PROGRESSIVE EDUCATION SOCIETY'S

MODERN COLLEGE OF ENGINEERING

1186A, SHIVAJINAGAR, OFF J.M, PUNE-411005

(AFFILIATED TO SAVITRIBAI PHULE PUNE UNIVERSIT, PUNE

DEPARTMENT OF ELECTRICAL ENGINEERING

E-CURRICULUM BOOKLET

(2019 Course)

FOR THE PROGRAMME

BE – ELECTRICAL ENGINEERING

(SEMISTER-II)

QUALITY POLICY OF THE INSTITUTE

We, PES Modern College of Engineering are committed to develop and foster cultured and promising professionals by imparting quality education in the field of Engineering and Management.

VISION OF THE INSTITUTION

To create a collaborative academic environment to foster professional excellence and ethical values

MISSION OF THE INSTITUTE

1. **To develop ethical standards capable of creating and managing global enterprises.**
2. **To foster innovation and research by providing a stimulating learning environment.**
3. **To ensure equitable development of students of all ability levels and backgrounds.**
4. **To be responsive to changes in technology, socio-economic levels and environmental conditions.**
5. **To foster and maintain mutually beneficial partnerships with alumni and industry.**

QUALITY POLICY OF THE DEPARTMENT

Electrical Engineering department is committed to develop promising engineers with ethical and social responsibility through excellence in academics, research, skill development and consultancy.

VISION OF THE DEPARTMENT

To build technically competent Electrical Engineers with ethical and social responsibility.

MISSION OF THE DEPARTMENT

- **To develop abilities in students for acquiring knowledge and skills to flourish in dynamic technical environment.**
- **To nurture cultured professionals by providing facilities for their overall development.**
- **To motivate the students for research work and activities beneficial to society.**
- **To enhance strong bonding with various organization and alumni.**

Program Educational Objectives (PEOs)

Graduates will be able to:

PEO 1: Solve and analyze problems in Electrical Engineering using fundamental knowledge.

PEO 2: Adopt lifelong learning ability by acquiring various skills.

PEO 3: Practice ethically in their profession.

PEO 4: Achieve global competency through interactions with various industries, research and professional organizations.

PROGRAM OUTCOMES (POs)

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, research literature, and analyses 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: The problems that cannot be solved by straight forward application of knowledge, theories and technique applicable to the engineering discipline that may not have a unique solution. For example, a design problem can be solved in many ways and lead to multiple possible solutions that require consideration of appropriate constraints/requirements not explicitly given in the problem statement. (Like: cost, power requirement, durability, product life, etc.). Which need to be defined (modeled) within appropriate mathematical framework that often requires use of modern computational concepts and tools.

PO5. 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.

PROGRAM SPECIFIC OUTCOMES:

PSO1: Students will be able to apply logical and technical concepts of automation, control syste and electric mobility.

PSO2: Students will be able to develop adequate competency in electrical energy manageme through conventional and non-conventional energy sources.

CORE VALUES

- Excellence in the field of Electrical Engineering.
- Social responsibility with integrity.
- Lifelong Learning.
- Unity in Diversity.

SHORT TERM GOALS

- To enhance alumni interaction.
- To develop innovation lab to enhance research and entrepreneurship by providing various facilities.

LONG TERM GOALS

- To promote consultancy activity for revenue generation by developing high-tech standard laboratory.
- To encourage the faculty for research work and up gradation of qualifications.
- To enhance teaching-learning process through ICT.
- To establish competitive entrance exam cell in department.

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Course Structure

BE Electrical (2019 Course)

SEM-I

Course Code	Course Name	Teaching Scheme				Examination Scheme						Credit				
		Th	Pr	Tu	PW	ISE	ESE	TW	PR	OR	Total	Th	Pr	Tu	PW	Total
403141	Power System Operation & Control	3	2	–	–	30	70	25	–	25	150	3	1	–	–	4
403142	Advanced Control System	3	2	–	–	30	70	–	–	50	150	3	1	–	–	4
403143	Elective-I	3	2	–	–	30	70	–	–	25	125	3	1	–	–	4
403144	Elective-II	3	–	2*	–	30	70	25	–	–	125	3	–	1	–	4
403145	Project Stage-I	–	–	–	4	–	–	50	–	50	100	–	–	–	2	2
403146	MOOCs	–	–	–	–	–	–	50	–	–	50	–	–	–	2	2
403147	Audit Course-VII	2#	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Total		**12**	**6**	**2**	**4**	**120**	**280**	**150**	**–**	**150**	**700**	**12**	**3**	**1**	**4**	**20**

403143: Elective-I	403144: Elective-II	403147: Audit Course-VII
403143A: PLC and SCADA 403143B: Power Quality Management 403143C: High Voltage Engineering 403143D: Robotics and Automation	403144A : Alternate Energy System 403144B : Electrical & Hybrid Vehicle 403144C : Special-purpose Machines 403144D: HVDC & FACTS	403147 A: German Language I 403147B: Engineering Economics I 403147C: Sustainability(IGBC)

SEM-II

Course Code	Course Name	Teaching Scheme				Examination Scheme						Credit				
		Th	Pr	Tu	PW	ISE	ESE	TW	PR	OR	Total	Th	Pr	Tu	PW	Total
403148	Switchgear and Protection	3	2	–	–	30	70	25	–	50	175	3	1	–	–	4
403149	Advanced Electrical Drives & Control	3	2	–	–	30	70	25	50	–	175	3	1	–	–	4
403150	Elective-III	3	–	–	–	30	70	–	–	–	100	3	–	–	–	3
403151	Elective-IV	3	–	–	–	30	70	–	–	–	100	3	–	–	–	3
403152	Project stage II	–	–	–	12	–	–	100	–	50	150	–	–	–	6	6
403153	Audit course VIII	2#	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Total		12	4	–	12	120	280	150	50	100	700	12	2	–	6	20

403150: Elective-III	403151: Elective-IV	403153: Audit Course-VIII
403150 A : Digital Control System 403150 B : Restructuring and Deregulation 403 150 C: Smart Grid 403150 D: SensorTechnology (Open Elective)	403151A: EHV AC Transmission 403151B : Illumination Engineering 403151C: Electromagnetic Fields 403151D: AI and ML (Open Elective)	403153A: German Language II 403153B: Engineering Economics II 403153C: Green Building

*** For the tutorial, one credit is given. # Audit Course: Conduct over and above these lectures.**

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DEPARTMENT OF ELECTRICAL ENGINEERING

Switchgear and Protection-(403148)

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MODERN COLLEGE OF ENGINEERING

DEPARTMENT OF ELECTRICAL ENGINEERING

Teaching Plan

Sr. No.	Unit	Topics to be covered	Book Referred	Total Lecture Planned
1	I	Fundamentals of protective relaying	T2, T1,R1,R2	8
2	II	Fundamentals of arc interruption	R1,R2, T1	8
3	III	Circuit Breaker	T1, T3, R1	7
4	IV	Static and Digital Relaying	T1, R1, T3	7
5	V	Equipment protection	T1, T2,R1	10
6	VI	Transmission line protection	T1, T3, R1	5

Text Books:

1.S. Rao, "Switchgear Protection & Power Systems", Khanna Publications

2. Y. G. Paithankar, S. R. Bhide, "Fundamentals of Power System Protection", Prentice Hall of India

3. Bhavesh Bhalja, R.P. Maheshwari, N.G. Chothani," Protection and Switchgear", Oxford University Press, 2011 Edition.

Reference Books:

1. Badri Ram, D. N. Vishwakarma, "Power System Protection & Switchgear", Tata McGraw Hill Publishing Co. Ltd.

2. J. Lewis Blackburn , Thomas J. Domin, "Protective Relaying: Principles and Applications", Fourth Edition, CRC Press.

3. Prof. Dr S.A. Soman, IIT Mumbai , A Web course on "Digital Protection of power System"http://www.cdeep.iitb.ac.in/nptel/Electrical%20Engineering/Power%20Syste %20Protection/Course_home_L27.html

4. A.G. Phadke and J.S. Thorp , Computer relaying for Power System, Research Studies Press LTD, England.(John Willy & Sons Inc New York)

5. Crussel Mason, "The Art and Science of Protective Relaying", Wiley Eastern Limited.

Reference Web Links/ Research Paper/ Referred Book other than Mention in Syllabus:

1. NPTEL link.

2.www.investopedia.com/terms/w/**whitepaper**.asp

3. ieeexplore.ieee*.org*

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DEPARTMENT OF ELECTRICAL ENGINEERING

Unit No.-I- Fundamentals of protective relaying

Lecture No.	Details of the Topic to be covered	References
1	Need for protective system, nature & causes of fault	T2, T1,R1
2	types of faults, effects of faults	T2, T1,R1
3	Evolution of protective relaying	T2, T1,R1
4	classification of relays, zones of protection	T2, T1,R1
5	primary and backup protection	T2, T1,R1
6	essential qualities of protective relaying	T2, T1,R1
7	Trip circuit of circuit breaker	T2, T1,R1
8	Various basic operating principles of protection- over current, (current graded & time graded),directional over current, differential, distance	T2, T1,R1

Question Bank: Theory & Numerical

Mapped to Course Outcome:

Q. 1 Explain classification of relays.

Q. 2 Explain zones of protection. Hence explain primary and backup protection.

Q. 3 With neat diagram, explain trip circuit of circuit breaker.

Q. 4 Classify various induction type of relay and explain any one.

Q. 5 Current rating of an over current relay is 5 A. Relay has plug setting of 150%
And time setting of 0.4. C.T ratio is 400:5. Determine operating time of relay for fault current of 6000 A.
At Time Setting Multiplier =1, Operating time at various P.S.M are given as follows:

P.S.M	2	4	5	8	10	20
Operating time	10	5	4	3	2.8	2.4

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Unit No.-II- Fundamentals of arc interruption

Lecture No.	Details of the Topic to be covered	References
1	Ionization of gases, deionization,	R1,R2, T1
2	Electric arc formation	R1,R2, T1
3	Current interruption in AC circuit breaker,	R1,R2, T1
4	high & low resistance principles,	R1,R2, T1
5	arc interruption theories,	R1,R2, T1
6	arc voltage, recovery voltage, derivation and definition of restriking voltage and RRRV	R1,R2, T1
7	current chopping, interruption of capacitive current	R1,R2, T1
8	resistance switching, Numerical on RRRV, current chopping and resistance switching	R1,R2, T1

Question Bank: Theory & Numerical

Mapped to Course Outcome:

Q. 1	Explain the methods of arc interruption.
Q. 2	Define following terms. Recovery voltage, Restriking voltage, RRRV & Arc Voltage
Q. 3	Derive the expression for RRRV.
Q. 4	A circuit breaker interrupts magnetizing current of 200 MVA transformer at220 kV. Magnetizing current of transformer is 7% of full load current. If current is interrupted at 61% of its peak value. Findthe voltage which appears across the gap. The capacitance is 2700 μF and inductance is 30H.
Q. 5	In 165 kV system, the reactance is 9Ω and capacitor of 0.03 μF connected along contacts of circuit breaker. Determine natural frequency of oscillation also find critical value of R which is to be connected so as to be have no transient oscillations.

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Unit No.-III- Circuit Breaker

Lecture No.	Details of the Topic to be covered	References
1	Different ratings of circuit breaker (like rated voltage, rated current, rated frequency	T1, T3, R1
2	rated breaking capacity – symmetrical and unsymmetrical breaking	T1, T3, R1
3	making capacity,	T1, T3, R1
4	Classification of high voltage circuit breaker.	T1, T3, R1
5	Working and constructional features of ACB, advantages & disadvantages, applications.	T1, T3, R1
6	Working and constructional features of SF6 VCB- disadvantages and advantages, Auto reclosing	T1, T3, R1
7	Numericals on making and breaking capacities	T1, T3, R1

Question Bank: Theory & Numerical

Mapped to Course Outcome:

Q. 1	Explain the classification of Circuit breakers. What are the properties of SF6 gas?
Q. 2	Explain the VCB (Vacuum Circuit breaker) with a neat diagram.
Q. 3	With neat diagram explain the construction and working of ACB (Air circuit breaker)
Q. 4	Compare various types of circuit breakers on the basis of their utilization.
Q. 5	Explain Auto Reclosing

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Unit No.-IV- Static and Digital Relaying

Lecture No.	Details of the Topic to be covered	References
1	Overvoltage, causes of overvoltage, Lightning phenomenon	T2, High voltage Engineering by Kamraju
2	wave shape of lightning stroke, direct & indirect strokes	T2, High voltage Engineering by Kamraju
3	protection of overhead transmission lines from direct lightning strokes	T1, R1
4	Lightning arresters, rod gap type, horn gap type, Thyrite type, Metal oxide (ZnO) type lightning arrester.	T1, R1
5	Overview of Static relay, block diagram, operating principal, merits & demerits of static relay.	T1, R1
6	Numerical Relays :-Introduction, Block diagram of numerical relay, Sampling theorem	T1, R1, R3
7	Anti –Aliasing Filter, Block diagram of PMU	T1, R1, T3

Question Bank: Theory & Numerical

Mapped to Course Outcome:

Q. 1	Give the comparison of static, numerical and electromechanical relays
Q. 2	Explain PMU with block diagram.
Q. 3	Explain direct and indirect strokes of lightning.
Q. 4	List all the types of lightning arresters and explain any one.
Q. 5	Describe Anti-Aliasing Filter, Block diagram of PMU

Unit No.-V- Equipment protection

Lecture No.	Details of the Topic to be covered	References
1	Types of faults in transformer.	T1, T2,R1
2	Percentage differential protection in transformers,	T1,T2,R2
3	Restricted E/F protection	T1, T2,R1
4	Incipient faults, Buchholz relay	T1, T2,R1
5	protection against over fluxing. Protection against inrush current,	T1, T2,R1
6	Various faults in Alternator, abnormal operating conditions- stator faults	T1, T2,R1
7	longitudinal percentage differential scheme and transverse percentage differential scheme.	T1, T2,R1
8	Rotor faults- abnormal operating conditions, inter turn fault, unbalance loading, over speeding, loss of excitation	T1, T2,R1
9	Abnormal conditions & causes of failures in 3 phase Induction motor	T1, T2,R1
10	single phasing protection, overload protection, Short circuit protection	T1, T2,R1

Question Bank: Theory & Numerical

Mapped to Course Outcome:

Q. 1	What is magnetizing inrush current? Explain protection scheme for the same.
Q. 2	A 3phase 11KV/66KV delta star connected transformer is protected by differential protection. The CTs on LV side have ratio 500/1. What should be the current ratio of CTs on HV side & how should they be connected.
Q. 3	Explain the transverse protection for alternator
Q. 4	11KV, 125MVA alternator is grounded through a resistance of 7ohm. The CTs have ratio of 1000/5. The relay is set to operate when there is an out of balance current of 1.5A. What

	percentage of generator winding will be protected by differential protection scheme?

Q. 5	Explain single phasing protection for 3phase Induction motor.

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Unit No.-VI- Transmission line protection

Lecture No.	Details of the Topic to be covered	References
1	Over current protection for feeder using directional and non directional over current relays	T1, T3, R1
2	Introduction to distance protection, impedance relay, reactance relay, mho relay and Quadrilateral Relays, three stepped distance protection	T1, T3, R1
3	Effect of arc resistance, and power swing on performance of distance relay	T1, T3, R1
4	Realization of distance relays(impedance, reactance, and mho relay) using numerical relaying algorithm(flowchart, block diagram)	T1, T3, R1
5	Introduction to PLCC, block diagram, advantages, disadvantages, Introduction to Wide Area Measurement (WAM) system.	T1, T3, R1

Question Bank: Theory & Numerical

Mapped to Course Outcome:

Q. 1	Explain the effect of arc resistance on the performance of distance relay.
Q. 2	Describe wide area measurement with a neat block diagram.
Q. 3	Explain any one type of relay used for distance protection.
Q. 4	Explain the method of selection of CT ratios for differential protection of busbars
Q. 5	Write a note on PLCC and WAM system

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Advanced Electrical Drives and Control (403149)

Teaching Plan

Sr. No.	Unit	Topics to be covered	Book Referred	Total Lecture Planned
1	I	Electrical Drives	T1 R3	7
2	II	DC Motor Drives	T1,T5,R2,R4	6
3	III	Induction Motor Drives	T1,T4,R1,R5	6
4	IV	BLDC drive	T1,T2,T5, R1,R2	6
5	V	Synchronous Motor drives	T1,T3,T5, R1,R6	6
6	VI	Drive Application	T1,T2, R3,R5,R7	6

Text Books:

[T1]	G. K. Dubey, "Fundamentals of Electric Drives", 2nd Edition, Narosa Publishing House
[T2]	N. K. De, P. K. Sen, "Electric Drives", Prentice Hall of India Eastern Economy Edition
[T3]	S. K. Pillai, "Analysis of Thyristor Power Conditioned Motors", University Press
[T4]	G.K. Dubey, "Power Semiconductor controlled drives", PHI publication
[T5]	B. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education

Reference Books:

[R1]	R. Krishnan, "Electric Motor Drives – Modeling Analysis and Control", PHI India
[R2]	B. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education
[R3]	V. Subrahmanyam, "Electric Drives: Concepts and Application", Tata Mc-Graw Hill (An imprint of Elsevier)
[R4]	M.D. Singh and Khanchandani "Power Electronics", Tata Mc-Graw Hill
[R5]	Austin Huges, "Electrical motor and drives: Fundamental, types and applications", Heinemann Newnes, London
[R6]	Tyagi MATLAB for engineers oxford (Indian Edition)
[R7]	Malcolm Barnes, "Practical Variable Speed Drives and Power Electronics", Elsevier Newnes Publications

Reference Web Links/ Research Paper/ Referred Book other than Mention in Syllabus:

NPTEL online course on Fundamentals of Electric Drives, I.I.T. Kanpur by Dr. S.P. Das.
NPTEL online course on advanced Electric Drives, I.I.T. Kanpur by Dr. S.P. Das.
Allen Bradley Powerflex 700 AC Drives User manual.

Unit No.-I- Electrical Drives

Lecture No.	Details of the Topic to be covered	References
1	A. Definition, components of electric drive system, types of electrical drives (DC and AC),	T1 R3
2	selection of drive parameters, List of Industrial Applications	T1 R3
3	**B** Motor-Load dynamics, speed-torque conventions	T1 R3
4	multi-quadrant operation	T1 R3
5	equivalent values of drive parameters	T1 R3
6	load torque components, nature and classification of load	T1 R3
7	Constant power operation of a drive, steady-state stability.	T1 R3

Question Bank: Theory & Numerical

Mapped to Course Outcome:

Q. 1	Explain steady state stability and derive the criteria of steady state stability of an electrical drive system. . .
Q. 2	State the essential parts of electrical drives and state its function.
Q. 3	Explain multi quadrant operation of a motor driving a hoist load
Q. 4	What are the main factors which decides the choice of electrical drive for given application

Q. 5	Explain different component of load torque
Q. 6	A drive has the following parameters: T = 150-0.1N, Nm where N is speed in RPM. Load torque Tl =100, Nm. Initially the drive is operating in steady state. The characteristics of the load torque are changed to Tl = – 100, Nm. Calculate initial and final equilibrium speeds.
Q.7	A weight of 500 kg is being lifted up at a uniform speed of 1.5 m/s by a winch driven by a motor running at a speed of 1000 RPM. The moment of inertias of the motor and winch are 0.5 kg-m2 and 0.3 kg-m2 respectively. Calculate the motor torque and the equivalent moment of inertia referred to the motor shaft. In the absence of weight, motor develops a torque of 100 Nm when running at 1000 RPM.
Q.8	A drive has following parameters : J = 1kg -m2, T = 15-0.01 N, N-m and passive load torque, TL = 0.005N, N-m, where N is the speed in rpm. Initially the drive is operating in steady-state. Now it is to be reversed. For this, motor characteristic is altered such that T = –15-0.01N. N-m for positive as well as negative values of N. Calculate the reversal Time.

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Unit No.-II- DC Motor Drives

Lecture No.	Details of the Topic to be covered	References
1	Single-phase performance of converter fed separately excited DC Motor for speed control operations,. and	T1,T5,R2,R4
2	three-phase fully controlled converter drives and performance of converter fed separately excited DC Motor for speed control operations	T1,T5,R2,R4
3	12 pulse converter drives	T1,T5,R2,R4
4	Chopper controlled drives for separately excited	T1,T5,R2,R4
5	Chopper controlled drives for series DC Motor operations.	T1,T5,R2,R4
6	Closed-loop speed control of DC motor below and above base speed for starting,	T1,T5,R2,R4
7	speed control and braking of DC Motor Drives	T1,T5,R2,R4

Question Bank: Theory & Numerical

Mapped to Course Outcome:

Q. 1	Explain plugging braking of DC motor along with speed torque characteristics.

Q. 2	Explain closed loop control speed control of DC motor with inner current control loop. How below and above speed control is obtained

Q. 3	Explain the operation of a Chopper controlled Separately excited DC motor drive with suitable waveforms. Draw speed torque characteristics.

Q. 4	Explain regenerative braking of DC motor along with speed torque characteristics.

Q. 5	Compare regenerative braking and dynamic braking of Separately excited DCmotor
Q.6	With neat diagram Explain regenerative braking of DC motor using class B chopper.
Q.7	A 230 volts, 870 RPM, 100 A separately excited motor has an armature resistance of 0.05 ohm. It is coupled to an overhauling load with a torque of 400 Nm. Determine the speed at which motor can hold the load by regenerative braking.
Q.8	A 220 volts, 1500 RPM, 10 A separately excited dc motor is fed from single phase fully controlled rectifier with an AC source voltage of 230 V, 50 Hz. Armature resistance is 2 ohm. Conduction can be assumed continuous. Calculate firing angle for half the rated torque and 500 RPM

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Unit No.-III- Induction Motor Drives

Lecture No.	Details of the Topic to be covered	References
1	Regenerative braking, dynamic braking, Plugging,	T1,T4,R1,R5
2	Numerical based on braking and speed control	T1,T4,R1,R5
3	voltage source inverter (VSI) control, Steady State Analysis.	T1,T4,R1,R5
4	Current source inverter (CSI) control-open and closed loop,	T1,T4,R1,R5
5	Regenerative braking and multi quadrant operation of Induction motor drives,	T1,T4,R1,R5
6	Principle of vector control, Block diagram of Vector control of induction motor, Failure modes of Drives.	T1,T4,R1,R5

Question Bank: Theory & Numerical

Mapped to Course Outcome:

Q. 1	Explain AC dynamic (rheostatic) braking of three-phase induction motor with the two-lead connection.
Q. 2	A 400 volt, star connected, three-phase 6 pole induction motor has following parameters referred to stator : ohm, ohm. For the regenerative braking operation of this motor determine maximum overhauling torque it can hold and range of the speed for the safe operation
Q. 3	Explain with neat circuit diagram V/f control of three-phase induction motor. What is the range of speed control?
Q. 4	Compare CSI and VSI control of induction motor with their relative merits and demerits.

Q. 5	A 3-phase, 400V, 50Hz, 6 pole, 925 rpm star connected induction motor has the following parameters: Rs = 0.2Ω, R'r = 0.3Ω, Xs = 0.5Ω. X'r = 1Ω. The motor is fed from a VSI with a constant V/f ratio. The motor is to be braked by plugging from its initial full load speed of 925 rpm. The stator to rotor turns ratio is 2. Calculate the initial braking torque.

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Unit No.-IV- BLDC drive

Lecture No.	Details of the Topic to be covered	References
1	Construction (Block diagram) of BLDC drive	T1,T2,T5, R1,R2
2	working for motoring and regenerative braking,	T1,T2,T5, R1,R2
3	Speed and torque Characteristics, closed loop control of BLDC drive (PI controller)	T1,T2,T5, R1,R2
4	vector control of BLDC drive	T1,T2,T5, R1,R2
5	Applications in EV (descriptive treatment)	T1,T2,T5, R1,R2

Question Bank: Theory & Numerical

Mapped to Course Outcome:

Q. 1	Explain the operation of three phase brushless dc motor drive along with related waveforms.
Q. 2	How Induction Motor is converted to Characteristics of DC motor
Q. 3	What are the similarities between a brushless dc motor and a conventional dc motor

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Unit No.-V- Synchronous Motor drives

Lecture No.	Details of the Topic to be covered	References
1	PMSM Drive: Construction (Block diagram)	T1,T3,T5, R1,R6
2	working for motoring and regenerative braking, Speed and torque Characteristics	T1,T3,T5, R1,R6
3	closed loop control of PMSM drive (PI controller)	T1,T3,T5, R1,R6
4	Vector control of PMSM drive.	T1,T3,T5, R1,R6
5	Synchronous Reluctance Motor -Introduction, working of SRM	T1,T3,T5, R1,R6
6	application in EV (descriptive treatment)	T1,T3,T5, R1,R6

Question Bank: Theory & Numerical

Mapped to Course Outcome:

Q. 1	What is a self control mode of synchronous motor?

Q. 2	Draw and explain the block diagram of a self controlled synchronous motor fed from a three phase VSI

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Unit No.-VI- Drive Application

Lecture No.	Details of the Topic to be covered	References
1	Classes of motor duty, types of enclosures for motor.	T1,T2, R3,R5,R7
2	Specific requirement and choice of drives for following applications: Machine tools ,	T1,T2, R3,R5,R7
3	Textile mills, Steel rolling mills,	T1,T2, R3,R5,R7
4	Sugar mills, Traction drives,	T1,T2, R3,R5,R7
5	Crane and hoist drives,	T1,T2, R3,R5,R7
6	Solar and battery powered drives	T1,T2, R3,R5,R7

Question Bank: Theory & Numerical

Mapped to Course Outcome:

Q. 1	Write a short note on selection criteria of motor. Why a motor of smaller rating can be selected for a short time duty?
Q. 2	Write a short notes on any three of the following a) Crane and hoist drives b) Traction drives c) Sugar mills d) Textile mills
Q. 3	A constant speed drive has the following duty cycle. [6] i) Load rising linearly from 200 to 500 KW : 4 min ii) Uniform load of 400KW: 2 min iii) Regenerative power returned to the supply reducing linearly from 400KW to 0:3 min iv) Remains idle: 4 min Determine the power rating of the motor assuming loss to be proportional to (power)2
Q. 4	What is the selection criterion for motors? How ratings of the motor subjected to variable load duty is decided.

Q. 5	Write a short note on Drives used in Sugar mills. Also mention the load requirements like power ratings, speed, duty cycle etc
Q. 6	Write a short note on applications of drives in machine tool.

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Elective-III - Smart Grid – (403150 C)

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Teaching Plan

Sr. No.	Unit	Topics to be covered	Book Referred	Total Lecture Planned
1	I	Introduction to Smart Grid	[T1] [T3]	07
2	II	Smart Grid Technologies	[T2] [T3]	07
3	III	Smart Meters and Advanced Metering Infrastructure	[T2] [T3], [R1]	07
4	IV	Communication Technology for Smart Grid	[T2] [T3]	07
5	V	Microgrids	[T4]	07
6	VI	Power Quality issues and Challenges	[R1]	07

Text Books:

1. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response",CRC Press
2. Stuart Borlase, "Smart Grids-Infrastructure, Technology and Solutions", CRC Press, Taylor and Francis group
3. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "SmartGrid: Technology and Applications", Wiley Publications.
4. Nikos Ziargyriour, "Micro grid, Architecture and Control", IEEE Press, Wiley Publications.

Reference Books:

1. Yang Xiao, "Communication and Networking in Smart Grids", CRC Press, Taylor and Francis group

Reference Web Links/ Research Paper/ Referred Book other than Mention in Syllabus:

- ***https://sites.google.com/view/smartgridbe/home***
- ***https://onlinecourses.nptel.ac.in/noc23_ee60/preview***
- *https://onlinecourses.nptel.ac.in/noc21_ee68/preview*

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Unit No.-I- Introduction to Smart Grid

Lecture No.	Details of the Topic to be covered	References
1	Concept of Smart Grid, Need of Smart Grid, Functions of Smart Grid.	[T1] [T3]
2	Opportunities and Barriers of Smart Grid, Drivers of SG in India.	[T2] [T3]
3	Difference between conventional and smart grid. Functionalities and key components of smart grid.	[T2] [T3], [R1]
4	Smart Grid Vision and Roadmap for India.	[T2] [T3]
5	Concept of Resilient and Self-Healing Grid.	T2] [T3], [R1]
6	Smart Grid National Policies, Smart Cities.	[T2] [T3]
7	Pilot projects in India.	[T3]

Question Bank: Theory & Numerical

Mapped to Course Outcome:

Q. 1	1. Write a note on opportunity and barriers in Smart Grid.
Q. 2	High light on need and functions of Smart Grid.
Q. 3	Write a note on present development in Smart Grid considering any one case Study
Q. 4	. Explain in brief objectives of mission IC1
Q. 5	State difference between traditional grid and smart grid Explain national initiative for smart grid in india.
Q. 6	Explain functions of smart grid.
Q. 7	Explain in detail about renewable energy integration in the smart grid. Also Define a smart grid as per different organizations.

Q. 8	List out primary goals of the pilot projects.

Unit No.-II- Smart Grid Technologies

Lecture No.	Details of the Topic to be covered	References
1	Intelligent Electronic Devices (IED)	[T1] [T3]
2	Phase Measurement Unit (PMU).	[T1] [T3]
3	Smart Substations.	[T2] [T3], [R1]
4	Substation and Feeder Automation, application for monitoring, protection and control.	[T1] [T3]
5	Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid (V2G).	[T1] [T3], [R1]
6	Energy Storage Technologies and applications – Battery (flow and advanced).	[T2] [T3]
7	SMES, Super Capacitors, Compressed Air Energy Storage (CAES) and its comparison.	[T3]

Question Bank: Theory & Numerical

Mapped to Course Outcome:

Q. 1	Explain how Smart Meters can play an important role to make a system Smart.
Q. 2	Explain the concept Plug in Hybrid Electric Vehicles. And vehicle to grid
Q. 3	. Explain how Smart Appliances can be a part of Smart Grid.
Q. 4	Explain the concept Vehicle to Grid.
Q. 5	Write a note on Smart Substation.
Q. 6	Explain the concept of SMES.
Q. 7	Write a note on Substation Automation.
Q. 8	Write a note on the Phase Measurement Unit.

Q. 9	Explain the concept of IED and its functions. With one example
Q.10	Explain the concept application of monitoring in smart grid

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Unit No.-III- Smart Meters and Advanced Metering Infrastructure

Lecture No.	Details of the Topic to be covered	References
1	Introduction to Smart Meters, Prepaid meters, Net Metering,	[T1] [T3]
2	Advanced Metering Infrastructure (AMI)	[T2] [T3]
3	Real Time Pricing, Automatic Meter Reading (AMR),	[T2] [T3], [R1]
4	Outage Management System (OMS),	[T1] [T3]
5	Smart Substation , IEC 61850,	[T2] [T3], [R1]
6	Smart Sensors, Geographic Information System (GIS).	[T4] [T3]
7	IS 16444, LowPAN RF meter	[T3]

Question Bank: Theory & Numerical

Mapped to Course Outcome:

Q. 1	Explain how Smart Meters can be play an important role to make a system Smart.
Q. 2	Write a short note on Outage Management System (OMS).
Q. 3	Describe Real Time Pricing
Q. 4	What is Geographic Information System (GIS),
Q. 5	State Advantages of Advanced Metering Infrastructure (AMI)

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Unit No.-IV- Communication Technology for Smart Grid

Lecture No.	Details of the Topic to be covered	References
1	Communication Architecture of SG.	[T1] [T3]
2	Wide Area Measurement Protection and Control (WAMPAC).	[T2] [T3] [R1]
3	Home Area Network (HAN), Neighborhood Area Network (NAN).	[T2] [T3],[R1]
4	Wide Area Network (WAN).	[T1] [T3]
5	ZigBee, GPS,Wi-Fi, Wi-Max based communication, Wireless Mesh Network,	[T2] [T3],[R1]
6	Basics of CLOUD Computing and Cyber Security for Smart Grid,	[T3] [R1]
7	LORaWAN, NB-IoT, SigFox.	[T3] [R1]

Question Bank: Theory & Numerical

Mapped to Course Outcome:

Q. 1	Write a note on Wi-Max based communication in smart grid.
Q. 2	Explain the, concept WAN related to smart grid.
Q. 3	Write a note on, Broadband over power line.
Q. 4	Describe Basics of CLOUD Computing and Cyber Security for Smart Grid,
Q. 5	Differentiate between LORaWAN, NB-IoT, SigFox.

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Unit No.-V- Microgrids

Lecture No.	Details of the Topic to be covered	References
1	Concept of Microgrid, need and applications of Microgrid.	[T4] [T2]
2	Microgrid Architecture, DC Microgrid.	[T2] [T4]
3	Hybrid Microgrid, Formation of Microgrid	[T2] [T4],[R1]
4	Issues of interconnection, protection and control of Microgrid ,Integration of renewable energy sources.	[T1] [T4]
5	Smart Microgrid.	[T2] [T4],[R1]
6	Microgrid and Smart Grid Comparison.	[T4]
7	Renewable Energy based Microgrid system	[T3], [T4]

Question Bank: Theory & Numerical

Mapped to Course Outcome:

Q. 1	Describe the concept and formation of Micro Grid.
Q. 2	Discuss different issues of micro grid when interconnected.
Q. 3	Write a note on Micro turbine.
Q. 4	Write a note on captive power plant.
Q. 5	Explain Renewable Energy based Microgrid system

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Unit No.-VI- Power Quality issues and Challenges

Lecture No.	Details of the Topic to be covered	References
1	Power Quality and EMC in Smart Grid.	[T4] [T3]
2	Power Quality issues of Grid connected Renewable Energy Sources	[T3] [T4]
3	Smart Grid data analytics.	[T3] [T4],[R1]
4	Distributed Generation.	[T1] [T4]
5	Reliability Indices (CAIDI, CAIFI, MAIDI, MAIFI),	[T3] [T4],[R1]
6	Load Forecasting Methods, Smart Appliances,	[T4]
7	Home and Building Automation.	[T3], [T4]

Question Bank: Theory & Numerical

Mapped to Course Outcome:

Q. 1	Describe the concept, power quality conditioners related to smart grid.
Q. 2	Write a note on, Power quality management in smart grid.
Q. 3	Describe the power quality issues of grid connected renewable energy sources.
Q. 4	Explain the power quality audit and its importance in smart grid.
Q. 5	Explain how Smart Appliances can be the part of Smart Grid.

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Elective-IV : Illumination Engineering – (403151B)

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DEPARTMENT OF ELECTRICAL ENGINEERING

Teaching Plan

Sr. No.	Unit	Topics to be covered	Book Referred	Total Lecture Planned
1	I	Importance of Lighting in Human Life:	H. S. Mamak, "Book on Lighting", Publisher International lighting Academy	5
2	II	Light Sources and Electrical Control of Light Sources	Joseph B. Murdoch, "Illumination Engineering from Edison's Lamp to Lasers" Publisher -York, PA : Visions Communications	8
3	III	Design Considerations for illumination schemes	Designing with light: Lighting Handbook., Anil Valia; Lighting System 2002	4
4	IV	Design of lighting schemes-I	Designing with light: Lighting Handbook., Anil Valia; Lighting System 2002	6
5	V	Design of lighting schemes-II	Designing with light: Lighting Handbook., Anil Valia; Lighting System 2002	8
6	VI	Modern trends in illumination	Organic Light Emitting Diodes (OLEDs): Materials, Devices and Applications, Alastair Buckley, University of Sheffieid, UK, ISBN: 978-0-85709-425-4.	5

Text Books:

1. H. S. Mamak, "Book on Lighting", Publisher International lighting Academy
2. Joseph B. Murdoch, "Illumination Engineering from Edison's Lamp to Lasers" Publisher -York, PA : Visions Communications

Reference Books:

1. "BIS, IEC Standards for Lamps, Lighting Fixtures and Lighting", Manak Bhavan, New Delhi
2. D. C. Pritchard, "Lighting", 4th Edition, Longman Scientific and Technical, ISBN 0-582-23422-0.
3. "IES Lighting Handbook", (Reference Volume 1984), Illuminating Engineering Society of North America.
4. "IES Lighting Handbook", (Application Volume 1987), Illuminating Engineering Society of North America
5. IESNA lighting Handbook., Illuminating Engineering Society of North America 9th edition 2000
6. Applied Illumination Engineering, Jack L. Lindsey FIES (Author), Scott C. Dunning PHD PE CEM (Author) ,ISBN-13: 978-0824748098 ISBN-10: 0824748093, 3rd Edition.
7. IS 3646: Part I: 1992, Code of practice for interior illumination.
8. Organic Light Emitting Diodes (OLEDs): Materials, Devices and Applications, Alastair Buckley, University of Sheffieid, UK, ISBN: 978-0-85709-425-4.

Reference Web Links/ Research Paper/ Referred Book other than Mention in Syllabus:

http://www.elcomaindia.m//http://isleind.org/

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Unit No.-I- Importance of Lighting in Human Life:

Lecture No.	Details of the Topic to be covered	References
1	Optical systems of human eye ,Dependence of human activities on light,	H. S. Mamak, "Book on Lighting", Publisher International lighting Academy
2	performance characteristics of human visual system,	
3	External factors of vision-visual acuity, contrast, sensitivity, time illuminance, colour,visual perception, optical radiation hazards,	
4	Good and bad effects of lighting and perfect level of illumination, Artificial lighting assubstitute to natural light, Ability to control natural light,.	
5	Production of light, physics of generation of light, Properties of light,	
6	Quantification and Measurement of light	

Question Bank: Theory & Numerical

Mapped to Course Outcome:

Q. 1	Enlist various effects of bad lighting. Explain methods of controlling natural light.
Q. 2	Explain the properties of light
Q. 3	What is visual acuity?
Q. 4	Explain difference between artificial light and natural light.

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Unit No.-II -Light Sources and Electrical Control of Light Sources

Lecture No.	Details of the Topic to be covered	References
1	Lamp materials: Filament, glass, ceramics, gases, phosphors and other metals and non-metals. Discharge Lamps: Theory of gas Discharge phenomena,	Joseph B. Murdoch, "Illumination Engineering from Edison's Lamp to Lasers" Publisher -York, PA : Visions Communications
2	lamp design considerations, characteristics of low and high pressure mercury and Sodium vapour lamps, Low Vapour Pressure discharge lamps - Mercury Vapour lamp,	
3	Fluorescent Lamp, Compact Fluorescent Lamp (CFL) High Vapour Pressure discharge lamps - Mercury Vapour lamp, Sodium Vapour lamp, Metal halide Lamps, Solid Sodium Argon Neon lamps, SOX lamps,	
4	Electro luminescent lamps, Induction lamps.	
5	Ballast, ignitors and dimmers for different types of lamps,(Types of Luminaries,	
6	Factors to be considered for designing luminaries Types of lighting fixtures. Optical controlschemes, design procedure of reflecting and refracting type of luminaries.	
7	Lighting Fixture types, use of reflectors and refractors, physical protection of lighting fixtures	
8	Types of lighting fixtures according to installation type, types of lighting fixtures according tophotometric usages, luminaries standard (IEC-598-Part I).	

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Question Bank: Theory & Numerical

Mapped to Course Outcome:

Q. 1	Explain with sketch. a) Sodium vapour lamp b) Fluorescent tube
Q. 2	Explain with sketch. a) Metal halide lamp. b) Sox lamp.
Q. 3	Describe the construction and working of mercury vapour lamp with sketch.
Q. 4	Enlist advantages of gas discharge lamp over incandescent lamp.
Q. 5	Explain types of lightning fixtures according to installation type.
Q. 6	What are different types of lighting fixtures according to photometric usages? Explain eachtype in brief.

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Unit No.-III- Design Considerations for illumination schemes

Lecture No.	Details of the Topic to be covered	References
1	Zonal cavity method for general lighting design,	Designing with light: Lighting Handbook., Anil Valia; Lighting System 2002
2	determination for zonal cavities and different shaped ceilings using COU (coefficient of utilization	
3	beam angles and polar diagrams	
4	Factors to be considered for design of indoor illumination scheme	
5	Numericals	

Question Bank: Theory & Numerical

Mapped to Course Outcome:

Q. 1	Explain zonal cavity method.
Q. 2	Which factors are considered while indoor illumination design?
Q. 3	Write a short note on 1. Beam angle 2. Polar diagrams
Q. 4	Explain COU.

Unit No.-IV- Design of lighting schemes-I

Lecture No.	Details of the Topic to be covered	References
1	Residential (Numerical)	Designing with light: Lighting Handbook., Anil Valia; Lighting System 2002
2	Residential (Numerical)	
3	Educational institute Commercial installation	
4	Hospitals	
5	Industrial lighting Special purpose lighting schemes	
6	Decorative lighting Theatre lighting	
7	Aquarium, swimming pool lighting	

Question Bank: Theory & Numerical

Mapped to Course Outcome:

Q. 1	Elaborate the steps involved in design of illumination scheme for indoor installation- Educationalinstitute.
Q. 2	Elaborate the steps involved in design of illumination scheme for indoor installation- Theatre.
Q. 3	Elaborate the steps involved in design of illumination scheme for hospital.
Q. 4	Elaborate the steps involved in design of illumination scheme for swimming pool.

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Unit No.-V- Design of lighting schemes-II

Lecture No.	Details of the Topic to be covered	References
1	Factors to be considered for design of outdoor Road classifications according to BIS	Designing with light: Lighting Handbook., Anil Valia; Lighting System 2002
2	pole arrangement, terminology, lamp and luminaries' selection,	
3	different design procedures, beam lumen method,	
4	Point by point method, isolux diagram, problems on point by point method.	
5	Problems on point by point method.	
6	Outdoor illumination design for following installations: Road lighting (Numerical)	
7	Road lighting (Numerical)	
8	Flood lighting (Numerical)	
9	Stadium and sports complex Lighting for advertisement/hoardings	

Question Bank: Theory & Numerical

Mapped to Course Outcome:

Q. 1	With suitable diagrams explain beam lumen method for designing of out door illumination scheme.
Q. 2	State and explain the road classification as per BIS
Q. 3	With a suitable example explain point by point method for outdoor illumination scheme design.

Unit No.-VI- Modern trends in illumination

Lecture No.	Details of the Topic to be covered	References
1	LED luminary designs Intelligent LED fixtures	Organic Light Emitting Diodes (OLEDs): Materials, Devices and Applications, Alastair Buckley, University of Sheffieid, UK, ISBN: 978-0-85709-425-4.
2	Natural light conduiting Organic lighting system	
3	LASERS, characteristics, features and applications,	
4	non-lighting lamps Optical fiber, its construction as a light guide,	
5	features and applications	

Question Bank: Theory & Numerical

Mapped to Course Outcome:

Q. 1	Write a short note on LED.
Q. 2	Explain LASER characteristics
Q. 3	Explain optical fiber applications.