Semester- I

ADVANCED ENGINEERING MATHEMATICS			
Course Code	MEE101	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To have an insight into solving Linear Algebraic Equations and the importance of Eigen values and Eigen vectors in singular value decompositions.
- To develop proficiency in vector spaces and linear transformations
- To enable learning concepts of probability theory and their implication in Electrical and Electrical Engineering

Module-1

Linear Algebra: Solution of Systems of Linear Equations: Direct methods-Partition method, Croute's Triangularisation method. Iterative method- relaxation method. Eigen values and Eigen vectors. Bounds on Eigen Values. Jacobi method & Givens method for symmetric matrices.

RBT Levels: L1, L2, L3

Module-2

Vector Space 1: Introduction to vectors paces and sub-spaces, definitions column , Null spaces, spaces illustrative example. Linearly independent and dependent vectors-Basis definition and problems. Linear transformations definitions. Matrix form of linear Transformations-Illustrative examples.

RBT Levels: L1, L2, L3

Module-3

Vector Space 2: Orthogonal vectors and orthogonal bases. Gram-Schmidt Orthogonalization process. QR decomposition, Least square problems, Singular value decomposition. Applications

RBT Levels: L1, L2, L3

Module-4

Probability distribution functions: Review of basic probability theory. Random variables, Probability distributions: Binomial, Poisson, uniform, and Normal (Gaussian) and Erlangdistributions. Joint probability distribution (discrete and continuous)-Illustrative examples. Independent random variables, covariance and correlation.

RBT Levels: L1, L2, L3

Module-5

Moments &Transformation of random variables: Moments, Central moments, Transformation of random variables Characteristic functions, probability generating and moment generating functions-illustrations. Engineering applications: Entropy and Source coding.

RBT Levels: L1, L2, L3

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. Linear Algebra and its Applications, David C.Lay et al, Pearson, 5th Edition, 2015.
2. Numerical Methods for Scientific and Engineering Computation, M. K. Jain et al, New Age International, 9th Edition, 2014.
3. Probability and Random Processes, Scott L. Miller, Donald G.Childers. Elsevier 2004

Reference Books

1. Numerical methods for Engineers, Steven C Chapra andRaymond P Canale, McGrawHill,7th Edition, 2015.
2. Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers, 44th Edition, 2017
3. Advanced Engineering Mathematics, E.Kreyszig, Wiley, 10thedition, 2015

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/
http://nptel.ac.in/courses.php?disciplineId=111
http://www.class-central.com/subject/math(MOOCs)
http://ocw.mit.edu/courses/mathematics/

Skill Development Activities Suggested

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Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Solve system of linear equations using direct and iterative methods.	
CO2	Understand the fundamentals of vector space and bases in reference to transformations.	
CO3	Use the idea of Eigen values and Eigen vectors for the application of Singular value decomposition.	
CO4	Describe the basic notions of discrete and continuous probability distributions.	
CO5	Find out responses of linear systems using statistical and probability tools.	

Semester- I

ADVANCED COMPUTATIONAL METHODS IN POWER SYSTEMS			
Course Code	MEE102	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:02:00	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 10-12 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course Learning objectives:

-

Module-1
Introduction, Concept of incidence matrix, formation of A and Â matrices, list of other types of incidence matrices and their limitations. Representation of Generator, Transmission lines and Transformers, Primitive and Network matrices, Y-bus formation by Inspection method and its algorithm. Merits and Demerits of Ybus and Z-bus matrices in Power System Analysis – Areas of application.
Module-2
Introduction to Load Flow Analysis – Y-bus based Power System Static Load Flow Equations. Gauss-Seidel (GS) method, PV-bus treatment, Gauss-Seidel load flow algorithm. Need of Sparsity technique for 'well-grown' power systems, Concept of Sparsity technique, Y-bus formation using Sparsity technique. GS with Sparsity technique, Merits and Demerits of GS method
Module-3
Newton-Raphson (NR) load flow method and its algorithm. Merits and Demerits of NR method; Newton's Decoupled, Fast Decoupled equation, algorithm of Fast Decoupled (FDC) method. Merits and Demerits of FDC method; Areas of application of load flow study. AC/DC load flow solutions.
Module-4
Distribution system Load Flow methods-Vector based load flow method, Backward-Forward Sweep method and Current injection method Load flow studies with Renewable Energy Sources; Solar and Wind Energy Sources. Need of short circuit studies – Assumptions in short circuit studies – Areas of application.
Module-5
Formation of Z-bus using step-by-step approach (Addition of a branch & Addition of a link). Modification of Z-bus elements for changes. Symmetrical Sequence Components, significance of symmetrical components, approximations, formation of primitive z abc , y abc , z 012 and y 012 for various types of faults Formation of Z_{bus}^{012} by step-by-step algorithm. Derivation of relevant equations for E012 for LLLG and LG faults.

PRACTICAL COMPONENT OF IPCC (May cover all / major modules)

Sl. NO	Experiments
1	Solution of Simultaneous Algebraic equations by Gauss Elimination – Crout's method and Cholesky method
2	Solution of Simultaneous differential equations by Range Kutta–4 and Modified Euler's method
3	Program to read and print out the power system load flow data of 5 BUS and 10 BUS Systems
4	Program to read and print out the power system load flow data of– IEEE 14 Bus and IEEE 30 Bus systems
5	Formation of YBUS using two dimensional arrays by inspection method
6	Formation of YBUS using Sparsity Technique
7	Load flow studies by Gauss-Seidel method using two– dimensional arrays – sparsity techniques
8	Newton Raphson method based Load flow studies by using two – dimensional arrays – sparsity techniques
9	Fast Decoupled Load flow method using two – dimensional arrays – sparsity techniques
10	Distribution system load flow using backward forward method
11	Can be Demo experiments for CIE
12	Can be Demo experiments for CIE

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

1. Two Tests each of **20 Marks**
2. Two assignments each of **10 Marks/One Skill Development Activity of 20 marks**
3. Total Marks of two tests and two assignments/one Skill Development Activity added will be CIE for 60 marks, marks scored will be proportionally scaled down to **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test at the end /after completion of all the experiments shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.**SEE for IPCC**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will be set for 100 marks and marks scored will be scaled down proportionately to 50 marks.
2. The question paper will have ten questions. Each question is set for 20 marks.
3. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
4. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 15 (50% of maximum marks-30) in the theory component and 10 (50% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 40% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50. (Student has to secure an aggregate of 50% of maximum marks of the course(CIE+SEE)

Suggested Learning Resources:

Books

1. Computer Methods in Power System Analysis, Stagg and El – Abiad , McGraw Hill, ISE, 1986
2. Computer techniques in Power System Analysis, M A Pai and Dr. Dheeman Chatterjee, McGraw hill, 2014, 3e
3. Power System Analysis, Hadi Sadat, McGraw Hill – International Edition – 1999
4. Computer Modeling of Electrical Power Systems, J. Arrilaga and NR Watson, John Wiley and Sons, 2001, 1e

Web links and Video Lectures (e-Resources):

1. Website reference links: https://www.engineeringonline.ncsu.edu/course/ece-753-computational-methods-for-power-systems/
2. https://www.youtube.com/playlist?list=PL36A60B630E8C7B56
3. https://www.youtube.com/playlist?list=PL-uxPiMl0_6GWFPGXgVapb1yjVAZs9YGz
4. https://nptel.ac.in/courses/108107028

Skill Development Activities Suggested

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Develop mathematical models for load flow studies for Transmission and Distribution systems and Fault analysis	
CO2	Prepare the input data required for load flow analysis and fault calculations	
CO3	Develop computer programs (MATLAB, Power World) to solve power flow problems Decoupled Power Flow, Fast Decoupled Power Flow, DC Power Flow Optimal power flow	
CO4	Apply appropriate algorithms for Distribution systems load flow studies	
CO5	Develop power system software /implementation of algorithm for static power system studies	

Semester- I

HIGH VOLTAGE & ELECTRICAL INSULATION ENGINEERING			
Course Code	MEE103	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3

Course Learning objectives:

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Module-1

INTRODUCTION: ELECTRIC FIELDS, THEIR CONTROL AND ESTIMATION-I

Electric Charge and Discharge, Electric and Magnetic Fields and Electromagnetics, Dielectric and Electrical Insulation, Electrical Breakdown, Global Breakdown, Local Breakdown, Corona, Streamer and Aurora, Capacitance and Capacitor, Stray Capacitance, Electric Field Intensity, "E", Breakdown and Electric Strength of Dielectrics, "Eb", Classification ofElectric Fields, Control of Electric Field Intensity (Stress Control), Estimation of Electric Field Intensity. Analysis of Electric Field Intensity in Isotropic Multidielectric System, Basic Equations for Potential and Field Intensity in Electrostatic Fields.

Module-2

ELECTRIC FIELDS, THEIR CONTROL AND ESTIMATION-I

Analytical Methods for the Estimation of Electric Field Intensity in Homogeneous Isotropic Single Dielectric, Direct Solution of Laplace Equation. Analysis of Electric Field Intensity in Isotropic Multidielectric System, Field with Longitudinal Interface, Field with Perpendicular Interface, Numerical Methods for the Estimation of Electric Field Intensity, Finite Element Method (FEM) Charge Simulation Method (CSM), Numerical Optimization of Electric Fields, Optimization by Displacement of Contour Points, Optimization by Changing the Positions of Optimization Charges, and Contour Points, Optimization by Modification of Contour Elements.

Module-3

ELECTRICAL PROPERTIES OF VACUUM AS HIGH VOLTAGE INSULATION

Pre-breakdown Electron Emission in Vacuum: Mechanism of Electron Emission from Metallic Surfaces Non-Metallic Electron Emission Mechanisms **Pre-Breakdown Conduction and Spark Breakdown in Vacuum:** Electrical Breakdown in Vacuum Interrupters, High Current Arc Quenching in Vacuum Delayed Re-Ignition of Arcs Effect of Insulator Surface Phenomena. Effect of Conditioning of Electrodes on Breakdown Voltage, Effect of Area of Electrodes on Breakdown in Vacuum.

Module-4

LIQUID DIELECTRICS, THEIR CLASSIFICATION, PROPERTIES AND BREAKDOWN STRENGTH

Classification of Liquid Dielectrics : Mineral Insulating Oils, Mineral Insulating Oil in Transformers, Vegetable Oils ,Synthetic Liquid Dielectrics, the Chlorinated Diphenyles, Halogen Free Synthetic Oils, Inorganic Liquids as Insulation**,** Polar and Nonpolar Dielectrics, **Dielectric Properties of Insulating Materials:** Insulation Resistance Offered by Dielectrics, Permittivity of Insulating Materials, Polarization in Insulating Materials, Effect of Time on Polarization, Polarization under Direct Voltage, Polarization under Alternating Voltage, Dielectric Power Losses in Insulating Materials, **Breakdown in LiquidDielectrics**: Electric Conduction in Insulating Liquids, Liquid Dielectrics in Motion and Electro hydrodynamics, Intrinsic Breakdown Strength, Practical Breakdown Strength Measurement at Near Uniform Fields, Effect of Moisture and Temperature on Breakdown Strength, Breakdown in Extremely Non-uniform Fields and the Development of Streamer, **Aging in Mineral Insulating Oils**

Module-5

SOLID DIELECTRICS, THEIR SOURCES, PROPERTIES AND BEHAVIOR IN ELECTRIC FIELDS

Classification of Solid Insulating Materials: Inorganic Insulating Materials, Ceramic Insulating Materials, Glass as an Insulating Material, Polymeric Organic Materials. **Partial Breakdown in Solid Dielectrics** , Internal Partial Breakdown, Surface Discharge (Tracking) Degradation of Solid Dielectrics Caused by, Inhibition of Partial Breakdown/Treeing in Solid Dielectrics, Partial Breakdown Detection and Measurement , Indirect Methods of PB Detection, Direct Methods of PB Detection and Measurement, **Breakdown and Pre-Breakdown Phenomena in Solid Dielectrics,** Intrinsic Breakdown Strength of Solid Dielectrics, Thermal Breakdown, Mechanism of Breakdown in Extremely Nonuniform Fields, "Treeing" a Pre-Breakdown Phenomenon in Polymeric Dielectrics, Forms of Treeing Patterns, Classification of Treeing Process, Requirement of Time for Breakdown, Estimation of Life Expectancy Characteristics, Practical Breakdown Strength and Electric Stress in Service of Solid Dielectrics

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

3. Two Unit Tests each of **25 Marks**
4. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

6. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
7. The question paper will have ten full questions carrying equal marks.
8. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
9. Each full question will have a sub-question covering all the topics under a module.
10. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. R. Arora and W. Mosch, "High Voltage and Electrical Insulation Engineering", Wiley-IEEE press
2. N. H. Malik, A. A. Al-Arainy and M. I. Qureshi, "Electrical Insulation in Power System", Marcel Dekker Inc.
3. A. Haddad and D. F. Warne, "Advances in High Voltage Engineering", Institution of Engineering and Technology
4. R. E. James and Q. Su, "Condition Assessment of High Voltage Insulation in Power System Equipment", The Institution of Engineering and Technology
5. S. Chakravorti, D. Dey and B. Chatterjee, "Recent Trends in the Condition Monitoring of Transformers", Springer- Verlag
6. S. Chakravorti, "Electric Field Analysis", CRC Press (Taylor & Francis)

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/
- https://archive.nptel.ac.in/courses/108/104/108104048/
- Online web portal http://nptel.ac.in
- YouTube channel for NPTEL – most subscribed educational channel

Skill Development Activities Suggested

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Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Understand the basic physics related to various breakdown processes in Dielectric, Electrical Insulation and Isotropic Multidielectric System.	
CO2	Learn different Numerical field estimation methods for Homogeneous Isotropic Single & Multi dielectric Systems	
CO3	Understand Pre-breakdown Electron Emission, Conduction and Spark Breakdown in Vacuum	
CO4	Understand Classification & dielectric properties of liquid insulating materials	
CO5	Understand Classification & dielectric properties of Solid insulating materials	

Semester- I

ENERGY, ECOLOGY AND ENVIRONMENT			
Course Code	MEE104	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

This course introduces students to environment concerns. Students are expected to learn about environment, factors affecting it, environmental ethics and its protection through lectures, presentations, documentaries and field visits.

Module-1

Interrelation between energy, ecology and environment. Sun as a source of energy, nature of its radiations. Interrelationship between energy and environment, Sun as a source of energy, nature of its radiation, Biological processes, photosynthesis, Autecology and Synecology.

Module-2

Population, Community Ecosystem (wetland, terrestrial, marine). Population, Community Ecosystem (wetland, terrestrial, marine) Food chains, Ecosystem theories.

Module-3

Sources of energy, Classification of energy sources. Environmental issues related to harnessing to fossil fuels (coal, oil, natural gas), geothermal, tidal, nuclear energy, solar, wind, hydropower, biomass.

Module-4

Energy flow and nutrient cycling in ecosystem and environmental, Degradation. Air and water pollution.

Module-5

Environmental issues related to harnessing to fossil fuels (coal, oil, natural gas), geothermal, tidal, nuclear energy, solar, wind, hydropower, biomass, Energy flow and nutrient cycling in ecosystems

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

5. Two Unit Tests each of **25 Marks**
6. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

11. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
12. The question paper will have ten full questions carrying equal marks.
13. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
14. Each full question will have a sub-question covering all the topics under a module.
15. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. G. M. Masters, W. P. Ela, Introduction to Environmental Engineering and Science, Prentice Hall, 2007.
2. D. Nevers, Air Pollution Control Engineering, McGraw Hill, 2001.
3. A. Mackenzie, A. S. Ball, S. Virdee, Instant Notes: Ecology, BIOS Scientific Publishers Ltd., 2001.
4. F. Armstrong, K. Blunde, Energy Beyond oil, Oxford University Press, 2007.
5. G. T. Miller, Spoolman S., Environmental Science, Yolanda Cossio, 2010.
6. J. L. Chapman, W. J. Reiss, Ecology Principles and Applications, Cambridge University Press,2008.

Web links and Video Lectures (e-Resources):

1. https://onlinecourses.nptel.ac.in/noc19_ge23/preview
2. https://nptel.ac.in/courses/127105018
3. https://archive.nptel.ac.in/noc/courses/noc19/SEM2/noc19-ge23/

Skill Development Activities Suggested

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Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1		
CO2		
CO3		

Semester- I

ELECTRICAL ENERGY MANAGEMENT			
Course Code	Mxx105	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

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Module-1

INTRODUCTION: Need for energy management - energy basics- designing and starting an energy management program – energy accounting -energy monitoring, targeting and reporting- energy audit process.

Module-2

ENERGY COST AND LOAD MANAGEMENT : Important concepts in an economic analysis - Economic models-Time value of money-Utility rate structures- cost of electricity-Loss evaluation- Load management: Demand control techniques-Utility monitoring and control system-HVAC and energy.

Module-3

ENERGY MANAGEMENT FOR MOTORS & ELECTRICAL EQUIPMENT: Systems and equipment- Electric motors - Transformers and reactors-Capacitors and synchronous machines.

Module-4

METERING FOR ENERGYMANAGEMENT: Relationships between parameters-Units of measure-Typical cost factors-Utility meters - Timing of meter disc for kilowatt measurement - Demand meters - Paralleling of current transformers - Instrument transformer burdens-Multitasking solid-state meters - Metering location vs. requirements- Metering techniques and practical examples.

Module-5

LIGHTING SYSTEMS: Concept of lighting systems - The task and the working space -Light sources - Ballasts - Luminaries - Lighting controls-Optimizing lighting energy - Power factor and effect of harmonics on power quality - Cost analysis techniques-Lighting and energy standards.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

7. Two Unit Tests each of **25 Marks**
8. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

16. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
17. The question paper will have ten full questions carrying equal marks.
18. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
19. Each full question will have a sub-question covering all the topics under a module.
20. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books :

1. Reay D.A, Industrial Energy Conservation, first edition, Pergamon Press, 1977.
2. IEEE Recommended Practice for Energy Management in Industrial and CommercialFacilities, IEEE, 1996.
3. Amit K. Tyagi, Handbook on Energy Audits and Management, TERI, 2003.

References :

1. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, Guide to EnergyManagement, Fifth Edition, The Fairmont Press, Inc., 2006
2. Eastop T.D & Croft D.R, Energy Efficiency for Engineers and Technologists,. LogmanScientific & Technical, ISBN-0-582-03184, 1990.
3. Capehart B.L., Turner W.C., Kennedy W.J. (2011). Guide to Energy Management (7thEdition). Fairmont Press. ISBN: 1439883483.
4. Patrick D.R., Fardo S.W., Richardson R.E., Fardo B.W. (2014). Energy ConservationGuidebook (3rd Edition). Fairmont Press. ISBN: 1482255693.
5. Kreith F., Goswami D.Y. (2007). Energy Management and Conservation Handbook. CRC Press. ISBN: 9781420044294.

Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=agSEQaVMkDE
https://www.youtube.com/watch?v=6vOg-u7c1IE
https://www.youtube.com/watch?v=uy9lZCdkQIM
https://www.youtube.com/watch?v=8Aqc44PG4Ws

Skill Development Activities Suggested

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Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1		
CO2		
CO3		

Semester- I

POWER SYSTEMS & POWER CONVERTERS LABORATORY			
Course Code	MEEL106A	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	40	SEE Marks	50
Total Hours of Pedagogy	1:2:0	Total Marks	100
Credits	02	Exam Hours	03

Course Learning objectives:

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The power system lab will be comprising of at least TWO experiments from each of the subjects 22XXX12 to 22XXX15 EXCEPT 22XXX14 such as representation of Power System Elements like Synchronous machines, transformers, transmission lines, loads, power system load flow, short circuit studies and power system stability studies using MATLAB-SIMULINK, PSCAD, CAPS software. Study of power semiconductor devices; study AC to DC, DC to DC converter circuits etc using software, design as well as by building up the circuits in laboratories. Renewable energy systems.

Sl. No.	Experiments
	POWER CONVERTERS
1	Analysis of DC-DC converters (a) Buck converter, (b) Boost converter, and (c) Buck- Boost converter
2	Closed loop control of Buck and Boost converter
3	Unipolar and bipolar PWM techniques for single-phase half-bridge inverters
4	Unipolar and bipolar PWM techniques for single-phase full-bridge inverters
5	Single phase Five level cascaded H-Bridge inverter
	Power Systems (This Lab Shall be Comprising of at least 5 Experiments from Part-A & 3 Experiments from Part-B)
	PART-A
6	To perform AC-DC Power flow analysis on 5 Bus systems with HVDC transmission line using PSCAD/POWER WORLD/SCI-LAB/MAT-LAB/…
7	To carry out Short Circuit studies on a given Power System using PSCAD/POWER WORLD/SCI-LAB/MAT-LAB/…
8	MVAR Compensation studies on normal and heavily loaded power systems using PSCAD/POWER WORLD/SCI-LAB/MAT-LAB/…
9	Transient Stability Analysis of Power Systems using PSCAD/POWER WORLD/SCI-LAB/MAT-LAB/…
10	Contingency evaluation and analysis of power system using simulation package
11	To perform State Estimation and bad data detection for a given Power System.
12	Fault studies using Zbus matrix
	PART-B
13	Determination of Sequence Impendence of an Alternator by direct method.
14	Determination of Sequence impedance of an Alternator by fault Analysis.
15	Measurement of sequence impedance of a three phase transformer
16	Power angle characteristics of a salient pole Synchronous Machine.
17	Poly-phase connection on three single phase transformers and measurement of phase Displacement.
	Demonstration Experiments (For CIE) if any
1	Study the characteristics of IGBT, MOSFET & GTO's. Design of gate drive circuits for IGBT & MOSFET's.
2	Study of 1 Φ - square wave and sinusoidal PWM inverter. Study of 3 Φ inverter with 120^{o} and 180^{o} mode of operation. Study of 3- Φ sinusoidal PWM inverter.
3	Determination of input p.f. and harmonic factor for 3- Φ full converter & for 3- Φ semi converter
4	Reactive Power Control Using Tap Changing Transformer
5	Regulation and efficiency characteristics of Artificial Transmission Line
6	Determination of Sequence Reactance's of Power System Elements (Alternator & 3- Φ Transformer)
7	Analysis of unbalanced voltages using Symmetrical Component Analyser
8	Short circuit studies using DC Network Analyser

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40% of maximum marks in the semester-end examination (SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for theevaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will beevaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8^{th} week of thesemester and the second test shall be conducted after the 14^{th} week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carrya weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of **scaled-down** marks scored in the report write-up/journal and average marks of two tests is the total

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks. SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University. All laboratory experiments are to be included for practical examination. (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly. Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners. General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure andresult in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners) Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero. The duration of SEE is 03 hours

Suggested Learning Resources:

Books

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/

Skill Development Activities Suggested

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1		
CO2		
CO3		

Semester- I

ENERGY LABORATORY			
Course Code	MEEL106B	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	40	SEE Marks	50
Total Hours of Pedagogy	1:2:0	Total Marks	100
Credits	02	Exam Hours	03

Course Learning objectives:

The aim of Energy Laboratory II is to ground the analytical subject material in a practical problem, meaning that the skills and knowledge students learn throughout the programme will be applied in real renewable energy engineering work.

Sl. No.	Experiments
1	Study of Characteristics of Francis Turbine
2	Characterization of solid fuel (Proximate Analysis)
3	Determination of calorific value of solid fuel
4	Performance study of heat pump system & Thermoelectric Generator and Refrigerator
5	To study the performance and emission characteristics of a spark ignition engine for ethanol/butanol-gasoline blend.
6	Fractional distillation of Petroleum
7	Performance of Solar Still & I-V Characteristics a Solar Cell 3, Performance of Photo-voltaic Thermal titles 3, Photovoltaic-Roof Top on Synergy Building
8	To study the performance and emission characteristics of a diesel engine for biodiesel-diesel blend

Assessment Details (both CIE and SEE)

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CO2		
CO3		