Curriculum Structure for Multi-Disciplinary Minor (MDM) Degree Offered by Different Programs

(In light of NEP 2020)

NCrF Level 6

(NEP_Version II)

For students admitted in 2023-24 onwards

Implemented year 2024-25

Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)
Near Kathora Naka, Amravati, Maharashtra
PIN 444604 www.gcoea.ac.in

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Curriculum Structure for
Multi-Disciplinary Minor (MDM) Degree in Energy Engineering

(In light of NEP 2020)

NCrF Level 6

(NEP_Version II)

Offered By

Department of Electrical Engineering

For students admitted in 2023-24 onwards

Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)
Near Kathora Naka, Amravati, Maharashtra
PIN 444604 www.gcoea.ac.in

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A: Structure for MDM course

Electrical Engineering Department offer Multidisciplinary Minor Basket , Track-I (Energy Engineering)														
Category	**Course Code**	**Name of the Course**	**Teaching Scheme**				**Evaluation Scheme**							**Credits**
							Theory				**Practical**		**Total**	
			TH	TU	PR	Total	CT1	**CT2**	TA	ESE	ICA	ESE		
MM1	EE1315	Introduction to Renewable Energy	3			3	15	15	10	60			100	3
MM2	EE1415	Energy Resources , Environment and Economics	3			3	15	15	10	60			100	3
MM3	EE1515	Energy Efficiency in Electric Utilities	3			3	15	15	10	60			100	3
MM4	EE1615	Energy Management	3			3	15	15	10	60			100	3
MM5	EE1715	Project			4						100		100	2
Total			**14**	**0**	**0**	**14**	**75**	**75**	**50**	**300**	**0**	**0**	**500**	**14**

A. **Eligibility criteria:** Students enrolled in B. Tech program other than Electrical Engineering are eligible. The allotment of minor degree Program will be as per the policy of the Institute.

B. Intake: Minimum 15

C. **Detailed syllabus:**

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Curriculum Structure for
Multi-Disciplinary Minor (MDM) Degree in Electrical Motor and Drives

(In light of NEP 2020)

NCrF Level 6

(NEP_Version II)

Offered By

Department of Electrical Engineering

For students admitted in 2023-24 onwards

Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)

Near Kathora Naka, Amravati, Maharashtra, PIN 444604 www.gcoea.ac.in

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Electrical Engineering Department offer Multidisciplinary Minor Basket , Track-II (Electrical Motors and Drives)														
Category	**Course Code**	**Name of the Course**	**Teaching Scheme**				**Evaluation Scheme**							**Credits**
							Theory				**Practical**		**Total**	
			TH	TU	PR	Total	CT1	**CT2**	TA	ESE	ICA	ESE		
MM1	EE1316	Electric Motors	3			3	15	15	10	60			100	3
MM2	EE1416	Special Electrical Machines	3			3	15	15	10	60			100	3
MM3	EE1516	Fundamentals of Power Electronics	3			3	15	15	10	60			100	3
MM4	EE1616	Electrical Drives and Control	3			3	15	15	10	60			100	3
MM5	EE1716	Project			4						100			2
Total			**14**	**0**	**0**	**14**	**75**	**75**	**50**	**300**	**0**	**0**	**500**	**14**

A. **Eligibility criteria:** Students enrolled in B. Tech program other than Electrical Engineering are eligible. The allotment of minor degree Program will be as per the policy of the Institute.
B. Intake: Minimum 15
C. **Detailed syllabus:**

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SEMESTER – III

Course Code	EE1315								Course category			MM
Course Name	INTRODUCTION TO RENEWABLE ENERGY											
Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2hrs. 30min.	--	--	100	03

Course Objectives:

To make the students aware and understand:

1. Energy scenario, energy sources and their utilization.
2. Society's present needs and future energy demands.
3. Principles of renewable energy conversion systems.
4. Energy conservation methods.
5. Different renewable energy technologies

Course Contents:

Energy Scenario: Indian energy scenario, different forms of energy, principles of renewable energy, renewable energy availability in India, renewable energy sources and features.

Solar Thermal Systems: Introduction to Solar and Thermal Systems, Energy conversion Principle and applications, solar water heaters, space cooling, solar distillation, solar cooking, solar green house, solar production of hydrogen, simple illustrative numerical.

Solar Photovoltaic Systems: Operating principle, concept of PV cell, module, array and array combination. Applications, battery charging, pumping, lighting. Simple illustrative numerical.

Wind energy system: Principle of wind energy conversion. Basic components of wind energy conversion system, classification of wind energy conversion system and design concepts. Extraction of power. Simple illustrative numericals.

Energy Storage systems: Mechanical energy storage, electrical energy storage, chemical energy storage, electromagnetic energy storage, thermal energy storage, biological storage.

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Energy conservation: Economic concept of energy, Principle of energy conservation, energy conservation technology, energy audit and co-generation.

Text Books:

1. S. P. Sukhatme, Solar Energy - Principles of Thermal Collection and Storage, Second Edition, Tata McGraw-Hill, New Delhi 1996.
2. G. D. Rai, Non-conventional Sources of Energy, Khanna Publications.
3. H. P. Gargand Jaipraksh, Solar Energy Fundamentals and Applications, Tata McGraw-Hill Publications
4. D. Mukharjee and S. Chakrabarti, Fundamentals of Renewable Energy Systems, New Age international Publication.
5. L. Umanand, Non-conventional Energy System, Web course: NPTEL, Course No. 22. Electrical Engineering Email: ums@cedt.iiisc.ernet.in.

Course Outcomes:

After completion of the course students will able to:

EE1315.1 Understand present energy scenario of India, energy sources/resources.
EE1315.2 Understand Society's present needs and future energy demands.
EE1315.3 Understand the Principles of renewable energy conversion systems.
EE1315.4 Understand energy conservation methods,
EE1315.5 Know about the energy auditing techniques.

CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1315.1	2	-	-	-	-	2	3	1	-	--	-	-	2	-	-
EE1315.2	2	2	1	2	2	2	2	1	-	2	3	-	2	-	1
EE1315.3	2	2	1	2	2	2	2	1	-	2	3	-	2	-	1
EE1315.4	2	2	1	2	2	2	3	1	-	2	3	-	2	-	1
EE1315.5	2	-	-	2	2	2	2	1	-	2	3	2	2	-	-

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SEMESTER – IV

Course Code	EE1415							Course category		MM
Course Name	ENERGY RESOURCES, ENVIRONMENT AND ECONOMICS									
Teaching Scheme				Examination Scheme						Credits
				Theory				Practical		
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE	Total	
03	--	--	03	15	15	10	60	2hrs. 30min.	--	--	100	03

Course Objectives:

To make the students aware and understand:

1. The concept of different energy sources.
2. Present Indian energy scenario and energy policies.
3. Energy efficiency and environment.
4. The energy economics.
5. The future energy sources.

Course Contents:

Basics of energy and its various forms: Overview of Indian energy scenario, various forms of energy, major primary and secondary energy sources, other primary energy sources available, commercial and non-commercial energy sources, renewable and non-renewable energy sources, global primary energy reserves, strategies for better energy security of nation, introduction to energy conservation and its importance, economics reforms in coal, oil, natural gas and electricity, energy pricing in India, energy sector reforms, energy policy, energy regulation, energy forecasting, energy efficiency.

Energy and Environment: Air pollution, So_x, No_x, Co, CFC, water pollution, acid rain, green-house effect, carbon cycle, environmental consequences of fossil fuel use.

Global environmental concerns: Ozone layer depletion, its effects, global warming, implications of global warming (climate change), Co_2 emissions, impacts, mitigation, sustainability, clean development mechanism (CDM), prototype carbon fund (PCF).

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Energy Economics: Cost factors, budgeting, standard costing, sources of capital, cash flow diagram, activity chart, simple payback period analysis, time value of money, net present value method, internal rate of return method, profitability index for benefit cost ratio. Simple illustrative numerical.

Future Energy Systems: Introduction to hydrogen, properties of hydrogen, sources of hydrogen, production of hydrogen, storage of hydrogen, Introduction to fuel cell.

Text Books:

1. Fowler, J. M., Energy and Environment, McGraw Hill, New York 1984.
2. Energy Management: W. R. Murphy, G. Mckay, Butteworths Heinemann. An imprint of Elsevier.
3. Guide book for National certification examination for energy managers and energy auditors. Bureau of energy efficiency.
4. Non-conventional energy sources: G. D. Rai, Khanna Publishers, Darya Gani, New Delhi.

Course Outcomes:

On completion of the course, students will be able to:

EE1415.1 Understand different sources of energy
EE1415.2 Understand energy pricing/marketing
EE1415.3 Understand the role of energy in the economy
EE1415.4 Understand energy economics and how to maintaining a balance between economic development and environmental quality
EE1415.5 Understand the importance of future energy sources.

CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1415.1	2	-	-	-	-	2	3	1	-	--	-	-	2	-	-
EE1415.2	2	2	1	2	2	2	2	1	-	2	3	-	2	-	1
EE1415.3	2	2	1	2	2	2	2	1	-	2	3	-	2	-	1
EE1415.4	2	2	1	2	2	2	3	1	-	2	3	-	2	-	1
EE1415.5	2	-	-	2	2	2	2	1	-	2	3	2	2	-	-

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SEMESTER - V

Course Code	EE1515							Course Category		MM
Course Name	ENERGY EFFICIENCY IN ELECTRICAL UTILITIES									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Th				Tu		Total	
				CT1	CT1	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2hrs. 30min.	-	-	100	03

Course Objectives:

To make the students aware and understand:

1. Electrical power system and tariffs in India.
2. Need and importance of energy saving practices in electrical utilities.
3. Energy saving opportunities in drives, fans, pumps, lighting, DG sets, etc.

Course Contents:

Introduction to Electrical systems: Introduction to Electrical energy systems, Tariff and economic considerations, T & D losses, Electrical load and various factors, Power factor and its introductory improvement techniques, Energy Efficient Technologies in Electrical Systems

Electric Motors and Drives: Energy Efficient Motors, Factors affecting Energy efficiency of a motor Introduction to power electronic controllers, soft starters and block diagrams of stator voltage and stator frequency controlled three phase induction motor drives, block diagrams of controlled rectifier and chopper fed dc shunt motor.

Fans and Blowers: Types, efficient system operation, Capacity selections, Performance assessment of fans and blowers, Energy conservation opportunities

Pumping systems: Types, Performance evaluation, efficient system operation, Energy conservation opportunities in pumping systems

Lighting systems: Basic terms of lighting systems recommended illumination level, Methodology of lighting systems, energy efficiency study, and Energy conservation opportunities.

DG Set and UPS systems: Introduction, Selection and capacity factor, Operational parameters, Performance assessment of DG Systems, Energy conservation opportunities, Block diagram and working of UPS Energy Efficiency in Renewable Energy Systems: Energy efficiency in solar and wind energy systems.

Text Books:

1. Doty S. and Turner W. C. (2012); Energy Management Handbook, Eighth Edition, Fairmont Press
2. Bureau of Energy Efficiency (BEE) (2012); Study material for Energy Managers and Auditors Examination: Paper I to IV
3. Bureau of Energy Efficiency (BEE) (2015); Electrical Efficiency in Electrical Utilities-Book3

Reference Books:

1. Thumann A. and Mehta D. P. (2008); Handbook of Energy Engineering, Sixth Edition, Fairmont Press
2. Capehart B. L. Turner W. C. and Kennedy W. J. (2011); Guide to Energy Management, Seventh Edition. Fairmont Press
3. Kao C. (1999); Energy Management in Illumination System, First Edition, CRC Press

Web Resources:

1. http://www.nptel.iitm.ac.in
2. http://www.ocw.mit.edu

Course Outcomes:

On completion of the course, students will be able to:

EE1515.1 Understand the components of electrical energy systems.
EE1515.2 Apply energy efficient technologies in electrical utilities..
EE1515.3 Utilize the various energy conservation techniques and practices.
EE1515.4 Evaluate the performance of various types of electrical loads..
EE1515.5 Select the proper capacity of various equipment's/accessories for given applications.

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
EE1515.1	2	1	0	0	0	0	0	0	0	0	0	0
EE1515.2	2	2	1	0	2	0	2	0	0	0	0	0
EE1515.3	2	2	1	1	2	1	0	0	0	0	0	2
EE1515.4	3	2	0	0	0	0	1	0	0	0	0	0
EE1515.5	3	0	0	0	3	0	1	0	0	0	0	0

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CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
EE1515.1	2	1	0	0	0	0	0	0	0	0	0
EE1515.2	2	2	1	0	2	0	2	0	0	0	0
EE1515.3	2	2	1	1	2	1	0	0	0	0	2
EE1515.4	3	2	0	0	0	0	1	0	0	0	0
EE1515.5	3	0	0	0	3	0	1	0	0	0	0

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SEMESTER – VI

Course Code	EE1615								Course Category			MM
Course Name	ENERGY MANAGEMENT											
Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2hrs. 30min.	--	--	100	03

Course Objectives:

To make the students aware and understand:

1. Various energy management techniques.
2. Energy auditing techniques.
3. Energy related policies.

Course Contents:

Energy Basics: Energy Demand Management, Conservation and Resource Development, Energy for Sustainable Development.

Need for Energy Management by Sector: Industry, Buildings and Houses, Transport, Electric Power. Need for Energy Management by Sector - Agriculture, Domestic; Energy forecasting techniques; Energy Integration, Energy Matrix.

Energy Auditing: Energy management for cleaner production, application of renewable energy, appropriate technologies.

Modeling techniques for supply and demand: Market structure, transportation models, game theory, futures markets, environmental issues, energy policy, energy regulation, input/output models.

Text Books:

1. Energy Audit and Management, Volume-I, IECC Press
2. Energy Management: W. R. Murphy, G. Mckay, Butterworths Scientific

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Reference Books:

1. Energy Management Handbook, W. C. Turner, John Wiley and Sons, A Wiley Inter-science
2. Industrial Energy Management and Utilization, L. C. Witte, P. S. Schmidt, D. R. Brown, Hemisphere Publication, Washington, 1988
3. Energy Management Principles, C. B. Smith, Pergamon Press

Course Outcomes:

After completion of the course, the students will be able to:

EE1615.1. Become efficient energy managers.
EE1615.2. Know different energy auditing methods.
EE1615.3. Suggest energy saving methods.
EE1615.4. Develop techniques for supply and demand.
EE1615.5. Prepare modelling by sector.

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
EE1615.1	3	0	0	0	0	0	0	0	0	0	0	0
EE1615.2	3	1	2	0	0	0	0	0	0	0	0	0
EE1615.3	2	3	2	2	1	0	0	0	0	0	0	0
EE1615.4	2	3	2	2	1	0	0	0	0	0	0	0
EE1615.5	3	2	0	1	0	0	0	0	0	0	0	0

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CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
EE1615.1	3	0	0	0	0	0	0	0	0	0	4
EE1615.2	3	1	2	0	0	0	0	0	0	0	2
EE1615.3	2	3	2	2	1	0	0	0	0	0	0
EE1615.4	2	3	2	2	1	0	0	0	0	0	0
EE1615.5	3	2	0	1	0	0	0	0	0	0	0

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SEMESTER – III

Course Code	EE1316							Course category			MM
Course Name	ELECTRIC MOTORS										
Teaching Scheme				Examination Scheme							Credits
				Theory					Practical		
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE	Total
03	--	--	03	15	15	10	60	2hrs30min	--	--	100	03

Course Objectives:

To make the students aware and understand:

1. Constructional features and operating principle of ac and dc motors.
2. Characteristics of ac and dc motors for different operating conditions
3. Testing of ac and dc motors and calculation of performance parameters

Course Contents:

DC motor: Working principle, constructional details, classifications, voltage equation, Toque equation, speed equation, Factors affecting speed, speed control, Starting of DC motors, and different types of starters.Characteristics of DC motors – electrical characteristics, mechanical characteristics, performance characteristics. Losses and efficiency - Condition for maximum efficiency, Testing of DC motor, load test on DC motors, Swinburne's test, and Application of DC motors.

Induction Motor: Rotating magnetic field, motor construction, motor specifications, and types of motor, principle of operation, Torque Slip Characteristics, Starting and Maximum Torque. Equivalent circuit, PhasorDiagram, Losses and Efficiency.Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, and frequency). Methods of starting, braking and speed control for induction motors. Doubly-Fed Induction Machines.

Single Phase Induction Motor: Types, double field revolving theory, equivalent circuit, determination of motor parameters, methods of starting, applications.

Synchronous Motor: Principle of operation, constructional features and types, Principle of reversibility, voltage equation, phasor diagram, torque and power equations, steady state operating characteristic, 'V' and inverted 'V' curves, starting, hunting, damper windings and its effect, synchronous condenser, working principle of auto synchronous motor.

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Text Books/References:

1. P. S. Bhimbra, Electrical Machinery, Khanna Publishers.
2. I. J. Nagrath and D. P. Kothari, Electrical Machines, Tata McGraw-Hill.
3. M. G. Say, Performance and Design of Alternating Current Machines, CBS Publishers.
4. B. L. Theraja, Electrical Technology, Vol. – II, S. Chand & Co.
5. E. Fitzgerald, Electric Machinery, Tata McGraw-Hill.
6. NEMA, IEC and IS Standards.

Course Outcomes:

After completion of the course, the students will able to:

EE1316.1 Illustrate constructional features and operating principle of ac and dc motors.
EE1316.2 Analyze characteristics of ac and dc motors for different operating conditions.
EE1316.3 Analyze performance of ac and dc machine
EE1316.4 Test ac and dc motors and calculate its performance parameters,
EE1316.5 Analyze and select machine for specific application

CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1316.1	3	1	1	3	--	--	--	--	--	--	--	--	1	3	--
EE1316.2	3	3	3	2	2	--	--	--	--	--	--	--	2	3	--
EE1316.3	3	3	3	2	2	--	--	--	--	--	--	--	2	3	--
EE1316.4	3	3	1	3	3	--	--	--	--	--	--	--	--	2	--
EE1316.5	3	3	2	3	1	--	--	--	--	--	--	--	--	3	--

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SEMESTER – IV

Course Code	EE1416								Course category		MM
Course Name	SPECIAL ELECTRICAL MACHINES										
Teaching Scheme				Examination Scheme							Credits
				Theory					Practical		
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE	Total
03	--	--	03	15	15	10	60	2hrs. 30min.	--	--	100	03

Course Objectives:

To make the students aware and understand:

1. Construction, principle of operation, control and performance of stepping motors.
2. Construction, principle of operation, control and performance of switched reluctance motors.
3. Construction, principle of operation, control and performance of permanent magnet brushless D.C. motors.The energy economics.
4. Construction, principle of operation and performance of permanent magnet synchronous motors
5. Construction, principle of operation and performance of other special Machines.

Course Contents:

Stepper Motors: Constructional features –Principle of operation –Types – Torque predictions – Linear Analysis – Characteristics – Drive circuits – Closed loop control – Concept of lead angle - Applications.

Switched Reluctance Motors (SRM): Constructional features –Principle of operation-Torque prediction–Characteristics Steady state performance prediction – Analytical Method – Power controllers – Control of SRM drive - Sensor less operation of SRM – Applications.

Permanent Magnet Brushless D.C. motors: Fundamentals of Permanent Magnets-Types- Principle of operation- Magnetic circuit analysis- EMF and Torque equations-Power Converter Circuits and their controllers - Characteristics and control-Applications.

Permanent Magnet Synchronous Motors (PMSM): Constructional features -Principle of operation – EMF and Torque equations - Sine wave motor with practical windings - Phasor diagram - Power controllers – performance characteristics -Digital controllers – Applications.

Other Special Machines: Constructional features – Principle of operation and Characteristics of Hysteresis motor- Synchronous Reluctance Motor–Linear Induction motor-Repulsion motor- Applications.

Text Books:

1. K. Venkataratnam, 'Special Electrical Machines', Universities Press (India) Private Limited, 2008.
2. T. Kenjo, 'Stepping Motors and Their Microprocessor Controls', Clarendon Press London, 1984.
3. E. G. Janardanan, 'Special electrical machines', PHI learning Private Limited, Delhi, 2014.

References:

1. R. Krishnan, 'Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application', CRC Press, New York, 2001.
2. T. Kenjo and S. Nagamori, 'Permanent Magnet and Brushless DC Motors', Clarendon Press, London, 1988.
3. T. J. E. Miller, 'Brushless Permanent-Magnet and Reluctance Motor Drives', Oxford University Press, 1989.
4. R. Srinivasan, 'Special Electrical Machines', Lakshmi Publications, 2013.

Course Outcomes:

On completion of the course, students will be able to:

EE1416.1 Explore the knowledge of construction and operation of stepper motor in practical applications.
EE1416.2 Utilize the knowledge of construction, operation, and applications of stepper switched reluctance motors.
EE1416.3 Correlate the theory of the construction and operation of permanent magnet brushless D.C. motors in practice.
EE1416.4 Acquire the knowledge of construction and operation of permanent magnet synchronous motors
EE1416.5 Select a special machine for a particular application.

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CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1416.1	3	3	3	3	-	-	1	1	-	2	-	3	3	3	3
EE1416.2	3	1	1	1	-	-	1	1	-	1	-	2	3	3	3
EE1416.3	3	3	3	3	-	-	1	1	-	2	-	3	3	3	3
EE1416.4	3	3	3	3	-	-	1	1	-	2	-	2	3	3	3
EE1416.5	3	3	3	3	3	-	2	1	-	3	-	3	3	3	3

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SEMESTER – V

Course Code	EE1516								Course Category			MM
Course Name	FUNDAMENTALS OF POWER ELECTRONICS											
Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Th					Tu		Total	Total
				CT1	CT1	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2hrs. 30min.	--	--	100	03

Course Objectives:

To make the students aware and understand:

1. The role of Power Electronics in society.
2. Selection and use of various power electronics devices.
3. AC/DC, DC/DC, DC/AC converters.

Course Contents:

Introduction to Power Electronics and Power Devices:

Applications, definitions and nature of power electronic circuits. Components of a power electronic system

Ideal switch, diode static characteristics, diode dynamic characteristics, introduction to diac and triac. SCR - operation, static and dynamic characteristic. Bipolar junction transistor - operation, static and dynamic characteristics

MOSFETs and IGBTs - operation, static and dynamic characteristics, parallel operation and loss calculation. Introduction to SiC and GaN devices

Gate and Base Drive Circuits and Protection of Devices:

Preliminary design considerations, dc-Coupled drive circuits, electrically isolated drive circuits, Cascode-connected drive circuits, thyristor drive circuits, power device protection in drive circuits, circuit layout considerations.

Non-polarised RC snubber, Polarised switching-aid circuits: The polarized turn-off snubber circuit - assuming a linear current fall, The turn-off snubber circuit - assuming a sinusoidal current fall, The polarized turn-on snubber circuit - with air core (non-

saturable) inductance, The polarized turn-on snubber circuit - with saturable ferrite inductance, The unified turn-on and turn-off snubber circuit. Snubbers for bridge legs.

Line-frequency diode rectifiers and phase-controlled rectifiers:

Diode bridge rectifiers: Single phase Half wave with R load, R-L load. Single phase Full bridge rectifier with dc link capacitive filter, issue of harmonics. Three phase Full bridge rectifier with dc link capacitive filter, issue of harmonics.

Phase-controlled rectifiers: Single phase fully-controlled AC to DC converter: Principle of operation, issue of line commutation, continuous mode of conduction: expression for average output voltage, discontinuous mode of conduction (Operation only), analysis with R-L-E load, significance of R-L-E load, operation as an inverter: constraints for line commutation. Dual converter: motivation, input displacement factor, distortion factor, harmonics, effect of source inductance.

Single phase half-controlled converter: Operating principle, input displacement factor, modes of operation in the voltage-current plane.

DC- DC Power Converters:

Limitations of Linear Power supplies, switched power supplies (Buck, Buck-Boost, Boost, Cuk, Fly-back and Forward Converters) (Operation only).

DC- AC Power Converters:

Principle of operation of Inverters: Half bridge, full bridge, three phase- six step operation (Operation only). Introduction to PWM techniques: Single, Multiple and Sinusoidal PWM.

Text Books:

1. Power Electronics – Converters, Applications and Design, Mohan, Undemand, Robbins, 3rd Ed., John Willey & Sons, 2004.
2. Power Electronics - Circuits Devices and Application, M. H. Rashid 2nd Ed., Prentice Hall of India (PHI) Pvt. Ltd., New Delhi, 2003.

Reference Books:

1. Cyril W. Lander, “Power electronics”, 3rd Ed., McGRAW-HILL Publishing Company, 1993.
2. Power Electronics–Devices, Drivers and Applications, B. W. Williams, John Wiley, 2005
3. Power Electronics Principles and Applications, Joseph Vithyathil, Tata MC-Graw-Hill Edition, 2010

Web Resources:

1. http://www.nptel.iitm.ac.in
2. www.ocw.mit.edu

Course Outcomes:

On completion of the course, students will be able to:

EE1516.1 Understand the role of Power Electronics in control and conversion of Electrical power along with various semiconductor device characteristics.

EE1516.2 Develop designing skills for device fabrication and protection.

EE1516.3 Analyse diode and phase-controlled rectifiers.

EE1516.4 Compare various DC-DC power converters and understand their working.

EE1516.5 Apply various PWM techniques to DC-AC power converters and understand inverters working.

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
EE1516.1	2	0	1	0	0	1	1	0	0	0	0	1
EE1516.2	3	2	3	3	2	0	0	0	0	0	0	0
EE1516.3	2	3	2	2	0	0	0	0	0	0	0	0
EE1516.4	3	2	1	1	0	0	1	0	0	0	0	0
EE1516.5	3	2	1	1	0	0	0	0	0	0	0	0

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
EE1516.1	2	1	0	0	0	0	0	0	0	0	1
EE1516.2	2	2	1	0	2	0	2	0	0	0	0
EE1516.3	2	2	1	1	2	1	0	0	0	0	0
EE1516.4	3	2	0	0	0	0	1	0	0	0	0
EE1516.5	3	0	0	0	3	0	1	0	0	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

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Principal

SEMESTER – VI

Course Code	EE1616							Course Category		MM
Course Name	ELECTRICAL DRIVES AND CONTROL									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2hrs. 30min.	--	--	100	03

Course Objectives:

To make the students aware and understand:

1. Operation, application and control of power conversion systems employing electric drive to cater to industrial needs.
2. Operation principles and design of starting, braking and speed control arrangements for electric motors and their applications.
3. Different industrial drives considering energy efficiency, power quality, economic justification, environmental issues and practical viabilities.

Course Contents:

Introduction to Electrical Drives: Concept, classification and advantages. Basic elements, components of load torque, torque equation, equivalent values of drive parameters. Types of mechanical loads. Selection of motor and controller, classes of duty, stability of an electrical drive. Comparison of AC and DC drives.

Starting and Braking of Electrical Drives: Solid-state starters, soft starting, calculation of starting/acceleration/reversal time and energy loss during starting. Types, advantages, limitations and purposes/objectives of electrical braking, braking of dc and induction motors.

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DC Drives: Single phase half, full and dual converter-based dc drives-circuit configurations, input output waveforms, calculation of torque, speed, power factor, firing angle etc. Torque-Speed characteristics.

Induction Motor Drives: Scalar control of induction motor–stator voltage and stator frequency control using stator voltage controllers and inverters–circuit configurations, calculation of current, torque, speed etc. Torque-Speed characteristics.

Industrial Applications: Electrical drives system for rolling mills, paper mills, cement mills, sugar mills, textile mills and traction and machine tool applications.

Text Books:

1. Fundamentals of Electrical Drives, G. K. Dubey, Narosa Publishing House, 2005
2. Electric Drives-Concepts and Applications, V. Subrahmanyam, TMH Pub, 2004
3. Modern Power Electronics and AC Drives by B. K. Bose, Pearson Education, Asia, 2003
4. Electric Drives, De and Sen, PHI Pub, 1999

References Books:

1. Thyristor DC Drives, P. C. Sen, John Wiley & Sons, 1981.
2. Power Electronic Control of AC Motors, JMD Murphy & FG Turnbull, Pergamon Press, 1988.
3. Power Semiconductor Controlled Drives, G. K. Dubey, PH Int., 1989.
4. Power Semiconductor Drives, Deewan, Straughan & Slemon, John Wiley & Sons.

Web Resources:

1. http://www.nptel.iitm.ac.in
2. www.ocw.mit.edu

Course Outcomes:

After completion of the course, the students will be able to:

EE1616.1	Identify various electrical controllers, motors, electrical drives and their functions/ characteristics.
EE1616.2	Understand starting and braking operations of electric drives.
EE1616.3	Analyse DC drives and its characteristics.
EE1616.4	Control induction motor drives.
EE1616.5	Understand various industrial applications of electrical drives.

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CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
EE1616.1	1	1	0	0	0	0	0	0	0	0	1	0
EE1616.2	2	1	1	0	0	0	0	0	0	0	1	0
EE1616.3	2	1	1	1	0	0	0	0	0	0	0	0
EE1616.4	2	1	1	0	0	0	0	0	0	0	0	0
EE1616.5	2	0	1	0	0	0	0	0	0	0	1	0

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CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
EE1616.1	1	1	0	0	0	0	0	0	0	0	0
EE1616.2	2	1	1	0	0	0	0	0	0	0	0
EE1616.3	2	1	1	1	0	0	0	0	0	0	0
EE1616.4	2	1	1	0	0	0	0	0	0	0	0
EE1616.5	2	0	1	0	0	0	0	0	0	0	0

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