detail of Marks Cards indicating CGPA score and Division obtained by him/her in the examination.

25. Award of Degree

The degree of M. Tech. (Electrical Engineering) stating the CGPA score and Division, will be awarded to the candidate who has successfully completed the course, passed all the papers of all the semesters and passed in the Dissertation. The degree will be awarded at the University Convocation. However, a degree in absentia can be issued before the convocation, on completion of required formalities and payment of prescribed fee.

DESH BHAGAT UNIVERSITY, MANDI GOBINDGARH

Faculty of Engineering and Applied Sciences

Department of Electrical Engineering

Master of Technology (EE)

Vision of the Department:

To produce dynamic, competent, knowledgeable electrical engineers who shall lead a Nation to a better future by establishing the strong teaching and research environment.

Mission of the Department:

M1: To provide our students an education of the highest quality.

M2: To promote excellence in teaching, research, consultancy activities and positive contribution to the society.

M3: To create and sustain an environment of learning in which students transform theory into practice with due consideration of ethical and economic issues

M4: To prepare our students for life-long learning to meet intellectual, ethical and career challenges.

Program Educational Objectives (PEO's):

PEO1: Encourage to develop start-up companies developing Electrical Engineering equipment's/appliances/machines to contribute to the society

PEO2: Graduates will be able to communicate effectively, adopt lifelong learning, act with Integrity and have inter-personal skills needed to engage in, lead and nurture diverse teams, with commitment to their ethical and social responsibilities.

PEO3: To train students of Electrical Engineering program who can contribute to teaching profession, research & development by pursuing higher studies.

Program Specific Outcomes (PSO's):

PSO1: To apply the knowledge of Mathematics and Science in solving simple Electrical Engineering problems.

PSO2: To specify, design and analyze systems that efficiently generate, transmit, distribute and utilize electrical power

Program Outcomes:

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

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

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

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

P05: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

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

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

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

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

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

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

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

DESH BHAGAT UNIVERSITY, MANDI GOBINDGARH

Faculty of Engineering and Applied Sciences

Department of Electrical Engineering

M. Tech SEMESTER-I

Sr. No.	Course Code	Course Name	Category	Internal		External		Total	Load Allocation			TCH	Credits
				Min	Max	Min	Max		L	T	P		
THEORY													
1.	**DBMEE-101**	Advanced Power System Analysis & Design	CC	16	40	24	60	100	4	0	0	4	4
2.	**DBMEE -102**	Modern Control Theory	CC	16	40	24	60	100	4	0	0	4	4
3.	**DBMEE - 103**	Applied Instrumentation & Measurements	CC	16	40	24	60	100	4	0	0	4	4
Departmental Elective-I (Select any one)													
4.	**DBMEE -104**	Energy Management and Energy Auditing	CC	16	40	24	60	100	3	1	0	4	4
5.	**DBMEE -105**	Microprocessors & Embedded Control											
6.	**DBMEE -106**	Non-Conventional Energy Resources											
7.	**DBMEE -107**	Wind Energy and Small Hydro Energy Station											
Departmental Elective-II (Select any one)			CC	16	40	24	60	100	3	1	0	4	4
8.	**DBMEE - 108**	EHVAC & HVDC Transmission Systems											
9.	**DBMEE - 109**	Digital Signal Processing & its Applications											
10	**DBMEE - 110**	Adaptive Control											
11	**DBMEE - 111**	Discrete Time Control Systems											
PRACTICAL													
12	**DBMEE - 112**	Power System Software Lab	ECC	24	60	16	40	100	0	0	2	2	1
Total				**260**		**340**		**600**	**18**	**2**	**2**	**22**	**21**

Subject Code: DBMEE-101

Title of the course: Advanced Power System Analysis & Design

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

At the end of the course, students should be able to

CO1: Explain different methods of power flow solutions.
CO2: Solve optimal power flow problem.
CO3: Analyze various types of short circuit faults
CO4: Discuss different techniques dealing with sparse matrix for large scale power systems.

CO/PO Mapping
(S-Strong Correlation, M- Medium Correlation, W-Weak Correlation

CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	W	M	W	W	M	M	W	M	M	W	M
CO2	M	M	S	S	S	M	W	M	S	M	M	M
CO3	W	S	S	S	M	W	M	W	M	W	W	S
CO4	S	M	S	M	S	M	M	W	W	W	M	S

Unit	Course Outlines	Lectures
1	**Load Flow** Network modeling – Conditioning of Y Matrix – Load Flow-Newton Rapson method- Decoupled – Fast decoupled Load flow -three-phase load flow.	11
2	**DC Power Flow** Single phase and three phase -AC-DC load flow - DC system model –Sequential Solution Techniques – Extension to Multiple and Multi-terminal DC systems – DC convergence tolerance – Test System and results.	12
3	**Fault Studies**	12

	Analysis of balanced and unbalanced three phase faults – fault calculations – Short circuit faults – open circuit faults. **System Optimization** Strategy for two generator systems – generalized strategies – effect of transmission losses - Sensitivity of the objective function- Formulation of optimal power flow-solution by Gradient Method-Newton's method	
4	**State Estimation** Method of least squares – statistics – errors – estimates – test for bad data – structure and formation of Hessian matrix – power system state estimation	10

Total -45

Recommended Books

1. D.P. Kothari, I.J. Nagrath, "Modern Power System Analysis", 4th Edition,2011
2. M.A. Pai, 'Computer Techniques in Power System Analysis', Tata McGraw Hill, New Delhi, 2014.
3. J.J. Grainger and W.D. Stevenson, 'Power System Analysis', Tata McGraw Hill, New Delhi, 2017.
4. X.-F. Wang et al., "Modern Power Systems Analysis".Springer,2008 (e-book) https://www.pdfdrive.com/modern-power-systems-analysis-power-electronics-and-power-systems-e184195439.html
5. https://nptel.ac.in/course.html
6. https://swayam.gov.in/nc_details

Subject Code: DBMEE-102

Title of the course: Modern Control Theory

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

At the end of the course, students should be able to

CO1: Formulate and solve deterministic optimal control problems in terms of performance indices.
CO2: Analyze dynamics of a linear system by State Space Representation.
CO3: Analyze the Non-Linear Systems with different stability methods
CO4: Modeling by energy approach using Lagrangian and Hamiltonian

CO/PO Mapping

(S-Strong Correlation, M- Medium Correlation, W-Weak Correlation

CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	S	M	S	M	M	W	W	W	W	M	M
CO2	M	S	W	S	M	W	S	W	M	M	W	S
CO3	M	S	M	M	S	S	S	W	W	W	M	S
CO4	M	M	S	S	S	W	M	W	W	W	S	M

Unit	Course Outlines	Lectures
1	**Mathematical Preliminaries :** Fields, Vectors and Vector Spaces – Linear combinations and Bases – Linear Transformations and Matrices – Scalar Product and Norms – Eigen-values, Eigen Vectors and a Canonical form representation of Linear operators – The concept of state – State Equations for Dynamic systems – Time invariance and Linearity – Non-uniqueness of state model – State diagrams for Continuous- Time State models.	12
2	**State Variable Analysis:** Linear Continuous time models for Physical systems– Existence and Uniqueness of Solutions to Continuous-Time State Equations – Solutions of Linear Time Invariant Continuous-Time State Equations – State	12

	transition matrix and its properties. General concept of controllability – General concept of Observability – Controllability tests for Continuous-Time Invariant Systems –Observability tests for Continuous-Time Invariant Systems – Controllability and Observability of State Model in Jordan Canonical form – Controllability and Observability ,Canonical forms of State model.	
3	**Non Linear Systems :** Introduction – Non Linear Systems - Types of Non-Linearties – Saturation – Dead-Zone – Backlash – Jump Phenomenon etc. ,Singular Points – Introduction to Linearization of nonlinear systems, Properties of Non-Linear systems – Describing function, describing function analysis of nonlinear systems – Stability analysis of Non-Linear systems through describing functions, Introduction to phase-plane analysis, Method of Isoclines for constructing trajectories.	10
4	**Stability Analysis :** Stability in the sense of Lyapunov, Lyapunov's stability and Lypanov's instability theorems - Stability Analysis of the Linear continuous time invariant systems by Lyapunov second method – Generation of Lyapunov functions – Variable gradient method – Krasooviski's method. State feedback controller design through Pole Assignment – State observers: Full order and Reduced order. **Optimal Control :** Introduction to optimal control - Formulation of optimal control problems – calculus of variations – fundamental concepts, functional, variation of functional – fundamental theorem of theorem of Calculus of variations – boundary conditions – constrained minimization – formulation using Hamiltonian method – Linear Quadratic regulator.	11

Total = 45

Recommended Books

1. M. Gopal 'Modern Control System Theory', New Age International, 2005.
2. I.J. Nagarath and M. Gopal, 'Control Systems Engineering', New Age International (P) Ltd,2009
3. K. Ogata 'Modern Control Engineering', Prentice Hall, 2010.(e-book) https://www.pdfdrive.com/modern-control-engineering-e18239881.html
4. https://nptel.ac.in/course.html
5. https://swayam.gov.in/nc_details

Subject Code: DBMEE-103

Title of the course: Applied Instrumentation & Measurements

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

At the end of the course, students should be able to

CO1: Acquire the knowledge in choosing the right transducer for measuring any electrical parameter in a measurement system
CO2: Know basic principles of telemetry
CO3: Expose various data acquisition system
CO4: Understand the basic principles of virtual instrumentation and develop programmes in it for any application.

CO/PO Mapping

(S-Strong Correlation, M- Medium Correlation, W-Weak Correlation

CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	S	S	S	W	W	W	W	S	W	W	M
CO2	S	W	S	W	S	W	M	W	W	M	M	M
CO3	S	M	W	M	M	M	W	W	M	W	W	W
CO4	S	S	M	W	W	W	M	W	M	W	M	W

Unit	Course Outlines	Lectures
1	**Transducers:** Classification of Transducers including analog and digital transducers, Selection of Transducers, Static and Dynamic response of transducer System, Measurement of length & thickness, linear Displacement, Angular Displacement, force, weight, torque, Moisture, Level, Flow, pH & Thermal Conductivity, Measurement of Frequency.	11
2	**Telemetry:** Basic Principles, Proximity & remote Action Telemetry systems, Multiplexing; Time Division and frequency division.	11

3	**Display Devices:** Various types of Display Device, Digital Voltmeters, Dual Slope DVMS, Digital encoders, and Analog and Digital encoders, Analog and Digital Data Acquisition System, A/D Converter. Fiber Optic Technology for data transmission, Supervisory Control and Data Acquisition Systems (SCADA), Q- meter, Electrical noise in control signals and its remedial measures.	12
4	**Virtual Instrumentation:** Introduction to Virtual Instrumentation, conventional vs. Virtual instrumentation, advantages and basic representations, Introduction to Lab view. Applications of virtual instrumentation in various fields like Industrial applications, defense, Medical.	11

Total -45

Recommended Books

1. W.D. Cooper & A.D. Helfrick, 'Electronic Instrumentation and Measurement Techniques', PHI 2007
2. B.C. Nakra and K.K. Chaudhary, 'Instrumentation Measurement Analysis', Tata McGraw-Hill,4th edition, 2016
3. Sanjay Gupta & Joseph John, 'Virtual Instrumentation Using Lab VIEW', TMG; Tata McGraw Hills, 2014.
4. Related IEEE/IEE Publications.
5. Prithwiraj Purkait, Budhaditya Biswas, "Electrical and Electronics Measurements and Instrumentation", Tata McGraw-Hill, 2013 (e-book) https://www.pdfdrive.com/electrical-and-electronics-measurements-and-instrumentation-e33434708.html
6. https://nptel.ac.in/course.html
7. https://swayam.gov.in/nc_details

Subject Code: DBMEE-104

Title of the course: Energy Management and Energy Auditing

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

At the end of the course, students should be able to

CO1: Acquire the knowledge of basic principles of energy auditing, types and objectives, instruments used.
CO2: Analyze the data collected during performance evaluation and recommend energy saving measures
CO3: Analyze energy saving opportunities, auditing and apply suitable methods to estimate the economic benefits of conservation, management and auditing of energy

CO/PO Mapping
(S-Strong Correlation, M- Medium Correlation, W-Weak Correlation

CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	W	M	W	W	M	W	W	W	M	S
CO2	M	S	M	S	S	M	M	W	M	W	M	S
CO3	S	S	M	W	M	M	M	W	S	M	M	M

Unit	Course Outlines	Lectures
1	**Energy Scenario :** Energy needs of growing economy, Long term energy scenario, Energy pricing, Energy sector reforms, Energy and environment: Air pollution, Climate change, Energy security, Energy conservation and its importance, Energy strategy for the future, Energy conservation Act- 2001 and its features.	12
2	**Energy Management and Audit :** Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach- understanding energy costs, Bench marking, Energy performance, matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy	16

	substitution, Energy audit instruments. **Data Gathering :** Level of responsibilities, energy sources, control of energy and uses of energy get Facts, figures and impression about energy /fuel and system operations, Past and Present operating data, Special tests, Questionnaire for data gathering.	
3	**Analytical Techniques :** Incremental cost concept, mass and energy balancing techniques, Inventory of Energy inputs and rejections, Heat transfer calculations, Evaluation of Electric load characteristics, process and energy system simulation	8
4	**Energy Audit and Instruments:** The plant energy study report- Importance, contents, effective organization, report writing and presentation, Instruments for Audit and Monitoring Energy and Energy Savings, Types and Accuracy.	9

Total -45

Recommended Books

1. C.B. Smith, 'Energy Management Principles', Pergamon Press, 2nd Edition , 2015
2. Related IEEE/IEE Publications, scholarly articles.
3. W.C. Turner, 'Energy Management Handbook', John Wiley and Sons, A Wiley Interscience, 7th edition, 2012
4. Hirzel,Simon, "A Study on Energy Efficiency in Enterprises: Energy Audits and Energy Management",European Commission, 2016 (e-book) https://www.pdfdrive.com/a-study-on-energy-efficiency-in-enterprises-energy-audits-and-energy-management-e124282152.html
5. https://nptel.ac.in/course.html
6. https://swayam.gov.in/nc_details

Subject Code: DBMEE-105`

Title of the course: Microprocessors & Embedded Control

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

At the end of the course, students should be able to

CO1: Understand the 8086 microprocessor and its interfacing with I/O devices.
CO2: Know the architecture and instruction set of Microcontroller and its applications
CO3: Understand embedded system and assembly language programming with case studies

CO/PO Mapping
(S-Strong Correlation, M- Medium Correlation, W-Weak Correlation

CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	W	W	W	W	M	W	W	M	M	W
CO2	W	W	M	M	W	M	W	W	M	W	W	M
CO3	S	S	S	M	S	W	W	W	W	W	S	M

Unit	Course Outlines	Lectures
1	**Introduction:** Microprocessor 8086, Architecture, PIN Diagram, BIU and EU, memory addressing, Clock generator 8284, buffers and latches, maximum and minimum modes.	10
2	**Addressing Modes :** Addressing modes of 8086, Assembly language Programming, Assemblers and Procedures, Macros, Interrupts. Interfacing of 8086: IC 8155 (Static RAM with ports and timers), 8755 (EPROM with I/O ports), 8251A (USART), 8255 A, 8253/8254,8257 and 8259 controllers.	11
3	**Microcontroller : I**ntroduction to microcontrollers, Architecture, Pin Diagram, I/O ports, Internal RAM and registers, Interrupts, addressing modes, memory organization and external addressing, Instruction set. Interfacing with LCD, ADC,	10

	DAC, Stepper motor, Key Board and sensors.	
4	**Embedded Systems :** Introduction, Classification, Processors, Hardware units, Software embedded into systems, applications and products of embedded systems, Structural Units in processor, Memory Devices,I/O Devices, Buses, Interfacing of Processor memory and I/O devices. Case Study of an embedded system for a smart card	14

Total -45

Recommended Books

1. Mazidi, Mazidi & McKinlay, 'The 8051 Microcontroller and Embedded Systems using Assembly and C', PHI, 2nd edition,2008
2. K. Raj, 'Embedded Systems- Architecture, programming and Design', Tata McGraw Hill Publishing, New Delhi, 2007.
3. Barry B. Brey, 'The Intel Microprocessors 8086/8088, 8086, 80286, 80386, 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4, Architecture, Programming and Interfacing', Prentice Hall of India Private Limited, New Delhi, 8th edition 2009 (e-book)
   https://www.pdfdrive.com/the-intel-microprocessors-80868088-8018680188-80286-80386-80486-pentium-pentium-pro-e76457550.html
4. https://nptel.ac.in/course.html
5. https://swayam.gov.in/nc_details

Subject Code: DBMEE-106

Title of the course: Non-Conventional Energy Resources

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

At the end of the course, students should be able to

CO1: Create awareness among students about Non-Conventional sources of energy technologies
CO2: Students will get knowledge about utilization of renewable energy sources and solar energy.
CO3: They will learn about wind energy conversion and bio-mass energy conversion systems.
CO4: They will become aware about geothermal energy, energy from biomass

CO/PO Mapping (S-Strong Correlation, M- Medium Correlation, W-Weak Correlation												
CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	W	W	M	W	S	S	W	W	W	M	W
CO2	S	M	W	W	W	M	W	W	W	M	W	S
CO3	M	M	S	M	S	S	M	W	S	W	S	S
CO4	S	W	M	W	M	M	M	W	W	W	M	S

Unit	Course Outlines	Lectures
1	**Introduction to Energy Sources :** World Energy Futures, Conventional Energy Sources, Non-Conventional Energy Sources, Prospects of Renewable Energy Sources.	10
2	**Solar Energy :** Introduction to Solar Radiation and its measurement, Introduction to Solar Energy Collectors and Storage. Applications of Solar Energy: Solar, Thermal Electric Conversion Systems, Solar Electric power Generation, Solar Photo-Voltaic, Solar Cell Principle, Semiconductor Junctions, Conversion efficiency and power	11

	output, Basic Photovoltaic System for Power Generation.	
3	**Wind Energy :** Introduction to wind energy Conversion, the nature of the wind, Power in the wind. Wind data and energy estimation, Site Selection Considerations, Basic Components of a Wind Energy Conversion System, Classification of WEC Systems, Schemes for Electric Generation using Synchronous Generator and Induction Generator, Wind energy Storage.	10
4	**Direct Energy Conversion Processes :** Magneto Hydro Dynamic Power Generation: Principles of MHD power generation, Open Cycle Systems, Closed Cycle Systems, Voltage and power output, Materials for MHD generators. Basic principles of thermo-electric power-generation, Seebeck, Peltier, Thomson effects, Thermo-Electric power generator, Analysis, materials. Thermionic emission and work function, Basic thermionic generation. Classification of Fuel Cells, Types, Advantages, Electrodes, Polarization. The basic Nuclear Function and Reactions Plasma Confinement, Thermo Nuclear Function Reactions. **Energy from Biomass :** Biomass conversion technologies, photosynthesis, Bio-gas generation, types of bio-gas plants. Biomass as a Source of Energy: Method for obtaining energy from Bio-mass, Biological Conversion of Solar Energy.	14
		Total -45

Recommended Books

1. G.D. Rai, 'Non-Conventional Sources of Energy', Khanna Publishers,2007
2. N.K. Bansal and M. Kleemann, M. Heliss, 'Renewable Energy Sources and Conversion Technology, Tata McGraw Hill, 1990.
3. Mudryk K. & Werle S. , "Renewable Energy Sources: Engineering, Technology, Innovation, Springer, 2016 (e-book)

   https://www.pdfdrive.com/renewable-energy-sources-engineering-technology-innovation-icores-2017-volume-in-springer-proceedings-in-energy-springer-d158438456.html
4. https://nptel.ac.in/course.html
5. https://swayam.gov.in/nc_details

Subject Code: DBMEE-107`

Title of the course: Wind Energy and Small Hydro Energy Station

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

At the end of the course, students should be able to

CO1: Learn about wind energy conversion
CO2: Know the working of hydro power plant and hybrid system with wind.
CO3: Acquire knowledge about the effects of power factor in setting up the tariff and its improvement.

CO/PO Mapping (S-Strong Correlation, M- Medium Correlation, W-Weak Correlation												
CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	S	M	S	S	M	W	S	W	S	S
CO2	S	M	S	S	S	W	M	W	W	W	W	M
CO3	S	S	M	S	S	S	S	W	S	S	S	S

Unit	Course Outlines	Lectures
1	**Wind Energy** Introduction, general theory of wind machines, basic laws and concepts of aerodynamics, Micro- siting, Description and performance of the horizontal–axis wind machines. Introduction to blade design, Description and performance of the vertical–axis wind machines, generation of electricity by wind machines and case studies.	10
2	**Hydro Power Plant** Overview of micro mini and small hydro, site selection and civil works. Penstocks and turbines, speed and voltage regulation, investment issues	11
3	**Tariffs** Study of load management and tariff scheme, distribution and marketing issues related to power generation.	10

4	**Hybrid Power System** Wind and hydro based stand-alone / hybrid power systems, control of hybrid power systems, wind diesel hybrid systems	9

Total -40

Recommended Books

1. O.L. Martin Hansen, 'Aerodynamics of Wind Turbines', Earthscan, 2008.
2. Fernando D. Bianchi, Hernan De Battista and Ricardo J. Mantz, 'Wind Turbine Control Systems- Principles, Modelling and Gain Scheduling Design', Springer, 2007.
3. Mudryk K. & Werle S. , "Renewable Energy Sources: Engineering, Technology, Innovation, Springer, 2016
4. Imene Yahyaoui , "Advances in Renewable Energies and Power Technologies Volume 1: Solar and Wind Energies" Elsevier,2018 (e-book) https://www.pdfdrive.com/advances-in-renewable-energies-and-power-technologies-volume-1-solar-and-wind-energies-e158317006.html
5. https://nptel.ac.in/course.html
6. https://swayam.gov.in/nc_details

Subject Code: DBMEE-108

Title of the course: EHVAC & HVDC Transmission Systems

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

CO1: Understand the factors that decide rating of EHVAC Transmission.
CO2: Understand basics of HVDC system, converters control schemes harmonics filters reactive power control and power flow analysis in HVDC systems
CO3: Analyze the Effect of corona on various parameters such as power loss and travelling waves.

CO/PO Mapping (S-Strong Correlation, M- Medium Correlation, W-Weak Correlation												
CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M	W	M	W	M	W	M	W	M	W
CO2	S	S	M	S	S	S	M	W	M	W	W	M
CO3	W	S	W	W	W	W	W	W	M	W	M	M

Unit	Course Outlines	Lectures
1	**Overview** Comparison of EHV AC and DC transmission, description of DC transmission systems, modern trends in AC and DC transmission. **EHVAC Systems** Limitations of extra-long AC transmission, Voltage profile and oltage gradient of conductor, Electrostatic field of transmission line, Reactive Power planning and control, traveling and standing waves, EHV cable transmission system.	10
2	**Static Var System** Reactive VAR requirements, Static VAR systems, SVC in power systems, design concepts and analysis for system dynamic performance, voltage support, damping and reactive support. **HVDC System** Converter configurations and their characteristics, DC link control, converter control characteristics; Monopolar operation, converter with and	14

	without overlap, smoothing reactors, transients in DC line, converter faults and protection, HVDC Breakers.	
3	**Corona and Interference** Corona and corona loss due to EHV AC and HVDC, Radio and TV interference due to EHV AC and HVDC systems, methods to reduce noise, radio and TV interference. **Harmonic Filters** Generation of harmonics, Design of AC filters, DC filters.	10
4	**Power Flow Analysis in AC/DC Systems** Component models, solution of DC load flow, per unit system for DC quantities, solution techniques of AC-DC power flow equations, Parallel operation of HVDC/AC systems, Multi terminal systems.	6
		Total -40

Recommended Books

1. K.R. Padiyar, 'HVDC Power Transmission Systems', New Age International Publishers, 2011.
2. E.W. Kimbark, 'Direct Current Transmission', Vol.1, Wiley Interscience, 1971
3. S. Kamakshaiah and V. Kamaraju, 'HVDC Transmission', McGraw Hill Education, 2017.
4. https://www.pdfdrive.com/high-voltage-direct-current-transmission-converters-systems-and-dc-grids-e157997309.html
5. https://www.pdfdrive.com/ehv-ac-undergrounding-electrical-power-performance-and-planning-e186074659.html
6. https://nptel.ac.in/course.html
7. https://swayam.gov.in/nc_details

Subject Code: DBMEE-109

Title of the course: Digital Signal Processing & its Applications

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

At the end of the course, students should be able to

CO1: Understand the nature of discrete time signals and DFS computation
CO2: Understand DTFT, DFT and the fast computation of DFT using FFT algorithms and implement in real-time applications.
CO3: Design IIR and FIR Digital filters for the given specifications.
CO4: Design Real time systems using the multirate processing techniques and the DSP processors.

CO/PO Mapping (S-Strong Correlation, M- Medium Correlation, W-Weak Correlation												
CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	W	W	S	W	W	W	W	W	M	W	M
CO2	S	M	M	S	M	W	M	W	M	M	W	S
CO3	M	S	S	M	S	M	W	W	W	W	M	M
CO4	M	M	S	M	S	M	W	W	S	S	S	S

Unit	Course Outlines	Lectures
1	**Introduction** Limitations of analog signal processing, Advantages of digital signal processing and its applications; Some elementary discrete time sequences and systems; Basic elements of digital signal processing such as convolution, correlation and autocorrelation, Concepts of stability, causality, linearity, difference equations. DFT and its properties; Linear Periodic and Circular convolution; Linear Filtering Methods based on DFT; Fast Fourier Transform algorithm using decimation in time and decimation frequency techniques.	13
2	**Z Transform** Introduction, Z-Transform, Region of convergence; Inverse Z Transform methods, properties of Z transform.	8

3	**Design of Digital Filters** Structures of realization of discrete time system, direct form, Cascade form, parallel form and lattice structure of FIR and IIR systems. Linear Phase FIR filters; Design methods for FIR filters; IIR filter design by Impulse Invariance, Bilinear Transformation, Matched Z-Transformation, Analog and Digital Transformation in the Frequency Domain. Finite Precision Effects: Fixed point and Floating point representations, Effects of coefficient unitization, Effect of round off noise in digital filters, Limit cycles.	13
4	**DSP Processors** Architectures of ADSP and TMS series of processor. Digital Signal Processing Principles, Algorithms and Application	6
		Total -40

Recommended Books

1. Andreas Antoniou "Digital Filters: Analysis, Design, and Signal Processing Applications" Tata Mc GrowHill Edition 2018
2. S. Salivahan, A. Vallavaraj, Gnanpiya, 'Digital Signal Processing', Tata McGraw Hill,2011
3. S.K. Mitra, 'Digital Signal Processing - A Computer based Approach', Tata McGraw Hill,2013
4. https://nptel.ac.in/courses/108/106/108106151/
5. https://nptel.ac.in/courses/108/105/108105055/
6. http://dl.icdst.org/pdfs/files/025bf242e23c7ed259ea93f3cdfbb2f2.pdf

Subject Code: DBMEE-110

Title of the course: Adaptive Control

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

The student should be able to get
CO1: Detailed knowledge of on-line parameter estimation and the development and properties of the various methods.
CO2: Detailed knowledge of adaptive and learning control systems and their development and properties.
CO3: Detailed knowledge of methods and tools for stability analysis of adaptive and learning systems.

CO/PO Mapping (S-Strong Correlation, M- Medium Correlation, W-Weak Correlation												
CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	W	S	W	W	W	W	W	M	W	M
CO2	S	M	M	S	M	W	M	W	M	M	W	S
CO3	M	S	S	M	S	M	W	W	W	W	M	M

Unit	Course Outlines	Lectures
1	**Introduction to Adaptive Control** Development of adaptive control problem-The role of Index performance (IP) in adaptive systems- Development of IP measurement process model.	13
2	**System Response Identification** Identification by Cross Correlation - Synthesis techniques for flat spectrum Pseudo random signals Quasi Linearization-Impulse Response Expansion-Identification using matched filter, Adaptive control using steepest Descent. **Perturbation Systems** Single and Multi-dimensional adaptive systems – Stability Analysis of Sinusoidal perturbation adaptive controllers – Formulation of signal synthesis system.	8
3	**Self-Tuning Regulators and Model Reference Adaptive Systems** Introduction - Pole Placement Design-Indirect Self-tuning regulators - Continuous Time Self-	13

	Tuners - Direct self-tuning regulators - Linear quadratic self - Tuning regulators - Adaptive predictive control, The MIT rule – Determination of Adaptation Gain – Design of MRAS using Lyapunov theory – BIBO Stability – Applications to Adaptive control- Model Free Adaptive Control	
4	**Gain Scheduling** Principle-Design of Gain Scheduling Controllers - Nonlinear Transformations of second Order Systems Applications of Gain Scheduling, Case study - ABB Adaptive Controllers, Satt Control ECA40, The First Control Adaptive Controller	6

Total -40

Recommended Books

1. Karl J. Astrom and Bjorn Wittenmark, 'Adaptive Control', 2nd Edn., Pearson Education Inc., New Delhi, 2008.
2. Shankar Sastry and Marc Bodson, 'Adaptive Control – Stability, Convergence and Robustness', Prentice Hall, Englewood Cliffs, New Jersey, 1989. https://www.pdfdrive.com/adaptive-control-stability-convergence-and-robustness-prentice-hall-advanced-reference-series-e156639085.html
3. L. Ljung, 'System Identification: Theory for the User', Prentice Hall, Englewood Cliffs, 1999. https://www.pdfdrive.com/system-identification-theory-for-the-user-e165696693.html
4. V.V. Chalam, 'Adaptive Control Systems – Techniques and Applications', Marcel Dekker Inc., New Jersey, 1987.
5. Kumpathi S. Narendra, Romeo Ortega and Peder Dorator, 'Advances in Adaptive Control', IEEE Press, New Jersey, 1991.
6. https://nptel.ac.in/course.html
7. https://swayam.gov.in/nc_details

Subject Code: DBMEE-111

Title of the course: Discrete Time Control Systems

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

At the end of the course, students should be able to

CO1: Develop the mathematical model of the system.
CO2: Know how to find Z – transform and Modified Z – transform of transfer functions and to solve various systems
CO3: Gain the knowledge on basic concepts of stability and analyze the stability of the system.
CO4: Design digital control systems with digital controllers

CO/PO Mapping (S-Strong Correlation, M- Medium Correlation, W-Weak Correlation												
CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	S	M	M	M	W	W	W	W	W	M
CO2	M	S	W	S	W	W	M	W	M	M	M	S
CO3	S	S	W	M	M	M	W	W	W	W	M	M
CO4	W	W	S	S	S	S	S	W	W	W	M	S

Unit	Course Outlines	Lectures
1	**Introduction** Configuration of the basic Digital Control Systems, types of sampling operations, Sample and Hold operations, Sampling theorem, Basic discrete time signals.	6
2	**Analysis of Digital Control Systems** Z-Transforms, Properties of Z-Transform, Inverse Z-Transforms, Pulse Transfer Function, Difference equations, Z-Transform method for solving the difference equations, Block diagram and signal flow graph analysis, Time response of digital control systems.	10
3	**Stability Methods** Mapping between s-plane and z-plane, stability methods:	11

	Modified Routh Criterion, Jury's method, modified Schur-Cohn criterion. **Models of Digital Control Systems** Digital temperature control System, Digital position control system, stepping motors and their control.	
4	**Control Systems Analysis Using State Variable Methods** State variable representation, conversion of state variable models to transfer function and vice-versa, Eigen values and Eigen vectors, Solution of state equations, Concepts of controllability and Observability. **State Variable analysis of Digital Control Systems** State variable description of digital control systems, conversion of state variable models to pulse transfer function and vice versa, solution of state difference equations, controllability and observability	13

Total -40

Recommended Books

1. M. Gopal, 'Digital Control and State Variable Methods', Tata McGraw-Hill, 2009 https://www.pdfdrive.com/digital-control-and-state-variable-methods-e38195713.html
2. K. Ogata, 'Discrete Time Control Systems', Pearson Education, Singapore, Thomson Press India,2014
3. I.J. Nagrath & Gopal, 'Control System Engineering', John Wiley & Sons,2017
4. https://www.pdfdrive.com/discrete-time-control-system-design-with-applications-e176035665.html
5. https://www.pdfdrive.com/control-systems-engineering-sixth-edition-e17317677.html
6. https://nptel.ac.in/course.html
7. https://swayam.gov.in/nc_details

Subject Code: DBMEE-112

Title of the course: Power System Software Lab

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

At the end of the course,

CO1: Familiarize Optimization programming tools and Software: MATLAB- SIMULINK
CO2: Develop programmes for solving simultaneous linear algebraic equations.
CO3: Analyze the techniques of numerical parameters

CO/PO Mapping

(S-Strong Correlation, M- Medium Correlation, W-Weak Correlation

CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	M	M	S	M	M	W	M	M	M	S
CO2	M	M	S	S	S	M	W	W	M	S	S	M
CO3	W	S	W	M	M	S	S	W	S	W	S	S

EXPERIMENTS

1. ABCD parameters for t network and ABCD parameters for long transmission network
2. Formation of y- bus using singular transformation method with and without mutual coupling
3. Formation of 'y- bus' by inspection method
4. Z-bus building algorithm
5. Determination of power angle curve for non- salient pole synchronous machines
6. Determination of power angle curve salient pole synchronous machines
7. Program for swing curve when the fault is cleared 20 07 Swing curve for sustained fault and critical clearing angle & time
8. Formation of jacobian for the system not exceeding 4 buses (no pv buses) in polar

coordinates

9. Gauss-seidel method
10. Determination of bus currents, bus power & line flows for a specified system voltage (bus) profile
11. Load flow studies for a given power system using software package
12. Fault studies for a given power system using software package
13. Optimal generator scheduling for thermal power plants using software package

DESH BHAGAT UNIVERSITY, MANDI GOBINDGARH

Faculty of Engineering and Applied Sciences

Department of Electrical Engineering

M. Tech SEMESTER-II

Sr. No.	Course Code	Course Name	Category	Internal		External		Total	Load Allocation			TCH	Credits
				Min	Max	Min	Max		L	T	P		
THEORY													
1.	**DBMEE -201**	Power System Operation and Control	CC	16	40	24	60	100	4	0	0	4	4
2.	**DBMEE -202**	Advanced Electrical Machines	CC	16	40	24	60	100	4	0	0	4	4
3.	**DBMEE -203**	Power Electronic Devices & Controllers	CC	16	40	24	60	100	4	0	0	4	4
Departmental Elective-III (Select any one)													
4.	**DBMEE -204**	Power System Modeling & Dynamics	CC	16	40	24	60	100	4	0	0	4	4
5.	**DBMEE -205**	Customized Power Devices											
6.	**DBMEE -206**	Advanced Electrical Machine Design											
7.	**DBMEE -207**	Artificial Intelligent Techniques											
8.	**Open Elective – I**		OEC	16	40	24	60	100	4	0	0	4	4
PRACTICAL													
9.	**DBMEE -208**	Simulation Lab.	EEC	24	60	16	40	100	0	0	4	4	2
Total				**260**		**340**		**600**	**18**	**2**	**2**	**22**	**21**

Open Elective-I

DBMEE-209 Engineering Optimization

DBMEE-210 Load Forecasting and Load Management

DBMEE-211 Neural Networks & Fuzzy Logic

Subject Code: DBMEE-201

Title of the course: Power System Operation and Control

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

At the end of the course, students should be able to

CO1: Understand the power system controls namely load-frequency and AVR control for both single-machine infinite bus system and multi machine systems
CO2: Understand the optimal system operation through optimal generation dispatch, unit commitment, hydro-thermal scheduling and pumped storage plant scheduling
CO3: Implement various classical methods to the system
.

CO/PO Mapping (S-Strong Correlation, M- Medium Correlation, W-Weak Correlation												
CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	W	M	W	W	M	M	W	M	M	W	M
CO2	S	W	M	S	M	M	W	M	S	W	M	M
CO3	M	S	S	S	S	W	M	W	M	W	W	S

Unit	Course Outlines	Lectures
1	**Introduction** Characteristics of power generation units (thermal, nuclear, hydro, pumped hydro), variation in thermal unit characteristics with multiple valves, Economic dispatch with and without line losses, lambda iteration method, gradient method, Economic dispatch without line losses, economic dispatch with line losses, Newton Raphson method, base point and participation factors.	11
2	**Transmission Losses** Coordination equations, incremental losses, penalty factors, B matrix loss formula (without derivation), methods of calculating	12

	penalty factors. **Unit Commitment** Constraints in unit commitment, priority list method, Dynamic programming method and Lagrange relaxation methods.	
3	**Hydro Thermal Co-Ordination** Introduction to long range and short range hydro scheduling, Types of short range scheduling problem, Scheduling energy. The short term hydro- thermal scheduling problems and its solution by Lambda-Gamma iteration method and gradient method **Generation With Limited Energy Supply** Take or pay fuel supply contract, composite generation production cost function, gradient search techniques.	12
4	**Optimal Power Flow Formulation** Gradient and Newton method, linear programming methods. **Automatic Generation Control:** Load frequency control, single area system, multi- area system, tie line control, automatic voltage control.	10

Total -45

Recommended Books

1. D.P. Kothari and J.S. Dillon, 'Power System Optimization', Prentice-Hall of India Pvt. Ltd. New Delhi, 2011.
2. G.L.K. Kirchmayer, 'Economic Operation of Power Systems', John Willey & Sons, N.Y., 2004.
3. A.J. Wood, B.F. Wollenberg, 'Power Generation Operation and Control', 3rd edition, 2013 https://www.pdfdrive.com/power-generation-operation-and-control-3rd-edition-by-allen-j-wood-and-bruce-f-wollenberg-e60361717.html
4. S. Sivanagaraju, "Power System Operation and Control", Pearson,2013 (e book) https://www.pdfdrive.com/power-system-operation-and-control-d187176753.html
5. https://nptel.ac.in/course.html
6. https://swayam.gov.in/nc_details

Subject Code: DBMEE-202

Title of the course: Advanced Electrical Machines

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

At the end of the course, students should be able to

CO1: Give a systematic approach for modelling and analysis of all rotating machines under both transient and steady state conditions.
CO2: Analyze all types of electrical machines.
CO3: Attain complete knowledge about electromagnetic energy conversion and time response analysis of reference frame theories for modelling of machines

CO/PO Mapping

(S-Strong Correlation, M- Medium Correlation, W-Weak Correlation

CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	S	S	M	M	W	W	W	W	M	M
CO2	M	S	M	S	M	W	S	W	M	M	S	S
CO3	M	M	S	M	S	S	S	W	M	W	W	S

it	Course Outlines	Lectures
1	**Polyphase Synchronous Machines** Mathematical: Basic Synchronous machine parameters, Voltage, Flux linkage and inductance relations, Park's transformation – its physical concept, equations of performance. **Balanced Steady State Analysis** Phasor equations and phasor diagrams, Power- angle characteristics, cylindrical rotor and Salient pole machines, Short circuit ratio	12
2	**Transient Analysis & Machine Dynamics** Three phase short-circuits,	12

	Armature and field transients, Transient torque, Sudden reactive loading and Unloading. Transient Analysis-a qualitative approach, Reactance and Time –Constants from equivalent circuits, Measurement of reactance, Transient Power-angle characteristics, The basic electromechanical equation, Linearized analysis, Large Angular/oscillation, Non-linear analysis.	
3	**Transformers & Its Transients** Multi-Circuit Transformers: General theory, Equivalent circuits, Three winding transformer as a multi-circuit transformer, Determination of parameters. In-rush current phenomena, Qualitative approach, Analytical approach, In-rush current in 3-phasetransformers.	11
4	**Excitation Phenomena In Transformer** Study of excitation and its effect on transformer performance, Harmonics in: Single phase transformers, three-phase transformers, Disadvantages of harmonics, Suppression of harmonics. **Unbalanced Operation Of Three-Phase Transformers** Single-phase load on three-phase transformers, Single-Phasing in 3-phase transformers, Effect of using tertiary winding.	10

Total = 45

Recommended Books

1. P.S. Bimbhra, 'Generalized Theory of Electrical Machines', 2010.
2. E.W. Kimbark., 'Power System Stability', Vol. III, 1998.
3. A. Draper, 'Electrical Machines', 2011.
4. Jan A. Melkebeek , Electrical machines and drives-fundamentals and advanced modeling, Springer, 2018 (e book) https://www.pdfdrive.com/electrical-machines-and-drives-fundamentals-and-advanced-modelling-e158453884.html
5. https://www.rsisinternational.org/IJRSI/Issue34/67-71.pdf
7. https://nptel.ac.in/course.html
6. https://swayam.gov.in/nc_details

Subject Code: DBMEE-203

Title of the course: Power Electronic Devices & Controllers

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

At the end of the course, students should be able to

CO1: Knowledge of power semiconductor devices and their Gate and base drive circuits
CO2: Develop skills to utilize the different PWM schemes
CO3: Know about the different types of power converters and their applications

CO/PO Mapping

(S-Strong Correlation, M- Medium Correlation, W-Weak Correlation

CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	S	S	W	W	W	W	S	W	W	M
CO2	M	W	S	W	S	W	M	W	W	M	M	M
CO3	S	S	W	M	M	M	W	W	M	W	W	W

Unit	Course Outlines	Lectures
1	**Review of Semiconductor Devices** Conduction Process in semiconductors, PN Junction, Charge control description, Avalanche breakdown, Power diodes, Thyristors, Gate Turn Off Thyristor (GTO), VI characteristics, Dynamic characteristics, ratings, protection.	11
2	**POWER MOSFET and IGBT** Basic structure, I-V Characteristic, Physics of device operation, switching characteristics, operating limitation and safe operating area. **Emerging Devices And Circuits** Power junction Field effect transistor	12

	(FET), Integrated Gate-Commutated Thyristor (IGCT), Field Control Thyristor, Metal oxide semiconductor (MOS) Control Thyristor etc. Power ICs, New semiconductor materials.	
3	**SNUBBER Circuits** Types of Snubber circuits, needs of Snubber circuit with diode, thyristor and transistors, Turn-off Snubber, over voltage snubber, turn on snubber, Snubber for bridge circuit configurations, GTO Snubber circuit	11
4	**GATE and Basic Drive Circuits** Design Consideration, De-coupled drive circuits, electrically isolated drive circuits, cascade connected drive circuits, Power device protection in drive circuits, circuit layout considerations	11

Total -45

Recommended Books

1. Mohan, Undeland and Robbins, 'Power Electronics: Converters, Applications and Design', John Wiley and Sons, 3rd edition, 2002
2. D. Finney, 'The Power Thyristor and its Applications', McGraw Hill, New York,1980
3. M.H. Rashid, 'Power Electronics - Circuits, Devices and Applications', PHI, India, 2014 https://www.pdfdrive.com/power-electronics-devices-circuits-and-applications-d187559996.html
4. https://www.pdfdrive.com/power-electronics-circuit-analysis-and-design-e158276112.html
5. https://nptel.ac.in/courses/108107128/

Subject Code: DBMEE-204

Title of the course: Power System Modeling & Dynamics

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

At the end of the course, students should be able to

CO1: Solve the reactive power problems in power system
CO2: Analyze and understand the electromagnetic and electromechanical phenomena taking place around the synchronous generator
CO3: Gain knowledge about the dynamic mechanisms behind angle and voltage stability problems in electric power systems, including physical phenomena and modelling issues.

CO/PO Mapping (S-Strong Correlation, M- Medium Correlation, W-Weak Correlation												
CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	W	M	W	W	M	W	W	W	M	S
CO2	M	S	M	S	S	M	S	W	M	W	M	S
CO3	S	S	M	W	M	M	M	W	S	M	M	M

Unit	Course Outlines	Lectures
1	**Static Model Of Power System Components** Generator, single circuit & multi-circuit transmission line, regulating & phase shifting transformer, VAR compensators and Loads for balanced and unbalanced conditions. Formulation of Admittance and Impedance Matrices for balanced and unbalanced conditions, their modifications, Sparcity and Optimal ordering,	12
2	**Transient Stability Analysis** Review of numerical integration methods: Euler and Fourth Order Runge-Kutta methods, Numerical stability and	16

	implicit methods, Interfacing of Synchronous machine (variable voltage) model to the transient stability algorithm (TSA) with partitioned –explicit and implicit approaches – Interfacing SVC with TSA-methods to enhance transient stability.	
3	**Unified Algorithm For Dynamic Analysis Of Power Systems** Need for unified algorithm-numerical integration algorithmic steps-truncation error-variable step size –handling the discontinuities-numerical stability-application of the algorithm for transient. Mid-term and long-term stability simulations.	8
4	**Transmission, Generation And Load Aspects Of Voltage Stability Analysis** Review of transmission aspects –Generation Aspects: Review of synchronous machine theory – Voltage and frequency controllers – Limiting devices affecting voltage stability –Voltage-reactive power characteristics of synchronous generators –Capability curves – Effect of machine limitation on deliverable power –Load Aspects –Voltage dependence of loads –Load restoration dynamics – Induction motors – Load tap changers –Thermostatic load recovery –General aggregate load models.	9
		Total -45

Recommended Books

1. R. Ramnujam, 'Power System Dynamics Analysis and Simulation', PHI, Course Private Limited, New Delhi, 2009.
2. P. Kundur, 'Power System Stability and Control', McGraw-Hill, 2015 (e-book) https://www.pdfdrive.com/power-system-stability-and-control-prabha-kundur-e47200104.html
3. J.D. Grainger, 'Power System Analysis', Tata McGraw Hill Publishing Company, 2008.
4. L.P. Singh, 'Advanced Power System Analysis and Dynamics', 3rd Edn., Wiley Eastern, New Delhi, 2012.
5. https://www.pdfdrive.com/power-system-dynamic-security-analysis-via-decoupled-time-domain-simulation-and-trajectory-e20851058.html (2016)
6. https://nptel.ac.in/courses/108102080/

Subject Code: DBMEE-205`

Title of the course: Customized Power Devices

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

At the end of the course, students should be able to

CO1: Select suitable FACTS device for the enhancement of power transfer capability and to control the power flow in an efficient manner.
CO2: Introduce advancements in Power Electronics Industry led to rapid development of Power Electronics controllers for fast real and reactive power control
CO3: Compensate and analyze the issues of power quality

CO/PO Mapping (S-Strong Correlation, M- Medium Correlation, W-Weak Correlation												
CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	W	W	W	W	M	W	W	M	M	W
CO2	S	W	M	M	S	M	W	W	M	W	W	M
CO3	W	S	S	M	M	W	W	W	W	W	S	M

Unit	Course Outlines	Lectures
1	**Static Power Frequency Changers** Fundamental Ideas: Historical Background, Basic Operational features and Operating Principles. Mathematical Representation (output voltage and Input Current) of Static Frequency Changers. Synthesis of the Output Voltage Waveform, Control of the Output Voltage (PWM, Amplitude Dependent Frequency Modulation, Phase Shift). Unwanted Components of Output Voltage, Analysis of the Input Current. Extra basal Components of the Input Current. Control Circuit Principles: Implementation of Modulating Functions. End Stop Control, Control of UDFFC, NCC and CDFFC. Forced Commutation of Frequency	15

	Changers: Fundamental Principles of Hard and Soft Commutation, Points of Connection of Commutating Circuits. Some Basic Commutating Circuits. Application of Static Frequency Changers: Speed Control of AC Machines, Constant Frequency Power Supplies and Static VAR Generators.	
2	**Compensators and Power Flow Controllers** Static shunt compensators, Static series compensators, Static Voltage and phase angle regulators, Principle of operation of Controllers, Control and characteristics, Model of IPFC for power flow and optimum power flow studies. FACTS Controller interactions –SVC–SVG interaction -co- ordination of multiple controllers using linear control techniques –Quantitative treatment of control coordination.	11
3	**Power Quality Improvement** Harmonic filters: passive, Active and hybrid filters –Custom power devices: Network reconfiguring Devices, Load compensation using DSTATCOM, Voltage regulation using DSTATCOM, protecting sensitive loads using DVR, UPQC –control strategies: P-Q theory, Synchronous detection method –Custom power park –Status of application of custom power devices.	10
4	**Recent Trends** Application of basic active filters, multilevel and multipulse converters and Z-source inverter in various FACTS and FACDS devices for improving the performances of transmission system net work and distribution system network.	9

Total -45

Recommended Books

1. N.G. Hingorani and L. Gyragyi, 'Understanding FACTS (Concepts and Technology of Flexible AC Transmission System)', Standard Publishers & Distributors, 2016 (e-book) https://www.pdfdrive.com/understanding-facts-concepts-and-technology-of-flexible-ac-transmission-systems-e187420780.html
2. R.M. Mathur and R.K. Verma, 'Thyristor based FACTS Controllers for Electrical Transmission Systems', IEEE Press, 2002
3. https://www.researchgate.net/publication/310706528_CUSTOM_POWER_DEVICES_AND_APPLICATIONS_IN_POWER_NETWORKS_STATCOM_and_SVC
4. https://nptel.ac.in/courses/108106025/
5. https://www.pdfdrive.com/flexible-ac-transmission-systems-facts-newton-power-flow-modeling-of-voltage-sourced-converter-e176088074.html

Subject Code: DBMEE-206

Title of the course: Advanced Electrical Machine Design

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

At the end of the course, students should be able to

CO1: Develop the basic elements of generalized theory and derive general equations for voltages and currents applicable to all types of rotating machines, to deal comprehensively with their steady-state, dynamic and transient analysis.
CO2: Obtain the voltage and torque equations for a symmetrical induction machine in terms of machine variables and transform these equations by applying reference-frame theory to analyze the dynamic performance of the machine.
CO3: Apply Park's transformation to transform the time varying synchronous machine equations to a time-invariant set of equations and study the dynamic performance.
CO4: Linearize the nonlinear equations of induction and synchronous machines to study the dynamic behaviour of small displacements about the operating point.

CO/PO Mapping
(S-Strong Correlation, M- Medium Correlation, W-Weak Correlation

CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	W	S	M	W	S	S	W	W	W	M	W
CO2	M	S	W	W	W	M	W	W	W	M	W	S
CO3	M	M	M	S	S	S	M	W	S	W	S	S
CO4	S	S	M	M	M	M	M	W	W	W	M	S

Unit	Course Outlines	Lectures
1	**Introduction** Design of Machines, Factors, limitations, Modern trends, Materials: Conducting, magnetic and insulating materials. Calculations of	10

	MMF for air gap and teeth, real and apparent flux densities, iron losses, field form, leakage flux, specific permanence. Modes of heat dissipation, Temperature gradients, types of enclosures, types of ventilation, conventional and direct cooling, amount of coolants used, Ratings.	
2	**Transformer** Magnetic circuit, core construction and design, winding types, insulation, Loss allocation and estimation, Reactance, Temperature rise. **D C Machine** No. of poles and main dimensions, armature, windings, Magnetic circuit and magnetisation curve, commutator and brushes.	11
3	**Induction Machine-3 Phase** Rating specifications, standard frame sizes, Main dimensions specific loadings, Design of stator windings, Rotor design –slots and windings, calculations of equivalent circuit parameters. **Synchronous Machine** Main dimensions, Magnetization characteristic, Field winding design.	10
4	**Computer Aided Design of Electrical Machines** Analysis and synthesis approaches, design algorithms, Introduction to optimization techniques, Implementing computer program for design of three phase induction motor.	14

Total -45

Recommended Books

1. A.K. Sawhney, 'A Course in Electrical Machine Design', Dhanpat Rai & Co, 2013
2. E.S. Hamdi, 'Design of Small Electrical Machine', John Wiley and Sons, 1994.
3. M. Ramamoorty, 'Computer Aided Design of Electrical Equipment', Eastern Press Private Limited, 2010 (e-book) https://www.pdfdrive.com/computer-aided-design-of-electrical-machines-e54592903.html
4. M.G. Say, 'Design and Performance of Machines', CBS Publications, 1981.
5. https://www.pdfdrive.com/design-modelling-and-control-of-electrical-machines-e41027844.html (2017)
6. https://nptel.ac.in/courses/108106023/

Subject Code: DBMEE-207`

Title of the course: Artificial Intelligent Techniques

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

At the end of the course, students should be able to

CO1: Outline the basic ANN architectures, algorithms and their limitations and will be able to know the different operations on the fuzzy sets.
CO2: Develop the ANN based models and control schemes for non-linear system
CO3: Develop the fuzzy logic rules for modeling and control of non-linear systems
CO4: Analyze the Genetic Algorithms for power system optimization problems

CO/PO Mapping (S-Strong Correlation, M- Medium Correlation, W-Weak Correlation												
CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	W	M	W	S	M	W	S	W	S	S
CO2	M	W	S	S	S	W	M	W	W	W	W	M
CO3	M	W	S	S	S	S	S	W	S	S	S	S
CO4	W	S	M	M	M	M	M	W	M	M	M	S

Unit	Course Outlines	Lectures
1	**Neural Networks** Neural Networks – biological neurons – Artificial neurons – activation function – Course rules – feed forward networks – supervised & Unsupervised Course –perceptron network- linear separability – back propagation networks Algorithms-Radial basis function networks.	10
2	**Associative Models And Control Schemes in NN** Auto & hetero associative	11

	memory – bi-directional associative memory – Self organizing feature Maps-Hopfield Networks-Neural Networks for non – linear system – Schemes of Neuro control – System identification – forward model and – Inverse model – Case studies.	
3	**Fuzzy Logic And Genetic Algorithm** Fuzzy set - Crisp set – vagueness – uncertainty and imprecision – fuzzy set – fuzzy operation- properties – crisp versus fuzzy relations – fuzzy relations – fuzzy Cartesian product and composition – composition of fuzzy Relations- Fuzzy to crisp conversion –structure of fuzzy logic controller – database – rule base – Inference engine. GA: Working principles – terminology – Importance of mutation – comparison with traditional methods – constraints and penalty function – GA operators – Real coded GAs.	10
4	**Applications** Applications of Neural network, Fuzzy system & Genetic algorithms for power systems and power electronics Systems-Designing of controllers using Simulation Software, NN tool box & Fuzzy Logic Toolbox	9

Total -40

Recommended Books

1. Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', McGraw Hill International Edition, USA, 2012 (e-book) https://www.pdfdrive.com/fuzzy-logic-with-engineering-applications-e40345033.html
2. Lawrene Fausett, 'Fundamentals of Neural Networks', Prentice Hall of India, New Delhi, 2004.
3. Simon Haykin, 'Neural Networks – A Comprehensive Foundation', Pearson Education Asia,2008.
4. https://www.pdfdrive.com/fuzzy-logic-models-and-fuzzy-control-an-introduction-e183968373.html (2017)
5. https://nptel.ac.in/courses/127105006/
6. https://nptel.ac.in/courses/108104157/
7. https://www.pdfdrive.com/artificial-intelligence-and-machine-learning-fundamentals-e185802940.html (2018)

Subject Code: DBMEE-208

Title of the course: Simulation Lab

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

At the end of the course,

CO1: Familiarize Optimization programming tools and Software: MATLAB- SIMULINK
CO2: Analyze the techniques of numerical parameters

CO/PO Mapping

(S-Strong Correlation, M- Medium Correlation, W-Weak Correlation

CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	M	M	S	M	M	W	M	M	M	S
CO2	W	S	W	M	M	S	S	W	S	W	S	S

EXPERIMENTS

1. Introduction to MATLAB and its basic commands.
2. MATLAB program to simulate Ferranti effect.
3. MATLAB program to model transmission lines.
4. MATLAB program to solve load flow equations by Gauss-Seidel method.
5. MATLAB program to find optimum loading of generators neglecting transmission losses.
6. MATLAB program to find optimum loading of generators with penalty factors.
7. MATLAB program to solve swing equation using point-by-point method.
8. Simulink model of single area load frequency control with and without pi controller and without pi controller in Simulink.
9. Simulink model for two area load frequency control.

10. Simulink model for evaluating transient stability of single machine connected to infinite bus.
11. Gauss Seidel load flow analysis using MATLAB Software.
12. Newton Raphson method of load flow analysis using MATLAB Software.
13. Fast decoupled load flow analysis using MATLAB Software.
14. Fault analysis using MATLAB Software.
15. Economic dispatch using MATLAB Software.

Subject Code: DBMEE-209`

Title of the course: Engineering Optimization

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

At the end of the course, students should be able to

CO1: Recognize the importance and value of Optimization Techniques in solving practical problems in industry
CO2: Understand Optimization models and apply them to real life problems
CO3: Analyze the Genetic Algorithms for power system optimization problems

CO/PO Mapping (S-Strong Correlation, M- Medium Correlation, W-Weak Correlation												
CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	S	M	S	S	M	W	S	W	S	S
CO2	S	M	S	S	M	W	M	W	W	W	W	M
CO3	S	S	M	S	S	S	S	W	S	S	S	S

Unit	Course Outlines	Lectures
1	**Introduction:** Definition, Classification of optimization problems, Classical Optimization Techniques, Single and Multiple Optimization with and without inequality constraints.	10
2	**Linear Programming (LP) and Non Linear Programming (NLP):** Simplex method of solving LP, revised simplex method, duality, Constrained Optimization, Theorems and procedure, linear programming, mathematical model, solution technique, duality. Steepest descent method, Conjugate gradient method, Newton Method, Sequential	11

	quadratic programming, Penalty function method, augmented Lagrange multiplier method.	
3	**Dynamic Programming (DP):** Multistage decision processes, concept of sub-optimization and principle of optimality, Recursive relations, Integer Linear programming, Branch and bound algorithm.	10
4	**Genetic Algorithm (GA):** Introduction to Genetic Algorithm, working principle, coding of variables, fitness function, GA operators; Similarities and differences between GA and traditional methods; Unconstrained and constrained optimization using genetic Algorithm, real coded GA, Advanced GA, global optimization using GA, Applications to power system.	9

Total -40

Recommended Books

1. D.A. Pierre, 'Optimization Theory with Applications', Wiley Publications,1986
2. Pelin G Canbolat, 'Introduction to Operation Research', 9th Edn, 2014 (e-book) https://www.pdfdrive.com/introduction-to-operations-research-d34458313.html
3. S.S. Rao, ' Engineering Optimization –Theory and Applications', Wiley-Eastern Limited,2009 (e-book) https://www.pdfdrive.com/engineering-optimization-theory-and-practice-fourth-edition-e17279363.html
4. D.P. Kothari & J.S. Dhillon, 'Power System Optimization', PHI Publishers,2004
5. https://nptel.ac.in/content/storage2/courses/105108127/pdf/Module_1/M1L1slides.pdf
6. https://nptel.ac.in/courses/108104112/

Subject Code: DBMEE-210

Title of the course: Load Forecasting and Load Management

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

At the end of the course, students should be able to

CO1: Acquire skills of load related energy management and tariff structure.
CO2: Gain knowledge about annual and monthly peak demands.
CO3: Model the energy scenario and analyze it with the help of case studies.

CO/PO Mapping
(S-Strong Correlation, M- Medium Correlation, W-Weak Correlation

CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	S	M	M	S	M	M	S	W	S	S
CO2	S	M	W	W	W	W	M	W	W	W	W	M
CO3	W	M	S	S	S	S	S	W	S	S	S	S

Unit	Course Outlines	Lectures
1	**Load Forecasting:** Classification and characterization of loads, Approaches to load forecasting, Forecasting methodology, Energy forecasting, Peak demand forecasting, Non-weather sensitive forecast and Weather sensitive forecast, Total forecast, Annual and monthly peak demand forecasts, Applications of state estimation to load forecasting.	10
2	**Load Management:** Introduction to Load management, Electric energy production and delivery system structure (EEPDS), Design alternatives for EEPD systems, Communication/control techniques for load management, Tariff structure and load management, principles of macro and microeconomics and energy pricing strategies, Assessing the impacts of	11

	load management	
3	**Energy Demand Forecasting:** Static and dynamic analysis of energy demand, Elements of energy demand forecasting, Methodologies and models for energy demand forecasting, Techno economic approach in energy demand forecasting, Energy auditing, Energy management, Power Pools and Energy Banking	10
4	**Trends and Case Studies:** Energy management strategy, Symbiotic relation between information, Energy models and decision making, Case studies like industrial energy forecasting, Transportation energy forecasting, Residential, Commercial and agricultural energy forecasting.	9

Total -40

Recommended Books

1. J. Martino, 'Technological Forecasting for Decision Making', Elsevier Press, 1992.
2. S. Makridakis, 'Forecasting Methods and Applications', John Wiley and Sons, 1997.
3. R.G. Brown, 'Smoothing, Forecasting and Prediction of Discrete Time Series', PHI Int., 1963.
4. https://www.pdfdrive.com/research-and-development-management-technology-journey-through-analysis-forecasting-and-decision-e191746360.html
5. http://almozg.narod.ru/bible/lf.pdf
6. https://nptel.ac.in/content/storage2/courses/110101005/downloads/Lecture%2015.pdf

Subject Code: DBMEE-211

Title of the course: Neural Networks & Fuzzy Logic

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

At the end of the course, students should be able to

CO1: Acquire the skills required to innovate and build, smart and intelligent applications in electrical and electronics engineering.
CO2: Understand review of Neural Networks: models of a neuron, various activation functions, Threshold function, piecewise – linear function, stochastic model of a neuron, feedback.
CO3: Take up fuzzy systems approach to solve applications in engineering.

CO/PO Mapping (S-Strong Correlation, M- Medium Correlation, W-Weak Correlation												
CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	S	M	S	S	M	W	S	W	S	S
CO2	S	M	S	S	M	W	M	W	W	W	W	M
CO3	S	S	M	S	S	S	S	W	S	S	S	S

Unit	Course Outlines	Lectures
1	**Review of Neural Networks:** models of a neuron, various activation functions: Threshold function, piecewise – linear function, stochastic model of a neuron, feedback.	8
	Network Architecture: Single layer feed forward network, multiplayer feed forward network, recurrent network, knowledge representation.	11

3	**COURSE Processes:** Memory Based COURSE Hebbian COURSE, Competitive COURSE, Boltzmann COURSE, COURSE with a teacher, COURSE without a teacher, adaptation, single layer perceptions, multi-layer perceptions	10
4	**Introduction to fuzzy logic:** membership function, rule generation, fuzzy concept, fuzzification, defuzzification, time dependent fuzzy logic, temporary fuzzy logic, fuzzy artificial neural network, neuro fuzzy control, fuzzy neural nets, Fuzzy Based ABS system, applications.	11

Total -40

Recommended Books

1. Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', McGraw Hill International Edition, USA, 2012 (e-book) https://www.pdfdrive.com/fuzzy-logic-with-engineering-applications-e40345033.html
2. Lawrene Fausett, 'Fundamentals of Neural Networks', Prentice Hall of India, New Delhi, 2004.
3. Simon Haykin, 'Neural Networks – A Comprehensive Foundation', Pearson Education Asia,2008.
4. https://www.pdfdrive.com/fuzzy-logic-models-and-fuzzy-control-an-introduction-e183968373.html (2017)
5. https://nptel.ac.in/courses/127105006/
6. https://nptel.ac.in/courses/108104157/
7. https://www.pdfdrive.com/artificial-intelligence-and-machine-learning-fundamentals-e185802940.html (2018)

DESH BHAGAT UNIVERSITY, MANDI GOBINDGARH

Faculty of Engineering and Applied Sciences

Department of Electrical Engineering

M. Tech SEMESTER-III

Sr. No.	Course Code	Course Name	Category	Internal		External		Total	Load Allocation			TCH	Credits
				Min	Max	Min	Max		L	T	P		
THEORY													
1.	**DBMEE-301**	Power System Reliability	CC	16	40	24	60	100	4	0	0	4	4
Departmental Elective- (Select any one)			CC	16	40	24	60	100	4	0	0	4	4
2.	**DBMEE-302**	Power System Planning											
3.	**DBMEE-303**	Electric Traction System											
4.	**DBMEE-304**	Distribution System Operation & Analysis											
5.	**DBMEE-305**	Smart Grid Technologies											
PRACTICAL													
6.	**DBMEE-306**	Project	CC	24	60	16	40	100	0	0	12	12	12
7.	**DBMEE-307**	Seminar	CC	40	100	-	-	100	0	0	2	2	2
8.	**DBMEE-308**	Research Lab.	ECC	24	60	16	40	100	0	0	2	2	2
Total				**300**		**200**		**500**	**8**	**0**	**16**	**24**	**24**

Subject Code: DBMEE-301

Title of the course: Power System Reliability

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

At the end of the course, students should be able to

CO1: Understand the concepts of Reliability, Availability and Maintainability.
CO2 Develop hazard-rate models to know the behavior of components.
CO3: Build system reliability models for different configurations.
CO4: Implement strategies for improving reliability of repairable and non-repairable systems

CO/PO Mapping

(S-Strong Correlation, M- Medium Correlation, W-Weak Correlation

CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	W	W	W	M	M	W	M	M	W	M
CO2	M	S	S	S	S	M	W	M	S	M	M	M
CO3	M	W	S	S	M	W	M	W	M	W	W	S
CO4	W	S	S	S	S	M	M	W	W	W	M	S

Unit	Course Outlines	Lectures
1	**Basic Reliability Concepts** The General reliability function, Hazard rate, MTTF, Markov processes. **Static Generating Capacity Reliability Evaluation** Capacity outage probability tables, loss of load probability method, Frequency and duration approach.	11
2	**Spinning Generation Capacity Reliability Evaluation** Spinning reserve, spinning reserve capacity evaluation, Load forecasting methods, Load forecast uncertainty, maximum capacity levels, Derated capacity levels.	12

3	**Transmission System Reliability Evaluation** Average interruption rate method, Frequency and duration method, Stormy and normal weather effects, The Markov process approach.	12
4	**Composite System Reliability Evaluation** Conditional probability approach, two–plant single load system, multi plant multi load system	10

Total -45

Recommended Books

1. M.L. Shooman, 'Probabilistic Reliability: An Engineering Approach', McGraw Hill,2ne edition,1990
2. E. Balaguruswamy, 'Reliability Engineering', McGraw Hill International, 2017
3. L.S. Srinath, 'Reliability Engineering', East-West Press Private Ltd, 4th edition, 2005
4. Ali Chowdhury Don Koval, 'Power Distribution System Reliability: Practical Methods and Applications', Wiley-IEEE Press, 2011 (e book)
https://www.pdfdrive.com/power-distribution-system-reliability-practical-methods- and-applications-ieee-press-series-on-power-engineering-
5. https://nptel.ac.in/course.html
6. https://swayam.gov.in/nc_details

Subject Code: DBMEE-302

Title of the course: Power System Planning

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

At the end of the course, students should be able to

CO1: To analyze the transmission system planning
CO2: List the objectives of load forecasting and to apply various techniques for load forecasting
CO3: To explain the expansion planning and capacitor placement problem in transmission system and radial distributions system.
CO4: To design the primary and secondary distribution system and to explain distribution system protective scheme and its coordination

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CO/PO Mapping

(S-Strong Correlation, M- Medium Correlation, W-Weak Correlation

CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	S	W	M	W	M	W	W	W	W	M	M
CO2	S	M	W	S	M	W	S	W	M	M	W	S
CO3	S	W	M	M	M	M	W	W	W	W	M	M
CO4	M	S	S	S	W	W	M	W	W	W	S	M

Unit	Course Outlines	Lectures
1	**Introduction** Power system planning, objective, stages in planning and design, the electric utility industry, growth characteristics generation, transmission and distribution systems. **Demand/energy forecasting** Electricity consumption pattern, peak demand and energy forecasting by trend and economic projection methods. Review of load forecasting	12

2	**Power System Planning** Investment planning: traditional generation expansion planning models, integrated resource planning models, production cost simulation models. **Generating system capability planning** Probabilistic models of generating units, growth rate, rate of generation capacity, outage performance and system evaluation of loss of load and loss of energy indices, power supply availability assessment, Expansion planning, unit maintenance schedule, unit effective load carrying capability. **Transmission system planning** Automatic transmission system expansion planning, automatic transmission planning using interactive graphics.	15
3	**Distribution system planning and automation** Load characteristics, design of sub transmission lines and distribution, substations, design considerations of' primary and secondary distribution systems, voltage drop and power loss calculations. **Interconnected systems** Multi-area reliability analysis, power pool operation and power exchange energy contracts, quantification of economic and reliability benefits of pool operation	10
4	**Power system Expansion planning** Formulation of least cost optimization problem involving capital, operation and maintenance costs of candidate units of different types.	8

Total = 45

Recommended Books

1. P. Sullivan, 'Power System Planning', McGraw Hill International,2017
2. J.R. McDonald, 'Modern Power System Planning', McGraw Hill International,1994
3. A.S. Pabla, 'Electrical Power System Planning', Macmillan, 2nd edition, 2016.
4. H. Seifi, 'Electric Power System Planning', Springer, 2012 (e-book) https://www.pdfdrive.com/electric-power-system-planning-d39893329.html
5. https://nptel.ac.in/course.html
6. https://swayam.gov.in/nc_details

Subject Code: DBMEE-303

Title of the course: Electric Traction System

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

At the end of the course, students should be able to

CO1: Evaluate tractive effort for the propulsion of train, name the traction motors, list the traction motor control, track equipment and collection gear
CO2: Distinguish different traction systems and latest trends in traction systems
CO3: Control different types of traction motors
CO4: Apply various control methods applied to traction motors

CO/PO Mapping

(S-Strong Correlation, M- Medium Correlation, W-Weak Correlation

CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	S	S	S	W	W	W	W	S	W	W	M
CO2	S	W	S	W	S	W	M	W	W	M	M	M
CO3	M	S	S	M	M	M	W	W	M	W	W	W
CO4	M	S	S	S	M	W	M	W	W	M	S	W

Unit	Course Outlines	Lectures
1	**Traction Systems and Latest Trends** Present scenario of Indian Railways – High speed traction, Metro, Latest trends in traction-Metro, monorail, Magnetic levitation Vehicle, Steam, diesel, diesel-electric, Battery and electric traction systems, General arrangement of D.C., A.C. single phase and 3-phase, Composite systems, Choice of traction system - Electric and Diesel- Electric.	11
2	**Mechanism of Train Movement** Analysis of speed time curves for main line, suburban and urban services,	11

	Simplified speed time curves. Relationship between principal quantities in speed time curves, Requirement of tractive effort, Specific energy consumption and Factors affecting it.	
3	**Traction Motors and their Control** Features of traction motors, Significance of D.C. series motor as traction motor, A. C. Traction motors-single phase, Three phase, Linear Induction Motor, Comparison between different traction motors, Series-parallel control, Open circuit, Shunt and bridge transition, Pulse Width Modulation control of induction motors, Types of electric braking system.	12
4	**Electric Locomotives** Important features of electric locomotives, Different types of locomotives, Current collecting equipment, Coach wiring and lighting devices, Power conversion and transmission systems, Control and auxiliary equipment, Distribution systems pertaining to traction (distributions and feeders), Traction sub-station requirements and selection, Method of feeding the traction sub-station.	11

Total -45

Recommended Books

1. J. Upadhyay S.N. Mahendra, 'Electric Traction', Allied Publishers Ltd., Dhanpat Rai and Sons, Delhi,2000
2. H. Partab, 'Modern Electric Traction', Dhanpat Rai and Sons, New Delhi,2013
3. J.B. Gupta, 'Electric Power Utilization', Kataria and Sons, New Delhi,10th edition ,2012
4. Andreas Steimel, "Electric Traction – Motive Power and Energy Supply", Karl Heinz Pantke,2008 (e-book) https://www.pdfdrive.com/electric-traction-motion-power-and-energy-supply-basics-and-practical-experience-e183991627.html
5. https://nptel.ac.in/course.html
6. https://swayam.gov.in/nc_details

Subject Code: DBMEE-304

Title of the course: Distribution System Operation and Analysis

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

At the end of the course, students should be able to

CO1: Analyze the transmission system planning
CO2: Use equipment in substations and their design considerations
CO3: Describe the concepts of voltage regulation, automation and various control cases
CO4: Explain the concepts linked with protection and coordination of protective devices in distribution systems

CO/PO Mapping

(S-Strong Correlation, M- Medium Correlation, W-Weak Correlation

CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	S	W	M	W	M	W	W	W	W	M	M
CO2	M	W	S	S	S	M	M	W	W	W	M	S
CO3	S	M	W	W	M	M	M	W	W	W	M	M
CO4	S	W	M	M	W	W	M	W	M	W	M	W

Unit	Course Outlines	Lectures
1	**System Planning** Introduction, Distribution system planning, Factors affecting system planning, present planning techniques, planning models, Introduction to optimum line network. future trends in planning, systems approach, distribution automation. Load Characteristic: Basic definitions, relation between load and loss factors, maximum diversified demand, load forecasting, Load management.	12
2	**System Design and Operation** Criteria, system developers, dispersed generation, distribution systems,	11

	economics and finance, mapping, Design of substation and feeder, Operation criteria, voltage measurements, harmonics, load variations, system losses, Introduction to energy management.	
3	**Voltage Regulation and Automation** Quality of Service and Voltage Standards, Voltage Control, Line Drop Compensation, Distribution capacitor automation, Voltage fluctuations, SCADA and Communication with Load Dispatch Centres.	11
4	**Distribution System Protection** Objective of distribution system protection, high impedance faults coordination of protective devices: fuse to fuse co-ordination, re-closer to re-closer coordination, re-closer to fuse coordination, re-closer to substation transformer high side fuse coordination, fuse to circuit breaker coordination, re-closer to circuit breaker coordination, lightning protection.	11

Total -45

Recommended Books

1. Gonen, Turan, 'Electric Power Distribution System Engineering', CRC PRESS, 2012, 3rd Indian Reprint.
2. A.S. Pabla, 'Electric Power Distribution', 6th Edn., TMH, 2011
3. A. J. Panseni, "Electrical Distribution Engineering", CRC Press,2012
4. T. Gonen, " Electric Distribution System engineering", 2nd edition, 2007
   https://www.pdfdrive.com/electric-power-distribution-system-engineering-second-edition-e175376615.html
5. http://www.nptel.ac.in/courses/108106022/8
6. https://swayam.gov.in/nc_details

Subject Code: DBMEE-305`

Title of the course: Smart Grid Technologies

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

At the end of the course, students should be able to

CO1: Understand the challenging issues and architecture of smart grid
CO2: Understand the communication and wide area monitoring in smart grid
CO3: Acquire the knowledge in computational intelligence and security issues in smart grid

CO/PO Mapping

(S-Strong Correlation, M- Medium Correlation, W-Weak Correlation

CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	W	S	M	M	W	W	M	M	W	S
CO2	S	W	M	M	S	M	M	W	M	S	W	S
CO3	M	S	S	M	S	W	W	W	W	W	S	M

Unit	Course Outlines	Lectures
1	**Introduction to Smart Grid** Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient & Self-Healing Grid, Present development & International policies in Smart Grid. Case study of Smart Grid. CDM opportunities in Smart Grid.	10
2	**Part 1:** Introduction to Smart Meters, Real Time Pricing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers. **Part 2:** Smart Substations, Substation Automation, Feeder Automation.	11

	Geographic Information System(GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU).	
3	**Micro grids and Distributed Energy Resources** Concept of micro grid, need & applications of micro grid, formation of micro grid, Issues of interconnection, protection & control of micro grid. Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel cells, micro turbines, Captive power plants, Integration of renewable energy sources	10
4	**Power Quality Management in Smart Grid** 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. **Information and Communication Technology for Smart Grid** Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN). Bluetooth, Zig-Bee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network, Basics of CLOUD Computing & Cyber Security for Smart Grid. Broadband over Power line (BPL). IP based protocols.	14
		Total -45

Recommended Books

1. C.W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press , 2009
2. J. Ekanayake, N. Jenkins, K. Liyanage, "Smart Grid: Technology and Applications", Wiley 2012
3. S.Borlase, "Smart Grid: Infrastructure, Technology and solutions " CRC Press,2012
4. A.G.Phadke, "Synchronized Phasor Measurement and their Applications", Springer, 2012
5. https://swayam.gov.in/courses/4778-july-2018-introduction-to-smart-grid
6. https://onlinecourses.nptel.ac.in/noc18_ee42/preview

Subject Code: DBMEE-306`

Title of the course: Project

L	T	P	Credits	Weekly Load
0	0	12	12	12

Course Outcomes:

At the end of the course, students should be able to

CO1: Formulate, Design , Analyze and implementation of various problems in practical form
CO2: Impart skills in preparing detailed report describing the project and results.

CO/PO Mapping

(S-Strong Correlation, M- Medium Correlation, W-Weak Correlation

CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	W	S	S	M	S	M	S	W	S	M	M	S
CO2	S	W	M	S	M	S	M	W	S	S	S	S

Internal Marks		External Marks	
1. Formulation of Problem	10	Implementation	10
2. Design	10	Result & Analysis	10
3. Implementation	20	Report	10
4. Testing & Analysis	10	Viva-Voce	10
5. Report	10	----	---
Total Marks	60	**Total Marks**	40

Subject Code: DBMEE-307

Title of the course: Seminar

L	T	P	Credits	Weekly Load
0	0	2	2	2

Course Outcomes:

At the end of the course, students should be able to

CO1: Collect useful information from the literature on the particular topic chosen by student

CO/PO Mapping (S-Strong Correlation, M- Medium Correlation, W-Weak Correlation												
CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	W	S	S	S	S	M	S	W	S	M	M	S

Each student will be required to prepare a Seminar Report and present a Seminar on a topic in any of the areas of modern technology related to Electrical Engineering including interdisciplinary fields.
Seminar will carry 4 credits. It will be done on any topic within/outside the curriculum. Its evaluation will be done as under:

Sr. No.	Parameters for Evaluation	Internal Marks	External Marks
1	Depth & Coverage of Topic	40	-
2	PPT Presentation & Report	20	-
3	Presentation	20	-
4	Questions & Answers	20	-
Total		**100**	**-**

Subject Code: DBMEE-308

Title of the course: Research Lab

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

At the end of the course,

CO1: Familiarize with various tools and Softwares like like MATLAB, ETAP, GAMS, Power System Toolbox, Power world Simulator, Network Simulator, LABVIEW

CO/PO Mapping

(S-Strong Correlation, M- Medium Correlation, W-Weak Correlation

CO's	Programme Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	M	S	M	M	W	M	S	M	S

Students will be made familiar with one or more available softwares like MATLAB, ETAP, GAMS, Power System Toolbox, Power world Simulator, Network Simulator, LABVIEW, etc. so that students can use any one or more of them for their dissertation. Students will be advised to go through maximum research papers and conclude a particular domain to work further.

DESH BHAGAT UNIVERSITY, MANDI GOBINDGARH

Faculty of Engineering and Applied Sciences

Department of Electrical Engineering

M. Tech SEMESTER-IV

Sr. No.	**Course Code**	Course Name	Category	Evaluation Criteria	Total	Load Allocation			TCH	Credits
						L	T	P		
1.	**DBMEE - 401**	Dissertation	CC	Satisfactory/ Unsatisfactory	100	0	0	24	24	24