SCHEME OF

M. TECH DEGREE IN

POWER ELECTRONICS & DRIVES

(Department of Electrical Engineering)

EFFECTIVE FROM 2024-2025

NATIONAL INSTITUTE OF TECHNOLOGY

DELHI

(NIT DELHI)

Department of Electrical Engineering
National Institute of Technology Delhi

1.1 About the Department

Department of Electrical Engineering (EE), National Institute of Technology Delhi was established in 2010 under the ages of Ministry of Human Resource and Development (MHRD), Govt. of India. Currently it is offering one Undergraduate (B. Tech) course and one Postgraduate (M. Tech) courses in Power Electronics & Drives. The Department also offers PhD programme in relevant areas. The department is equipped with state-of-the-art facilities to carry out research work at all levels. The research focus of the department is in the area of power system reliability, power electronics, renewable energy systems, power systems, control/time delay systems, pattern recognition, image processing etc. The department also actively involved in multi-disciplinary research activities. The UG program is embraced by rigor and span to prepare a practicing engineer for a lifetime of creative work and ongoing technical learning. The department provides healthy & competitive environment for all round development of students leading to several remarkable achievements in GATE, CAT, GRE, TOEFEL, PSUs etc. The department has laboratories, equipped with latest equipment and software platforms, to impart state-of-the art technical knowledge. The department aims to setup new laboratories such as Green Energy Technologies, Digital Control & FPGA Design, Biometric etc. The Department has active collaborations with Institutes & research institutes in India and abroad.

The Department of EE has a blend of young as well as experienced dynamic faculty members and is committed to provide quality education and research in the field. Faculty members of the department have excellent academic & research credentials and published numerous peer reviewed journal articles/ papers, Books, Book Chapters etc. in diversified field and having adequate experience in advanced research. The department hopes to achieve the national goals and objectives of industrialization and self-reliance. As a result, it hopes to produce graduates with strong academic and practical background so that they can fit into the industry immediately upon graduation.

1.2 Vision

- To excel in education, research and development services in electrical engineering in tune with societal aspirations.

1.3 Mission

- Impart quality education to produce globally competent electrical engineers capable of extending technological services.
- To create entrepreneurial environment and industry interaction for mutual benefit.
- To be a global partner in training human resources in the field of power and energy systems.
- Nurture scientific temperament, professional ethics and industrial collaboration.

M. Tech. (Power Electronics and Drives) Semester wise Credit Structure

Sl. No.	Courses	Credits				Total
		1st Year		2nd Year		
		1st Sem	2nd Sem	3rd Sem	4th Sem	
1	Program Core	09	09	0	0	18
2	Program Electives	09	09	0	0	18
3	Dissertation	0	0	16	16	32
4	Lab	02	02	0	0	04
5	MOOCs Course / Independent Study Course	0	0	3	3	06
6	Seminar	0	0	1	1	02
Total		20	20	20	20	80

M. Tech (PED) 1 Year I Semester				
S.No	**Course**	**Course Title**	**L-T-P**	**C**
1	EELM 501	Power Electronics Devices & Converters (Mandatory)	3-0-0	3
2	EELM 5XX	Core-I	3-0-0	3
3	EELM 5XX	Core-II	3-0-0	3
4	EELM 5XX	Elective-I	3-0-0	3
5	EELM 5XX	Elective – II	3-0-0	3
6	EELM 5XX	Elective – III	3-0-0	3
7	EEPM 504	Power Electronics Lab	0-0-3	2
Total			**18-0-3**	**20**
M. Tech (PED) 1 Year II Semester				
S.No	**Course**	**Course Title**	**L-T-P**	**C**
1	EELM 551	Switched Mode Power Converters (Mandatory)	3-0-0	3
2	EELM 5XX	Core-III	3-0-0	3
3	EELM 5XX	Core-IV	3-0-0	3
4	EELM 5XX	Elective – IV	3-0-0	3
5	EELM 5XX	Elective – V	3-0-0	3
6	EELM 5XX	Elective – VI	3-0-0	3
7	EEPM 554	Electrical Drives Lab	0-0-3	2
Total			**18-0-3**	**20**
M. Tech (PED) II Year III Semester				
S.No	**Course**	**Course Title**	**L-T-P**	**C**
1	EEPM 603	Dissertation-I		16
2		MOOC Course/ Independent Study*		3
2	EEPM 604	Seminar-I	0-0-2	1
Total				**20**
M.Tech (PED) II Year IV Semester				
S.No	**Course**	**Course Title**	**L-T-P**	**C**
1	EEPM 652	Dissertation-II		16
2		MOOC Course/ Independent Study		3
3	EEPM 653	Seminar-II	0-0-2	1
Total				**20**
Total Credits				**80**

Special Note for Selection of Massive Open Online Courses (MOOCs)/ Independent Study Courses

- Students are encouraged to take the above-mentioned MOOCs courses in their 3rd and 4th semesters preferably. The MOOCs courses can only be decided by the students in consultation with the Supervisor / Convener, DPGC (EE) and HoD (EE) and should be in allied/ relevant area related to the list of elective courses provided in the scheme.

- However, students willing to take those above MOOCs courses during their 1st and 2nd semester are also allowed but their evaluation and marks to be credited during their 3rd and 4th semesters respectively as indicated above.

- If a student completes a MOOC course and submits the evaluation result by the end of 3rd and 4th semester respectively, the they will be exempted from appearing for the Institute examination in the respective Independent Study Course – I (in the 3rd semester) and Independent Study Course – II (in the 4th semester).

- A student failing to complete the MOOC courses will have to choose an Independent Study course-I (in the 3rd semester) and Independent Study Course – II (in the 4th semester), (*from the list of elective courses and also which is not running in that semester/ previously not studied by the concern student*), have to complete (as per the Institute's procedure) the self-study and examinations as per the Institute's rules and regulations.

Departmental Core

S.No	Course	Course Title	L-T-P
1	EELM 502	Dynamics of Electrical Machines	3-0-0
2	EELM 503	Electrical Drives	3-0-0
3	EELM 552	Advanced Electrical Drives	3-0-0
4	EELM 553	Power Electronics for Renewable Energy Systems	3-0-0

Departmental Elective

S.No	Course	Course Title	L-T-P
1	EELM 511	Power Quality	3-0-0
2	EELM 512	Flexible AC Transmission Systems (FACTs)	3-0-0
3	EELM 513	Digital Control in Power Electronic Systems	3-0-0
4	EELM 514	Digital Signal Processor & its applications to Power Electronics	3-0-0
5	EELM 515	Soft Computing and Applications	3-0-0
6	EELM 516	Analog Integrated Circuit Design	3-0-0
7	EELM 517	AI Techniques and Applications	3-0-0
8	EELM 518	Internet of Things	3-0-0
9	EELM 525	Digital Control	3-0-0
10	EELM 534	Digital Signal Processing	3-0-0
11	EELM 539	Electric Machine Design	3-0-0
12	EELM 537	Signal Processing and Transforms	3-0-0
13	EELM 538	Deep Learning with Artificial Neural Network	3-0-0
14	EELM 557	Energy Auditing and Management	3-0-0
15	EELM 561	Robust Control	3-0-0
16	EELM 562	Special Electrical Machines	3-0-0
17	EELM 563	Applied Linear Algebra	3-0-0
18	EELM 564	Advanced Control Systems	3-0-0
19	EELM 565	FPGA based Digital Design Techniques	3-0-0
20	EELM 566	Optimal Control	3-0-0
21	EELM 567	Electric Vehicles	3-0-0
22	EELM 568	Energy Storage Devices	3-0-0
23	EELM 569	Telemetry Systems	3-0-0
24	EELM 591	Introduction to Smart Grid	3-0-0
25	EELM 592	DC Microgrid and Control System	3-0-0
26	EELM 593	Digital Control in Switched Mode Power Converters and FPGA based Prototyping	3-0-0
27	EELM 594	Design of Electric Motors	3-0-0
28	EELM 599	Condition Monitoring and Faults Diagnosis	3-0-0

***MOOC Course/ Independent Study**

Sr. No.	Course code	Course Title	C
1	EELM 605	Smart Grid: Basics to Advanced Technologies	3
2	EELM 606	Power Electronics Application in Power Systems	3
3	EELM 607	Microelectronics: Devices to Circuits	3
4	EELM 608	Design of Photovoltaic Systems	3
5	EELM 609	Advanced Linear Continuous Control Systems: Applications with MATLAB Programming and Simulink	3
6	EELM 610	DC Microgrid and Control System	3
7	EELM 611	Advance power electronics and Control	3
8	EELM 612	Energy Conversion Technologies (Biomass and Coal)	3
9	EELM 613	Sensor Technologies: Physics, Fabrication and Circuits	3
10	EELM 614	An Introduction to Coding Theory	3
11	EELM 615	Technologies for Clean and Renewable Energy Production	3
12	EELM 616	Digital Switching - I	3
13	EELM 617	Introduction to Adaptive Signal Processing	3
14	EELM 618	Physical Modelling for Electronics Enclosures using Rapid prototyping	3
15	EELM 619	Advances in UHV Transmission and Distribution	3
16	EELM 620	Electronic Modules for Industrial Applications using Op-Amps	3
17	EELM 621	Electrical Equipment and Machines: Finite Element Analysis	3
18	EELM 622	System Design Through Verilog	3
19	EELM 623	VLSI Interconnects	3

Course no: EELM 501	**Open course (Y/N)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
Type of course	N	N	Y	N
Course Title	**Power Electronics Devices & Converters**			
Course Coordinator				
Course objectives:	• To introduce students with the basic theory of power semiconductor, their practical application in power electronics. • To familiarize the operation principle of AC-DC, DC-DC, DC-AC conversion circuits and their applications. • To enhance the knowledge and understanding of power electronic converters and their application in power electronic systems. • To provide students with the skills and techniques necessary to analyze and synthesize power electronic circuits utilizing modern power electronic devices.			
POs				

Semester	Autumn: I Semester		Spring	
	Lecture	Tutorial	Practical	Credits
Contact Hours	3	0	0	3
Prerequisite course code as per proposed course numbers				
Prerequisite credits				
Equivalent course codes as per proposed course and old course				
Overlap course codes as per proposed course numbers				

Text Books:		
1.	Title	Power Electronics Converters, Applications, and Design
	Author	Ned Mohan, Tore M. Undeland, William P. Robbins
	Publisher	Wiley India Pvt Ltd
	Edition	3rd
2.	Title	Semiconductor Device Modeling with Spice
	Author	G. Massobrio, P. Antognetti
	Publisher	McGraw-Hill
	Edition	2nd
Reference Book:		
1.	Title	Power Semiconductor Devices
	Author	B. Jayant Baliga
	Publisher	International Thompson Computer Press
	Edition	1st
2.	Title	Discrete and Integrated Power semiconductor Devices: Theory and Applications
	Author	V. Benda, J. Gowar, and D. A. Grant
	Publisher	John Wiley & Sons
	Edition	1999

Content	**Unit I: Power Electronic Devices** Overview of power switching devices such as: Thyristor, GTOs, BJTs, MOSFETs, and IGBTs etc. and their static and dynamic characteristics. Firing / Triggering techniques and commutation techniques. **Unit II: Phase Controlled Multi-pulse Converters** Review of uncontrolled converters, Phase controlled converters: Single-Phase and Three-Phase full converters, semi-converters, Half-controlled converters, dual converters etc. Effect of source inductance, Harmonic Analysis, Extinction and Symmetrical Angle control, PWM control, SPWM control. Power Factor Correction rectifiers. **Unit III: AC Controllers and Cycloconverters** Principle of phase control, Integral cycle control, Single phase voltage controllers, Sequence control of AC voltage controllers, step-up cycloconverter, step-down cycloconverter, three phase to single phase cycloconverter, three phase to three phase cycloconverter, carrier based control schemes & non-carrier based control scheme. **Unit IV: Switching Mode Inverters** Basic concept of 1-Φ, 3-Φ Switching Inverters: 120o and 180o modes of operation, Inverter configurations Voltage-Source Inverter, Current-Source Inverter, Line Commutated Inverters, Unipolar and Bipolar Switching, PWM modulation techniques for Switching Inverters: single, multiple and sinusoidal, space vector modulation (SVM), Harmonic Reduction Techniques. Multi-Level Inverters: topologies and control strategies.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EELM 502	**Open course (Y/N)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
Type of course	N	N	Y	N
Course Title	**Dynamics of Electrical Machines**			
Course Coordinator				
Course objectives:	• To improve the analysis and solving problem skills related to electrical machines • To apply the theory of machine dynamics to induction motor starting, speed control, braking, and protection. • To develop the research, and design of power electronic circuits, automated systems, and electrical power systems.			
POs				

Semester	Autumn		Spring	
	Lecture	Tutorial	Practical	Credits
Contact Hours	3	0	0	3
Prerequisite course code as per proposed course numbers				
Prerequisite credits				
Equivalent course codes as per proposed course and old course				
Overlap course codes as per proposed course numbers				

Text Books:		
1.	Title	Analysis of Electrical Machines and Drive Systems
	Author	Krauss, Wasyncsuk and Sudholf
	Publisher	John Wiley
	Edition	3rd
2.	Title	Generalized Theory of Electrical Machines
	Author	PS. Bhimbra
	Publisher	Khanna Publishers
	Edition	2006
Reference Book:		
1.	Title	Electric Machinery
	Author	A E Fitzgerald, Kingsley, and Umans
	Publisher	McGraw Hill
	Edition	6th
2.	Title	Modern Power Electronics & AC Drives
	Author	Bimal K Bose
	Publisher	Pearson Education
	Edition	2002

Content

Unit I: Introduction

Unified approach to the analysis of electrical machine, basic two-pole machine, Kron's primitive machine, voltage, power and torque equation, linear transformation from 3-phase to 2-phase, transformation from rotating axes to stationary axes, power invariance, park's transformation for 3-phase synchronous and induction machines.

Unit II: DC Machines

Application of generalized theory to separately excited, shunt, series and compound machines, sudden short circuit of separately excited generator,

	separately excited dc motor, steady state and transient analysis, transfer functions of separately excited dc generator & motor. **Unit III: Polyphase Synchronous Machines** Generalized machine equations, steady state analysis of salient pole and non salient pole machines, phasor diagrams, power angle characteristics, reactive power, short circuit ratio, transient analysis, sudden 3-phase short circuit at generator terminals, reactance, time constants, transient power angle characteristics. **Unit IV: Induction Machines** 3-phase induction machine, generalized model, voltage equation, steady state analysis, equivalent circuit, torque-slip characteristics, effect of voltage and frequency variations, electric transients in induction machines, speed control of induction motor, introduction to vector control, applications in speed control of induction machine.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EELM 503	Open course (Y/N)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
Type of course	N	N	Y	N
Course Title	**Electrical Drives**			
Course Coordinator				
Course objectives:	• To understand the basic principles of power electronics in drives to synthesize the voltages in dc and ac motor drives. • To understand the basic concepts of magnetic circuits as applied to electric machines. • To learn to use space vectors presented on a physical basis to describe the operation of an ac machine. • To earn about the energy efficiency of electric drives and inverter-motor interactions.			
POs				

Semester	Autumn		Spring	
	Lecture	Tutorial	Practical	Credits
Contact Hours	3	0	0	3
Prerequisite course code as per proposed course numbers				
Prerequisite credits				
Equivalent course codes as per proposed course and old course				
Overlap course codes as per proposed course numbers				

Text Books:		
1.	Title	Fundamentals of Electric Drives
	Author	Dubey G. K.
	Publisher	Narosa Publishing House
	Edition	2nd
2.	Title	Power Electronics and Motor Control
	Author	Shepherd, Hulley, Liang
	Publisher	Cambridge University Press
	Edition	2nd Edition, 2012
3.	Title	Modern power Electronics and AC drives,
	Author	B.K.Bose
	Publisher	pearson publications
	Edition	1st Edition, 2001
4.	Title	Control of Electric Drives
	Author	Werner Leonhard
	Publisher	Springer
	Edition	1st Edition, 2001
Reference Book:		
1.	Title	Power Electronic Circuits, Devices and Applications
	Author	Muhammad H. Rashid
	Publisher	Pearson Publishers
	Edition	4th Edition, 2023

2.	Title	Control of Induction Motors
	Author	Andrzej M. Trzynadlowski
	Publisher	Academic Press
	Edition	1st Edition, 2000

3.	Title	Dynamics and control of electrical drives
	Author	Piotr Wach
	Publisher	Springer, 2011 Edition
	Edition	1st Edition, 2011

Content	**Unit I: Introduction** Introduction to Electric Drives, Electric Drive Systems versus Mechanical Drive Systems. Converter Controlled Dc Motor Drives: Steady state analysis of semi-controlled and fully controlled converter fed series and separately excited D.C motor drives: Continuous and discontinuous conduction mode, open /closed loop control. Chopper Controlled Dc Motor Drives: Four quadrant chopper circuit – closed loop control of chopper fed dc drive –Steady state analysis of chopper controlled DC motor drives. **Unit II: Voltage Source Inverter Fed Induction Motor Drives** Scalar control- Voltage fed Inverter control-Open loop volts/Hz control- Speed control with slip regulation-Speed control with torque and Flux control-Current controlled voltage fed Inverter Drive**.** **Unit III: Current Source Inverter Fed Induction Motor Drives** Current-Fed Inverter control-Independent current and frequency control-Speed and flux control in Current-Fed Inverter drive-Volts/Hz control of Current-Fed Inverter drive-Efficiency optimization control by flux program. **Unit IV: Rotor Side Control of Induction Motor** Rotor resistance control- fixed resistance control, variable resistance control-converter controlled rotor resistance control, Slip power recovery schemes-Static Kramer drive-Phasor diagram-Torque expression-Speed control of a Kramer drive-Static scherbius drive-Modes of operation
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EELM 552	Open course (Y/N)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
Type of course	N	N	Y	N
Course Title	**Advanced Electrical Drives**			
Course Coordinator				
Course objectives:	• To understand that how to operate and maintain different types of DC/AC and special electrical machine drives in the industry • To understand the principle of soft switching in inverters and converters utilizing resonant circuits, modulation strategies and application in IM drives • To understand the application of modern and evolutionary techniques such as fuzzy and ANN control in Advanced electrical drives			
POs				

Semester	Autumn		Spring	
	Lecture	Tutorial	Practical	Credits
Contact Hours	3	0	0	3
Prerequisite course code as per proposed course numbers				
Prerequisite credits				
Equivalent course codes as per proposed course and old course				
Overlap course codes as per proposed course numbers				

Text Books:		
1.	Title	Electric Motor Drives Modeling, Analysis & control
	Author	R. Krishnan
	Publisher	Pearson Education
	Edition	1st Edition, 2015
2.	Title	Modern Power Electronics and AC Drives
	Author	B. K. Bose
	Publisher	Pearson Publications
	Edition	1st Edition, 2001
3.	Title	Sensorless Vector Direct Torque control
	Author	Peter Vas
	Publisher	Oxford University Press
	Edition	1st Edition, 1998
Reference Book:		
1.	Title	Power Electronics control of AC motors
	Author	MD Murphy & FG Turn Bull
	Publisher	Pergman Press
	Edition	1st edition-1998
2.	Title	Power Semiconductor drives
	Author	G.K. Dubey
	Publisher	Prentice Hall of India Private Limited
	Edition	1st edition-1998

Content	**Unit I:** Scalar Control versus Vector Control, vector control of induction motor: Principles of vector control, Direct vector control, Indirect vector control, implementation – block diagram; estimation of flux, flux weakening operation. Sensor less vector control of induction motor: Estimation techniques. **Unit II:** Direct Torque Control of Induction Motor Drives, Space Phasor representation, Flux and torque control, Switching implementation, Sensor less operation **Unit III:** Control of synchronous motor drives: Structure-Stator Excitation-techniques of sensor less operation-convertor topologies- Waveforms- drive design factors-Torque controlled synchronous motor drives-Torque Ripple- Instantaneous Torque control -using current controllers-flux controllers. **Unit IV:** Control of Special Machines: principle of operation of PMSM and BLDC Machine, Stepper Motors, Switched Reluctance Motors and Synchronous Reluctance motors
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EELM 553	Open course (Y/N)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
Type of course	No	No	Yes	No
Course Title	Power Electronics for Renewable energy sources			
Course Coordinator				
Course objectives:	CO-1: Gain comprehensive understanding of the solar photovoltaic systems, wind generation system and their design. CO-2: Gain comprehensive understanding of the Fuel Cells and energy storage systems. CO-3: Illustrate the power converters for renewable energy systems. CO-4: Comprehend the knowledge of operation and control of multi-source renewable energy systems.			
POs				
Semester	Autumn: 1st Semester		Spring:	
	Lecture	Tutorial	Practical	Credits
Contact Hours	3	0	0	3
Prerequisite course code as per proposed course numbers	NA			
Prerequisite credits	NA			
Equivalent course codes as per proposed course and old course	NA			
Overlap course codes as per proposed course numbers	NA			

Text Books:		
1.	Title	Power Electronics for Renewable and Distributed Energy Systems
	Author	Sudipta Chakraborty, Marcelo G. Simoes, William E Kramer
	Publisher	Springer
	Edition	-
2.	Title	Non-Conventional Energy Resources
	Author	S. N. Singh
	Publisher	Pearson
	Edition	-
Reference Book:		
1.	Title	Power Electronics for Renewable Energy Systems, Transportation, and Industrial Application
	Author	Haitham Abu-Rub, Mariusz Malinowski, Kamal Al-Haddad
	Publisher	IEEE Press, Wiley
	Edition	-
2.	Title	Wind Power Technology
	Author	Joshua Earnest
	Publisher	PHI
	Edition	2nd
3.	Title	Solar Photovoltaics (Fundamental, Technologies, and Applications
	Author	Chetan S. Solanki
	Publisher	PHI

	Edition	2nd
4.	Title	Renewable Energy, Power for Sustainable Future
	Author	Godfrey Boyle
	Publisher	Oxford
	Edition	3rd
5	Title	Grid Converters for Photovoltaic and Wind Power Systems
	Author	Remus Teodorescu, Marco Liserre, Pedro Rodriguez
	Publisher	Wiley-IEEE Press
	Edition	2011
6	Title	Power Electronic Converters for Microgrids
	Author	Suleiman M. Sharkh, Mohammad A. Abu-Sara, Georgios I. Orfanoudakis, Babar Hussain
	Publisher	Wiley-IEEE Press
	Edition	2014

Content

Unit-I: Introduction

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment. Qualitative study of different renewable energy resources: Solar, Wind, Tidal, Small-hydro, Biomass, Hydrogen energy systems (Fuel cell) and hybrid renewable energy systems.

Unit II: Solar Photovoltaic Systems

Construction and working, mathematical models (single-diode and two-diode), I- V and P-V characteristics. Concept of maximum-power, maximum-power point tracking algorithms (P&O and InC). Power converter configurations and their selection for solar PV application: dc-dc converters and solar inverters. Grid connected and off-grid PV systems with and without storage. Grid synchronization and PLLs. Battery and PV array sizing.

Unit III: Wind Energy System

Wind: Wind energy basics, aerodynamic power, Betz limit. On-shore and Off-shore wind farms. Wind turbines and generators: types of wind turbines-HAWT, VAWT: construction and operation. Control of wind turbines: pitch control, stall control, yaw control, and speed variation. Power electronics for wind power: power converter and inverter configuration, partial rated power electronics, soft-starters etc. Introduction to IG, PMSG, SEIG, and DFIG.

Unit IV: Fuel Cell System and Energy Storage

Fuel cells: construction and working, types of fuel cells, characteristics. Power converter configurations for integrating fuel cells. Energy-storage solutions for renewable energy systems.

Unit V: Hybrid Renewable Energy Systems

Need for hybrid renewable energy systems, block-diagram representation, demonstration of operation and control of multi-source (solar pv, wind, fuel-cell and battery) hybrid AC/DC Nano-Grid in grid connected and islanded mode. Grid connection issues.

Course Assessment	Theory: Continuous Evaluation 25%, Mid Semester 25%, End Semester 50%. Continuous evaluation shall depend on course coordinator.

Course no: EEPM 504	**Open course (Y/N)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
Type of course	N	N	Y	N
Course Title	**Power Electronics Lab**			
Course Coordinator				
Course objectives:	A student who successfully fulfills the course requirements will have: • The knowledge of analysis, design, simulation, and experimentation of various power electronics circuits including AC-DC, and DC-AC • The skills and knowledge of techniques necessary to analyze and synthesize power electronic circuits utilizing modern power electronic devices.			
POs				

Semester	Autumn: I Semester		Spring	
	Lecture	Tutorial	Practical	Credits
Contact Hours	0	0	3	2
Prerequisite course code as per proposed course numbers				
Prerequisite credits				
Equivalent course codes as per proposed course and old course				
Overlap course codes as per proposed course numbers				

Text Books:		
1.	Title	Power Electronics Laboratory: Theory, Practice & Organization
	Author	O. P. Arora
	Publisher	Alpha Science International Limited
	Edition	2007
2.	Title	Power Electronics Converters, Applications, and Design
	Author	Ned Mohan, Tore M. Undeland, William P. Robbins
	Publisher	Wiley India Pvt Ltd
	Edition	3rd
3.	Title	Semiconductor Device Modeling with Spice
	Author	G. Massobrio, P. Antognetti
	Publisher	McGraw-Hill
	Edition	2nd
Reference Book:		
1.	Title	Power Semiconductor Devices
	Author	B. Jayant Baliga
	Publisher	International Thompson Computer Press
	Edition	1st
2.	Title	Discrete and Integrated Power semiconductor Devices: Theory and Applications
	Author	V. Benda, J. Gowar, and D. A. Grant

		Publisher	John Wiley & Sons
		Edition	1999
Content	1. To study & operate MOSFET/IGBT with gate-base triggering circuit. 2. To study & operate single phase Semi converter with: a) R Load. b) RL load. c) RLE (Motor) Load 3. To study & operate single phase Fully controlled converter with: a) R Load. b) RL load. c) RLE (Motor) Load 4. To study & operate three phase semi converter 5. To study & operate three phase fully controlled converter 6. To study & operate single phase Dual converter 7. Simulation of single phase AC Voltage Controller. a) Lamp load b) Motor load 8. Simulation of three phase AC Voltage Controller. a) Lamp load b) Motor load 9. To study the operation of three phase full bridge inverter for: a) 180 degree mode b) 120 degree mode. 10. Simulation of PWM inverters with: a) Sinusoidal PWM b) Square PWM 11. To study & operate step-up cycloconverter for continuous and discontinuous mode. 12. To study & operate step-down cycloconverter for continuous and discontinuous mode.		
Course Assessment	Continuous Evaluation 50% End Semester 50%		

Course no: EELM 551	**Open course (Y/N)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
Type of course	N	N	Y	N
Course Title	**Switched Mode Power converters**			
Course Coordinator				
Course objectives:	• To understand the concepts and basic operation of efficient switched-mode power conversion, including basic circuit operation and magnetics design. • To understand how to analyze and model steady-state converter operation, switch realization, and continuous/discontinuous operation modes for converters with and without transformer isolation. • To understand how to analyze and model design techniques related to magnetic components in switched-mode power converters. • To make practically acquainted with digital technology applications in control of switched mode power electronic converters			
POs	After successful completion of this course students will be able to: • Understand various approaches for the analysis and to model steady-state converter operation. • Understand dynamic of modeling of DC-DC converters, Resonant Converters etc. • Design and Model SMPS.			

Semester	Autumn		Spring: II Semester	
	Lecture	Tutorial	Practical	Credits
Contact Hours	3	0	0	3
Prerequisite course code as per proposed course numbers				
Prerequisite credits				
Equivalent course codes as per proposed course and old course				
Overlap course codes as per proposed course numbers				

Text Books:		
1.	Title	Fundamentals of Power Electronics
	Author	Robert W. Erickson, and Dragan Maksimovic
	Publisher	Springer
	Edition	2nd (2002)
2.	Title	Power Electronics: A first course
	Author	Ned Mohan
	Publisher	John Wiley & Sons, Inc.
	Edition	2012
Reference Book:		
1.	Title	Power Electronic Circuits
	Author	Issa Batarseh
	Publisher	John Wiley & Sons, Inc.

	Edition	2003
2.	Title	Power Electronics Handbook
	Author	M.H. Rashid
	Publisher	Butterworth-Heinemann
	Edition	3rd (2010)
3.	Title	Switching Power Supply design
	Author	Abraham I Pressman, Keith Billings, and Taylor Morey
	Publisher	McGraw-Hill Professional
	Edition	3rd

Content	**Unit I: Application of Power Converters** Power Supplies: Introduction to Linear Power Supplies, Overview of Switch-Mode DC Power Supply (SMPS). Power Conditioners and UPS. Electric Utility Applications of power electronic converters. **Unit II: DC-DC Converters** Study of class A,B,C,D choppers, Non-Isolated Converters:- BUCK, BOOST, BUCK-BOOST, Cuk, SEPIC etc. steady-state and time-domain analysis in CCM & DCM mode of operation. Isolated Converter: – Classification, need of isolation, Basic concepts and analysis of Buck and Boost derived isolated converters such as Forward, Fly-Back, Push-Pull, Half-Bridge, Full-Bridge etc. **Unit III: Resonant Converters** Classification of Resonant converters, Concepts of soft-switching, Zero-Voltage (ZVS) and Zero-Current Switching (ZCS), Classification of soft switching resonant converters. Introduction to Zero-voltage transition (ZVT) and zero current transition (ZCT) converters. **Unit IV: Design and Modeling of DC-DC Converters** Design of power stage of converters: magnetic components, filter capacitor, selection of rating of devices, Thermal Design, Filter Design. Basic AC modeling, State-Space Average model, Circuit Averaging, Averaged Switched Model, Canonical Circuit Model. Derivation of converter transfer functions. **Unit V: Control of DC-DC Converters** Mechanism of loop stabilization, Compensator design, Feedback control schemes for dc-dc converters such as voltage-mode control and current mode control etc. PWM techniques for converters.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course No. EEPM 554	Open Course (Yes/No)	HM Course (Y/N)	DC (Y/N)	DE(Y/N)
Type of the Course	N	N	Y	N
Course Title	**Electrical Drives Lab**			
Course Co-ordinator				
Course Objectives	The objective of this course is simulation of various AC and DC drives and experimental validation of some of them.			
POs				
Semester	Autumn		Spring	
	Lecture	Tutorial	Practical	Credits
Contact Hours	0	0	4	2
Pre-requisite course code as per proposed course members	Nil	Nil	Nil	0
Prerequisite credits	Nil	Nil	Nil	Nil
Equivalent course codes as per proposed course and old course	Nil	Nil	Nil	Nil
Overlap course codes as per proposed course numbers	Nil	Nil	Nil	Nil
Text Book(s)				
1.	**Title**	Modern Power Electronics and AC Drives		
	Author	Bimal K. Bose		
	Publisher	Prentice Hall PTR		
	Edition	2nd Edition		
Reference Book(s)				
1.	**Title**	Electric Motor Drives – Modeling, Analysis & Control		
	Author	R. Krishnan		
	Publisher	Prentice Hall		
	Edition	2nd Edition		
Content	**Student ought to perform any three out of the following:** 1. To perform dynamic simulation of speed controlled DC motor drive 2. To simulate speed control of Kramer Drive 3. To simulate Field Oriented Control (FOC) of a three-phase induction motor without using speed sensors. 4. To simulate Direct Stator Flux and Torque control (DSFTC) of a three-phase induction motor. 5. To simulate open-loop volts/hertz control of synchronous motor drive. 6. To simulate and experimentally validate V/F control of a three-phase induction motor using micro-controller. 7. To simulate speed control of a BLDC motor drive employing Hall-sensors.			
Course Assessment	Continuous Evaluation - 50% End Semester - 50%			

Course No. **EELM 511**	**Open Course (YN)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
Type of the Course	N	N	N	Y
Course Title	**Power Quality**			
Course Coordinator				
Course Objectives	The objectives of the course include introduction of the power quality definitions, voltage sags, interruptions, harmonic problems andmitigation.			
POs				
Semester	Autumn		Spring	
	Lecture	Tutorial	Practical	Credits
Contact Hours	03	0	0	3
Pre-requisite course code as per proposed course members	Nil	Nil	Nil	0
Prerequisite credits				
Equivalent course codes as per proposed course and old course				
Overlap course codes as per proposed course numbers				

Text Book(s)		
1.	**Title**	Electrical Power Systems Quality
	Author	Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H.Wayne Beaty
	Publisher	McGraw Hill Education
	Edition	Third Edition
Reference Book(s)		
1.	**Title**	Power System Harmonic Analysis
	Author	Arrillaga J., Smith B. C., Watson N. R. and Wood A. R
	Publisher	Wiley India
	Edition	2nd Edition
2.	**Title**	Power System Analysis
	Author	Arthur R.B.
	Publisher	Pearson Education
	Edition	2nd Edition
3.	**Title**	Power Quality
	Author	Sanskaran
	Publisher	C.R.C. Press
	Edition	2nd Edition

Content	**Unit I: Concept of Power Quality** Frequency variations, voltage variations- sag and swell, waveform distortion –dc offset, harmonics, inter-harmonics, notching and noise. **Unit II: Fundamentals of Harmonics** Representation of harmonics, waveform, harmonic power, measures of harmonic distortion; Current and voltage limits of harmonic distortions: IEEE, IEC, EN, NORSOK. **Unit III: Causes of Harmonics** 2-pulse, 6-pulse and 12-pulse converter configurations, input current waveforms and their harmonic spectrum; Input supply harmonics of AC regulator, integral cycle control, cycloconverter, transformer, rotating machines, ARC furnace, TV and battery charger. **Unit IV: Effect of Harmonics** Parallel and series resonance, effect of harmonics on static power plant – transmission lines, transformers, capacitor banks, rotating machines, harmonic interference with ripple control systems, power system protection, consumer equipments and communication systems, power measurement. **Unit V: Elimination/ Suppression of Harmonics** High power factor converter, multi-pulse converters using transformer connections (delta, polygon) Passive Filters: Types of passive filters, single tuned and high pass filters, filter design criteria, double tuned filters, damped filters and their design. Active Power Filters: Compensation principle, classification of active filters by objective, system configuration, power circuit and control strategy. Shunt Active Filter: Single-phase active filter, principle of operation, expression for compensating current, concept of constant capacitor voltage control; Three-phase active filter: Operation, analysis and modelling; Instantaneous reactive power theory. Three-phase Series Active Filter: Principle of operation, analysis and modelling.
Course Assessment	Continuous Evaluation - 25% Mid Semester- 25% End Semester - 50%

Course No. EELM 515	Open Course (Yes/No)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
Type of the Course	N	N	Y	N
Course Title	**Soft Computing and Applications**			
Course Coordinator				
Course Objectives	• Single and multi-layer perceptron understanding for classification in machine learning • Develop and validate Matlab based mathematical models for data classification • Comprehend neuro-fuzzy model implementation • Learn to use machine learning model implementation			
POs				
Semester	Autumn		Spring	
	Lecture	Tutorial	Practical	Credits
Contact Hours	3	0	0	3
Pre-requisite course code as per proposed course members	Nil	Nil	Nil	0
Prerequisite credits				
Equivalent course codes as per proposed course and old course				
Overlap course codes as per proposed course numbers				

Text Book(s)		
1.	**Title**	Neuro Fuzzy and Soft Computing
	Author	J.S.R. Jang, C.T. Sun and E. Mizutani
	Publisher	Prentice Hall
	Edition	3rd
2.	**Title**	Neural Network & Learning Machines
	Author	Simon O. Haykin
	Publisher	Prentice Hall
	Edition	2nd Edition
Reference Book(s)		
1.	**Title**	Soft Computing
	Author	Saroj Kaushik
	Publisher	Mc Graw Hill
	Edition	
2.	**Title**	Applied Machine Learning
	Author	M. Gopal
	Publisher	Mc Graw Hill
	Edition	

3.	**Title**	An Introduction to Genetic Algorithms
	Author	M. Mitchell
	Publisher	MIT Press
	Edition	
Content	**Unit I: Introduction** Basic mathematics of soft computing, Learning and statistical approach to regression and classification. **Unit II: Neural Networks** Single layer perceptron, ADALINE, LMS algorithm, Multi-layer perceptron, Radial basis function, Associative Memory Networks, Hopfield Network, Principal component analysis, RNN, MATLAB Programming. **Unit III: Support Vector Machines (SVM)** Introduction to SVM, Binary classification, Regression by SVM: linear & nonlinear, Decomposing multiclass classification into binary classification. SVM MATLAB Applications **Unit IV: Hybrid Intelligent System: Neuro-Fuzzy** Introduction, Models of Neuro-fuzzy system (NFS), Interpretation of NFS layers, Adaptive N-F Inference system (ANFIS) Architecture, T-S Fuzzy system, Mamdani Fuzzy System, ANFIS MATLAB Applications **Unit V: Optimization Techniques** Introduction to Optimization, Genetic algorithms, Particle swarm optimization, Matlab programming.	
Course Assessment	Continuous Evaluation - 25% Mid Semester- 25% End Semester - 50%	

Course no: EELM 518	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
Type of course				YES
Course Title	**Internet of Things**			
Course Coordinator				
Course objectives:	1. To study fundamental concepts and architecture of IoT. 2. To understand the role of sensors and actuators in IoT. 3. To learn different protocols used for IoT design. 4. To understand design methodology and hardware development platforms. 5. To understand the applications of IoT in different domains and the challenges associated with IoT.			
POs				

Semester	**Autumn: Yes**		**Spring:**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:

1.	Title	Internet of Things - A Hands-on Approach
	Author	Arsheep Bahga and Vijay Madisetti
	Publisher	Orient Blackswan Private Limited - New Delhi.
	Edition	1st
2.	Title	The Internet of Things: Key Applications and Protocols
	Author	Olivier Hersent, David Boswarthick, and Omar Elloumi
	Publisher	Wiley
	Edition	2nd Edition

Content

Unit I: Fundamentals of IoT

Introduction to Internet of Things, Definition and Characteristics of IoT, Evolution of IoT, Related concepts: M2M, IIoT, Wireless Sensor Networks, and Industry 4.0, IoT Networking Components, Addressing strategies, Basic building blocks of IoT device.

Unit II: Sensors and Actuators

Sensors, Characteristics of sensors, Types of sensors, Sensing considerations, Sensors for different IoT applications, Wireless Sensor Networks, Actuators, Types of actuators, Actuator characteristics.

Unit III: IoT Standards and Protocols

Introduction to IoT connectivity and communication technologies, IEEE

	802.15.4, Zigbee, WirelessHART, RFID, NFC, Z-Wave, Bluetooth, Internet protocol version 6 (IPv6), RPL, 6LoWPAN, MQTT, CoAP, REST, EPC, uCode, Device Management and Semantic Protocols. Middleware and Interoperability. **Unit IV: IoT Design and Prototyping** IoT Design Methodology, Features of IoT hardware development platforms, Arduino and Raspberry Pi, Design and prototyping of IoT Applications. **Unit V: IoT Applications and Challenges** IoT Applications: Agriculture, Transportation, Healthcare, New IoT Paradigms, Challenges associated with IoT, Security issues in IoT, security critical applications, Sources of security threats, Techniques for securing IoT environments and applications.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EELM 525	Open course(YES/NO)	HM Course (Y/N)	DC(Y/N)	DE(Y/N)
Type of course				YES
Course Title	**Digital Control**			
Course Coordinator				
Course objectives:	To provide knowledge of digital control systems and analytical techniques for analysis and design of digital control systems.			
POs				

Semester	**Autumn: Yes**		**Spring:**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	3	0	0	3	36
Prerequisite course Code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and Old course					
Overlap course codes as per proposed Course numbers					

Text Books and Reference Books:

1.	Title	Discrete - Time Control Systems
	Author	K. Ogata
	Publisher	Prentice Hall India Learning Private Limited
	Edition	2nd Edition
2.	Title	Digital Control Systems
	Author	Benjamin C. Kuo
	Publisher	Oxford University Press
	Edition	2nd Edition

Content

Unit I: Introduction

Introduction to Digital Control Systems, Sampling Process, Quantization and Quantization error, Data acquisition, conversion and distribution systems: Sample-and-hold, A/D converter, D/A converter, Digital controllers vs. Analog controllers.

Unit II: Analysis of Discrete-Time Control in z-Plane

Impulse sampling and Data hold, Convolution integral method, Reconstructing original signals from sampled signals, Pulse transfer function, Realization of digital controllers.

Unit III: Design of Discrete-Time Control

	Mapping between s-plane and z-plane, Stability analysis, Transient and Steady-state response, Design based on root-locus and frequency-response method. **Unit IV: State-Space Analysis** State-space representation, Solution of discrete-time state-space equation, Pulse-transfer-function matrix, Discretization of continuous-time state-space equation, Lyapunov stability analysis. **Unit V: Pole Placement and Observer Design** Controllability and Observability, Transformations in State-space analysis and design, Design via pole placement, State observers, Servo systems.
Course Assessment	Continuous Evaluation: 25% Mid-Semester Examination: 25% End-Semester Examination: 50%

Course no: EELM 534	**Open Course (Y/N)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
Type of course	N0	N0	Yes	No
Course Title	**Digital Signal Processing**			
Course Coordinator				
Course objectives:	CO1: Understanding Signal Representation and Analysis: This objective focuses on ensuring students grasp the fundamental principles of representing signals in discrete form and analyzing them using techniques such as sampling, quantization, and signal reconstruction. CO2: Exploring Time and Frequency Domain Analysis: Students should become proficient in analyzing signals in both time and frequency domains. This involves understanding concepts like convolution, correlation, and spectral analysis, including the use of Fourier series, Fourier transforms, and the Discrete Fourier Transform (DFT). CO3: Learning Digital Filter Design and Implementation: This objective involves teaching students the theory and practical aspects of designing digital filters to manipulate signals in various applications. CO4: understanding filter specifications, types of filters (e.g., FIR and IIR), design methods (e.g., windowing, frequency sampling, and Parks-McClellan algorithm), and			
POs				
Semester			Spring: NA	

	Lecture	Tutorial	Practical	Credits
Contact Hours	3	0	0	3
Prerequisite course code as per proposed course numbers	Nil			
Prerequisite credits	Nil			
Equivalent course codes as per proposed course and old course	Nil			
Overlap course codes as per proposed course numbers	Nil			

Text Books:

1.	Title	Digital Signal Processing: Principles, Algorithm &
	Author	Proakis, Manolakis, Proakis, Manolakis
	Publisher	Pearson
	Edition	4th
2.	Title	Discrete Time Signal Processing
	Author	Oppeheim, Schafer, Buck

	Publisher	Pearson
	Edition	2003
Reference Book:		
1.	Title	Digital Signal Processing fundamentals and applications
	Author	Li Tan
	Publisher	Elsevier
	Edition	
2.	Title	Digital Signal Processing
	Author	S.Salivahanan, A.Vallavaraj, C.Gnapriya
	Publisher	TMH
	Edition	
Content	**Unit I: Introduction** Signals, System and signal processing, Classification of signals, Concept of frequency in continuous time and discrete time for sinusoidal signals, Analog to Digital and Digital to analog conversion, Sampling theorem, Quantization, Coding of Quantized Samples, Analysis of digital signals and systems versus discrete – time signals and systems. **Unit II: Discrete Time Signals And Z Transform** Discrete – Time Signal, Discrete – Time Systems. Direct z-transform and its properties; poles and zeros; pole location and time domain relation for causal signals; system function of LTI system Inverse z-transform: by power series expansion and partial fraction expansion Analysis of Linear Time-Invariant System in the Z-domain: **Unit III: Structures For Discrete Time Systems** Block Diagram and signal flow diagram representations of Linear Constant Coefficient Difference equations, Basic Structures of IIR Systems, Transposed forms, Direct and cascade form Structures for FIR Systems, Effects of Coefficient quantization **Unit IV: Discrete Fourier Transform** Frequency –Domain Sampling (The Discrete Fourier Transform), discrete Fourier transform (DFT), the DFT as a linear transformation, relationship of the DFT with other transformation Properties of the DFT: periodicity, linearity, symmetry, multiplication of two DFTs and circular convolution, Linear Filtering Methods Based on the DFT. **Unit V: Fast Fourier Transform** Efficient Computation of DFT:(FFT Algorithm): Direct computation of a DFT, divide & conquer approach to computation of DFT, radix2 and radix 4 FFT Algorithms Filter Design Techniques Design of Discrete-Time IIR filters from Continuous-Time filters Approximation by derivatives, Impulse invariance and Bilinear Transformation methods; Design of FIR filters by windowing techniques, Illustrative design examples of IIR and filters.	

Course Assessment	Theory: Continuous Evaluation 25%, Mid Semester 25%, End Semester 50%. 100% weightage to theory for overall grading. Continuous evaluation shall depend on course coordinator.

Course no: **EELM 539**	**Open Course (Y/N)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
Type of course	N0	N0	No	Yes
Course Title	**Electric Machine Design**			
Course Coordinator				
Course objectives:	• To understand the principles of electrical machine design and magnetic circuit calculations • To study and design of armature winding and D.C machines. • To understand the design of induction and synchronous machines.			
POs				
Semester			Spring: NA	
	Lecture	Tutorial	Practical	Credits
Contact Hours	3	0	0	3
Prerequisite course code as per proposed course numbers	Nil			
Prerequisite credits	Nil			
Equivalent course codes as per proposed course and old course	Nil			
Overlap course codes as per proposed course numbers	Nil			

Text Books:		
1.	Title	Electric Machine Design
	Author	A. K. Sawhney
	Publisher	Dhanpat Rai and Sons
	Edition	
2.	Title	Electrical Machine Design
	Author	R. K. Agarwal
	Publisher	S. K. Kataria and Sons
	Edition	
Reference Book:		
1.	Title	Design of Electrical Machines
	Author	Mittal and Mittal
	Publisher	Standard Publishers and Distributors
	Edition	
2.	Title	A Text Book of Machine Design
	Author	R. S. Khurmi and J.K. Gupta
	Publisher	S. Chand Publishers
	Edition	

Content	**Unit I: Introduction** Major considerations in Machine design Limitations in design Standard specifications Electrical Engineering materials High conductivity materials Insulating materials Magnetic circuit calculations mmf for airgap and iron path real and apparent flux densities in rotating machines- Choice of specific electric and magnetic loadings. **Unit II: DC Machines** Output equation, main dimensions, armature design, armature windings, design of commutator and brushes, design of field systems, design of interpoles. **Unit III: Transformers** Output equation, core design, winding design, yoke design, design of transformer tank with tubes, design of insulation. **Unit IV: Induction Motors** Output equation, main dimensions, stator winding, stator conductors, shape of stator slots, number of stator slots, stator core, rotor design. **Unit V: Synchronous Machines** Output equation - Design of salient pole rotor machine - Dimensions - Short circuit ratio - Effect of Short Circuit ratio – Air gap length - Armature design - Slot dimensions – Rotor design - Design of damper winding - Design of cylindrical rotors
Course Assessment	Theory: Continuous Evaluation 25%, Mid Semester 25%, End Semester 50%. 100% weightage to theory for overall grading.

Course no: EELM 537	**Open Course (Y/N)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
Type of course	N0	N0	Yes	No
Course Title	**Signal Processing and Transforms**			
Course Coordinator				
Course objectives:	CO1: Understanding Signal Processing Fundamentals: This objective aims to equip students with a comprehensive understanding of fundamental concepts in signal processing CO2: Time-domain and frequency-domain representations, filtering, convolution, and Fourier analysis. CO3: Mastering Transform Techniques: CO4: Enabling students to master various transform techniques commonly used in signal processing, including			
POs				
Semester			Spring: NA	
	Lecture	Tutorial	Practical	Credits
Contact Hours	3	0	0	3
Prerequisite course code as per proposed course numbers	Nil			
Prerequisite credits	Nil			
Equivalent course codes as per proposed course and old course	Nil			
Overlap course codes as per proposed course numbers	Nil			

Text Books:		
1.	Title	Statistical and Adaptive Signal Processing
	Author	D.G. Manolakis, V.K. Ingle and S. M. Kogon
	Publisher	McGraw Hill,
	Edition	2000
2.	Title	A Wavelet Tour of Signal Processing
	Author	S. Mallat
	Publisher	Academic Press,
	Edition	1999
Reference Book:		
1.	Title	Adaptive Filter Theory
	Author	S. Haykin
	Publisher	Prentice Hall,
	Edition	2001
2.	Title	Time-frequency analysis

	Author	L. Cohen
	Publisher	Edition, Prentice Hall,
	Edition	1995
Content	**Unit I: Introduction to Signals and Systems** Introduction to signals: Continuous-time and discrete-time signals, signal classification (periodic, aperiodic, deterministic, random).Basics of systems: Classification of systems (linear, time-invariant), system properties (causality, stability, time-invariance).Mathematical representation of signals and systems: Continuous-time and discrete-time signal representations, convolution operation. **Unit II: Fourier Transform** Continuous Fourier Transform (FT): Definition, properties, and inverse Fourier transform. Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT): Definition, properties, FFT algorithms. Frequency domain analysis: Spectrum analysis, power spectral density, Fourier series. **Unit III: Laplace and Z-Transforms** Laplace Transform: Definition, properties, inverse Laplace transform, region of convergence.Z-Transform: Definition, properties, inverse Z-transform, region of convergence. **Unit IV: Wavelet Transforms** Wavelet basics: Introduction to wavelets, mother wavelet, scaling function. Continuous Wavelet Transform (CWT): Definition, properties, scalogram representation. Discrete Wavelet Transform (DWT): Definition, properties, multiresolution analysis. **Unit V: Advanced Transforms** Short-Time Fourier Transform (STFT): Definition, properties, time-frequency analysis. Multidimensional Transforms: Two-dimensional Fourier Transform, two-dimensional DWT. Advanced signal processing techniques: Time-frequency signal analysis, sparse signal representation.	
Course Assessment	Theory: Continuous Evaluation 25%, Mid Semester 25%, End Semester 50%. 100% weightage to theory for overall grading. Continuous evaluation shall depend on course coordinator.	

Course no: EELM 538	Open Course (Y/N)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
Type of course	N0	N0	Yes	No
Course Title	**Deep Learning with Artificial Neural Network**			
Course Coordinator				
Course objectives:	CO1: Understanding Neural Network Fundamentals: This objective focuses on providing students with a solid understanding of the foundational concepts behind neural networks. CO2: topics such as perceptron, activation functions, feedforward and backpropagation algorithms, and the principles of gradient descent optimization. CO3: Exploring Deep Learning Architectures: In this objective, students delve into various deep learning architectures beyond simple feedforward neural networks. CO4: convolutional neural networks (CNNs) for image recognition, recurrent neural networks (RNNs) for sequence modeling, and more advanced architectures like generative adversarial networks (GANs) and transformers.			
POs				
Semester			Spring: NA	
	Lecture	Tutorial	Practical	Credits
Contact Hours	3	0	0	3
Prerequisite course code as per proposed course numbers	Nil			
Prerequisite credits	Nil			
Equivalent course codes as per proposed course and old course	Nil			
Overlap course codes as per proposed course numbers	Nil			

Text Books:

1.	Title	Deep Learning
	Author	Goodfellow, I., Bengio,Y., and Courville, A.,
	Publisher	MIT Press,
	Edition	2016
2.	Title	Pattern Recognition and Machine Learning
	Author	Bishop, C. ,M.,
	Publisher	Springer
	Edition	2006

<table>
<tr><td colspan="3">Reference Book:</td></tr>
<tr><td rowspan="4">1.</td><td>Title</td><td>Artificial Neural Networks</td></tr>
<tr><td>Author</td><td>Yegnanarayana, B.,</td></tr>
<tr><td>Publisher</td><td>PHI Learning Pvt. Ltd,</td></tr>
<tr><td>Edition</td><td>2009</td></tr>
<tr><td rowspan="4">2.</td><td>Title</td><td>Neural Networks: A Classroom Approach</td></tr>
<tr><td>Author</td><td>Satish Kumar</td></tr>
<tr><td>Publisher</td><td>Tata McGraw-Hill Education,</td></tr>
<tr><td>Edition</td><td>2004</td></tr>
<tr><td>Content</td><td colspan="2">Unit I: Artificial Neural Networks
Human Brain, Model of an artificial Neuron, Basic concepts of Neural Networks, Characteristics of Neural Networks, Learning Methods – supervised, unsupervised and reinforcement, Taxonomy of Neural Network Architectures, Terminologies – weights, bias, threshold, learning rate, Applications of Neural Networks.

Unit II: Supervised and Unsupervised Neural Networks
Hebb Network theory and training algorithm, Perceptron Networks architecture and training algorithm, Backpropagation Network architecture and training algorithm, Associative Memory Network architecture and training algorithm, Hopfield Networks architecture and training algorithm.

Unit III: Advanced Neural Networks
Kohonen Self-Organising Feature Maps architecture and training algorithm, Learning Vector Quantization architecture and training algorithm, Boltzmann Machine, Cognitron Network, Neocognitron Network, Optical Neural Networks Electro-optical Multipliers and Holographic Correlators.

Unit IV: Deep Learning
Machine learning basics, Simple Machine Learning Algorithm -- Linear Regression, underfitting and overfitting challenges in Machine Learning, Supervised Learning approach for Support Vector Machine, Deep Feedforward Networks, Convolutional Networks, Deep Recurrent Networks, Deep Boltzmann Machine, Applications in Speech Recognition and Natural Language Processing.

Unit V: MATLAB Application
Supervised and unsupervised neural network programming, Programming for data set classification.</td></tr>
<tr><td>Course Assessment</td><td colspan="2">Theory: Continuous Evaluation 25%, Mid Semester 25%, End Semester 50%.
100% weightage to theory for overall grading.
Continuous evaluation shall depend on course coordinator.</td></tr>
</table>

Course no: EELM 557	**Open course**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
Type of course				
Course Title	**Energy Auditing and Management**			
Course Coordinator				
Course objective:	To impact concepts behind economic analysis and Load management. Energy management on various electrical equipment's andmetering. Concept of lighting systems and cogeneration.			
POs				
Semester	Autumn: I Semester		Spring	
	Lecture	**Tutorial**	**Practical**	**Credits**
Contact Hours	**3**	**0**	**0**	**3**
Prerequisite course code as per proposed course numbers				
Prerequisite credits				
Equivalent course codes as per proposedcourse and old course				
Overlap course codes as per proposed course numbers				

Text Books:		
1.	Title	Guide to Energy Management
	Author	Barney L. Capehart, Wayne C. Turner, and William J. Kennedy,
	Publisher	The Fairmont Press, Inc.
	Edition	5th Edition, 2006
2.	Title	Energy Efficiency for Engineers and Technologists
	Author	Eastop T.D & Croft D. R
	Publisher	Logman Scientific & Technical
	Edition	1990
Content		**Unit I: Introduction** Basics of Energy – Need for energy management – Energy accounting - Energy monitoring, targeting and reporting - Energy audit process. **UNIT II: Energy Management for Motors and Cogeneration** Energy management for electric motors – Transformer and

	reactors - Capacitors and synchronous machines, energy management by cogeneration – Forms of cogeneration – Feasibility of cogeneration – Electrical interconnection. **Unit III: Lighting Systems** Energy management in lighting systems – Task and the working space - Light sources – Ballasts – Lighting controls – Optimizing lighting energy – Power factor and effect of harmonics, lighting and energy standards. **Unit IV: Metering for Energy Management** Metering for energy management – Units of measure - Utility meters – Demand meters – Paralleling of current transformers – Instrument transformer burdens – Multi tasking solid state meters, metering location vs requirements, metering techniques and practical examples. **Unit V: Economic Analysis and Models** 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 management – Economic justification.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EELM 562	**Open course**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
Type of course				Y
Course Title	Special Electrical Machines			
Course Coordinator				
Course objectives:	To impart knowledge on Construction, principle of operation and performance of synchronous reluctance motors. To impart knowledge on the Construction, principle of operation, control and performance of stepping motors. To impart knowledge on the Construction, principle of operation, control and performance of switched reluctance motors. To impart knowledge on the Construction, principle of operation, control and performance of permanent magnet brushless D.C. motors. To impart knowledge on the Construction, principle of operation and performance of permanent magnet synchronous motors.			
POs				

Semester	**Autumn: I Semester**		**Spring**	
	Lecture	**Tutorial**	**Practical**	**Credits**
Contact Hours	3	0	0	3
Prerequisite course code as per proposed course numbers				
Prerequisite credits				
Equivalent course codes as per proposed course and old course				
Overlap course codes as per proposed course numbers				

Text Books:

1.	Title	Special Electrical Machines
	Author	K.Venkataratnam
	Publisher	Universities Press (India) Private Limited
	Edition	2008
2.	Title	Brushless Permanent Magnet and Reluctance Motor Drives
	Author	T.J.E. Miller
	Publisher	Clarendon Press, Oxford
	Edition	1989

Content	**Unit I: Synchronous Reluctance Motors** Constructional features – Types – Axial and Radial flux motors – Operating principles – Variable Reluctance Motors – Voltage and Torque Equations - Phasor diagram - performance characteristics –Applications **Unit II: Stepper Motors** Constructional features – Principle of operation – Variable reluctance motor – Hybrid motor – Single and multi-stack configurations – Torque equations – Modes of excitation – Characteristics – Drive circuits – Microprocessor control of stepper motors – Closed loop control-Concept of lead angle– Applications. **Unit III: Switched Reluctance Motors (SRM)** Constructional features – Rotary and Linear SRM - Principle of operation – Torque production – Steady state performance prediction- Analytical method -Power Converters and their controllers –Methods of Rotor position sensing – Sensor less operation – Characteristics and Closed loop control **Unit IV: Permanent Magnet Brushless D.C. Motors** Permanent Magnet materials – Minor hysteresis loop and recoil line-Magnetic Characteristics – Permeance coefficient -Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations – Commutation - Power Converter Circuits and their controllers – Motor characteristics and control–Applications. **Unit V: Permanent Magnet Synchronous Motors (PMSM)** Principle of operation – Ideal PMSM – EMF and Torque equations – Armature MMF – Synchronous Reactance – Sine wave motor with practical windings - Phasor diagram – Torque/speed characteristics -Power controllers - Converter Volt-ampere requirements– Applications.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EELM 563	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
Type of course				Yes
Course Title	**Applied Linear Algebra**			
Course Coordinator				
Course objectives:	This course gives the applications of linear algebra for engineering problems.			
POs				

Semester	Autumn:		Spring	
	Lecture	Tutorial	Practical	Credits
,	3	0	0	3
Prerequisite course code as per proposed course numbers				
Prerequisite credits				
Equivalent course codes as per proposed course and old course				
Overlap course codes as per proposed course numbers				

Text Books:		
1.	Title	Linear Algebra and its Applications
	Author	Gilbert Strang
	Publisher	Saunders College Publishers
	Edition	1988
2.	Title	Applied Linear Algebra and Matrix Analysis
	Author	Thomas S. Shores
	publisher	Springer
	Edition	2007
Reference Book:		
1	Title	Matrix and Linear Algebra
	Author	Datta Kanti B.
	Publisher	Oxford- Prentice Hall of India
	Edition	3rd edition 1999
2.	Title	Linear Algebra
	Author	Hoffman K. and Kunze Ray
	Publisher	Oxford- Prentice Hall of India
	Edition	2007

Content

Unit I: Linear systems of equations

Gaussian elimination, matrix algebra, applications of matrix arithmetic Matrix Inverses Determinants, Tensor Product.

Unit II: Vector Spaces

Definitions and basic concepts, subspaces, linear combinations, subspaces associated with matrices and operators, bases and dimension, linear systems, change of basis and linear operators, standard norm and inner product, applications of norm and inner product, unitary and orthogonal matrices.

Unit III: Eigen value Problem

Definitions and basic properties, similarity and diagonalization, applications to discrete dynamical systems, orthogonal diagonalization, singular value

	decomposition. **Unit IV: Abstract Spaces** Normed linear spaces, inner product spaces, gram-schmidt algorithm, operator norms.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EELM 564	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
Type of course				Yes
Course Title	**Advanced Control Systems**			
Course Coordinator				
Course objectives:	1. To learn the modelling and control design concepts of system using state space. 2. To understand the concept of stability for linear systems. 3. To understand the application of optimal control techniques. 4. To learn the fundamentals of non-linear systems			
POs				

Semester	Autumn:		Spring	
	Lecture	Tutorial	Practical	Credits
Contact Hours	3	0	0	3
Prerequisite course code as per proposed course numbers				
Prerequisite credits				
Equivalent course codes as per proposed course and old course				
Overlap course codes as per proposed course numbers				

Text Books:		
1.	Title	Modern Control Theory
	Author	William L Brogan
	Publisher	Pearson Education India
	Edition	3rd Edition
2.	Title	Modern Control System Theory,
	Author	Madan Gopal
	publisher	New Age International Private Limited
	Edition	2nd Edition
Reference Book:		
1. 1.	Title	Linear System Theory
	Author	J. S. Hespanha
	Publisher	Princeton University Press
	Edition	

Content

Unit I: State-Space Representation
Concepts related to state space, state space representation, state transition matrix, solution of linear time invariant and linear time-varying state equations, state-space realizations, Canonical forms.

Unit II: Stability
Equilibrium points, Stability definitions, stability of linear system, Direct method of Lyapunov, Feedback design using Lyapunov's method.

Unit III: Control System Design in State-Space
Controllability, Pole placement design using full state feedback-regulator and

	tracking systems, observers, observability and compensators, full order and reduced order observers, separation principle. **Unit IV: Linear Optimal Control** Optimal control problem, Infinite-time linear optimal regulator design, Optimal control of tracking systems, Output weighted linear optimal control. **Unit V: Nonlinear Control Systems** Sources of nonlinearities and characteristics of nonlinear systems, linearization, Dynamic linearization using state feedback, Describing function method, Lyapunov stability theory.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EELM 567	**Open course**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
Type of course	N	N	Y	N
Course Title	**Electric Vehicles**			
Course Coordinator				
Course objectives:	Comprehend the basics concepts of electric vehicles, their architecture, and technologies. Able to understand the operation of battery driven and designing of Battery Pack. Able to interpret the working of different electrical machines in electric vehicles and their control technique. Ability to understand the control and configurations of EV chargers and charging stations.			
POs				
Semester	**Autumn: NA**		**Spring: II**	
	Lecture	**Tutorial**	**Practical**	**Credits**
Contact Hours	3	0	0	3
Prerequisite course code as per proposed course numbers				
Prerequisite credits				
Equivalent course codes as per proposed course and old course				
Overlap course codes as per proposed course numbers				

Text Books:		
1.	Title	Electric and Hybrid Vehicles
	Author	Iqbal Husain
	Publisher	Routledge Taylor & Francis Group
	Edition	3rd Edition
2.	Title	Electric Vehicle Engineering
	Author	Per Enge, Nick Enge, and Stephen Zoepf
	Publisher	McGraw Hill
	Edition	1st Edition
Reference Book:		
1.	Title	Electric and Hybrid Vehicles
	Author	Tom Denton, Hayley Pells
	Publisher	Routledge Taylor & Francis Group
	Edition	3rd Edition
2.	Title	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles

	Author	Mehrdad Ehsani, Yimin Gao, Stefano Longo, Kambiz Ebrahimi
	Publisher	Routledge Taylor & Francis Group
	Edition	3rd Edition
Content	**Unit I: Vehicle Dynamics** Forces and aerodynamic drag, rolling resistance and uphill resistance, power and torque to accelerate, concept of drive cycles and energy, design of EV drive train. **Unit II: EV Battery Pack** Introduction to battery parameters, Li-Ion battery cells, SoH and SoC estimation and self-discharge, battery pack development, computation of effective cost of battery and batteries charging. **Unit III: Battery Pack Design** Mechanical Design and Thermal Design, Electrical Design, BMS Design of Electric Vehicle, Cell Testing & Characterization. **Unit IV: EV Motors and Controllers** Vehicle Dynamics, Power and Efficiency, Torque Production, Speed and Back EMF, Field oriented control of induction machines, BLDC motor, Modelling of PMSM Drives, Vector Control of PMSM Drives. **Unit V: EV Chargers** Introduction, Slow or Fast chargers, Battery Swapping, Standardization and on-board Chargers, Public Chargers, Bulk Chargers/Swap Stations.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no. EELM 568	Open course (Yes/No)		HM Course (Y/N)		DC (Y/N)	DE (Y/N)
	N		N		N	Y
Type of course	**Theory**					
Course Title	**Energy Storage Devices**					
Course Objectives:						
Semester						
	Autumn:		**Spring: Yes**			
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**	
Contact Hours	**03**	**0**	**0**	**03**	**36**	
Prerequisite course code as per proposed course number						
Prerequisite credits						
Equivalent course codes as per proposed course and old course						
Overlap course codes as per proposed course numbers						
Text Books:						
1.	Title	Energy Storage for Power Systems				
	Author	A.G.Ter-Gazarian				
	Publisher	The Institution of Engineering and Technology (IET) Publication, UK, (ISBN - 978-1 84919-219-4),2011.				
	Edition	Second Edition				
2.	Title	Energy Storage in Power Systems				
	Author	Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt				
	Publisher	Wiley Publication, ISBN: 978-1-118-97130-7, Mar 2016.				
	Edition					
3.	Title	The Physics of solar cell				
	Author	Jenny Nelson				
	Publisher	Imperial college Press				
	Edition	1st				
4.	Title	Energy Storage Benefits and Market Analysis				
	Author	James M. Eyer, Joseph J. Iannucci and Garth P. Corey				
	Publisher	Sandia National Laboratories, 2004.				
	Edition					
Reference Books:	Title	Behaviour of Lithium-Ion Batteries in Electric Vehicles: Battery Health, Performance, Safety, and Cost.				
1.	Author	Pistoia, Gianfranco, and Boryann Liaw.				
	Publisher	Springer International Publishing AG, 2018.				
	Edition					
Content	**Unit I: Introduction to energy storage in power systems** Importance of energy storage in modern energy systems, renewable and non-renewable resources, Types of energy storage systems: Electrochemical, mechanical, thermal, and chemical, Applications of energy storage, Challenges and future trends					

	in energy storage. **Unit II: Energy storage technologies and renewable power sources** Electrochemical energy: Batteries, Fuel cells, Electrostatic energy (Super Capacitors), Electromagnetic energy (Super conducting Magnetic Energy Storage), Comparative analysis, Environmental impacts of different technologies. **Unit III: Features of Energy Storage Systems** Classification of energy storage systems, Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES), Flywheel energy storage (FES), Electrochemical storage systems, Secondary batteries, Flow batteries, Chemical energy storage, Hydrogen, Synthetic natural gas (SNG). **Unit IV: Applications** Utility use (conventional power generation, grid operation & service), Consumer use (uninterruptable power supply for large consumers), Internal configuration of battery storage systems, External connection of energy storage systems, Aggregating energy storage systems and distributed generation (Virtual Power Plant), Battery SCADA–aggregation of many dispersed batteries.
Course Assessment	Continuous Evaluation - 25%Mid Semester- 25% End Semester - 50%

Course No. EELM 593	Open Course (Y/N)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
Type of the Course	N	N	N	Y
Course Title	**Digital Control in Switched Mode Power Converters and FPGA-based Prototyping**			
Course Coordinator				
Course Objectives	• Gain comprehensive understanding of the digital control in switch-mode converters • Develop and validate Matlab based mathematical models for digital control • Comprehend digital control implementation • Learn to use embedded control implementation platforms			
POs				
Semester	Autumn		Spring	
	Lecture	Tutorial	Practical	Credits
Contact Hours	3	0	0	3
Pre-requisite course code as per proposed course members	Nil	Nil	Nil	0
Prerequisite credits				
Equivalent course codes as per proposed course and old course				
Overlap course codes as per proposed course numbers				

Text Book(s)		
1.	**Title**	Fundamentals of Power Electronics
	Author	R. W. Erickson and D. Maksimovic
	Publisher	Springer, 2020
	Edition	3rd
2.	**Title**	Digital Control in Power Electronics
	Author	Simone Buso, Paolo Mattavelli
	Publisher	Springer
	Edition	2nd
Reference Book(s)		
1.	**Title**	Computer Techniques for Dynamic Modeling of DC-DC Power Converters
	Author	Farzin Asadi
	Publisher	Springer Cham
	Edition	1st
2.	**Title**	Dynamics and Control of DC-DC Converters
	Author	Farzin Asadi, Kei Eguchi
	Publisher	Springer Cham
	Edition	1st
3.	**Title**	Digital Control of High-Frequency Switched-Mode Power Converters

	Author	Luca Corradini, Dragan Maksimovic, Paolo Mattavelli, Regan Zane
	Publisher	Wiley-IEEE Press
	Edition	
Content	**Unit I:** Introduction to digital control in switched mode power converters (SMPCs), Fixed and variable frequency digital control architectures. **Unit II:** Modeling techniques and model validation using MATLAB, MATLAB custom model development for simulation under digital control. **Unit III:** Frequency and time domain digital control design approaches. Digital control implementation blocks and steps for FPGA based prototyping. **Unit IV:** Introduction to Verilog HDL and simulation using Xilinx Webpack. Digital controller implementation using fixed point arithmetic and Verilog HDL. Digital Control Implementation using STM32/C2000 Series Microcontrollers. **Unit V:** FPGA prototyping of digital voltage mode and current mode control. Design and validation case studies using digital voltage and current mode control. Hardware case studies of advanced digital control techniques and course summary.	
Course Assessment	Continuous Evaluation - 25% Mid Semester- 25% End Semester - 50%	

Course No. EELM 594	Open Course (Y/N)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
Type of the Course	N	N	N	Y
Course Title	**Design of Electric Motors**			
Course Coordinator				
Course Objectives				
POs				
Semester	Autumn		Spring	
	Lecture	Tutorial	Practical	Credits
Contact Hours	3	0	0	3
Pre-requisite course code as per proposed course members	Nil	Nil	Nil	0
Prerequisite credits				
Equivalent course codes as per proposed course and old course				
Overlap course codes as per proposed course numbers				

Text Book(s)		
1.	**Title**	Introduction to AC Machine Design
	Author	Thomas A. Lipo
	Publisher	IEEE Press, John Wiley & Sons,
	Edition	
2.	**Title**	Electrical Machine Design - The Design And Specification Of Direct And Alternating Current Machinery
	Author	Alexander Gray
	Publisher	Mc. Graw Hill
	Edition	
Reference Book(s)		
1.	**Title**	Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design, and Applications
	Author	Krishnan, R
	Publisher	CRC Press
	Edition	
2.	**Title**	Design of Rotating Electrical Machines
	Author	Juha Pyrhonen, Tapani Jokinen, Valeria Hrabovcova
	Publisher	John Wiley & Sons Ltd
	Edition	2nd Edition
3.	**Title**	A Course in Electrical Machine Design
	Author	A. K. Sawhney
	Publisher	Dhanpat Rai and Sons
	Edition	

Content	**Unit I: Fundamentals Law** Electric Fields, Magnetic Fields, Review of Electromagnetic laws (Ohms Law, Amperes Law, Faraday's Laws, Thumb rule, Fleming's Left-hand and Right-hand rules, Lorentz Force Law) **Unit II: Principles of Electromagnets** Magnetic Materials and Concepts of BH Curves, Magnetic Circuits with and without Air gaps, Multiple Winding Magnetic Circuits, Electromechanical Energy Conversion and Force in Electromagnetic Systems, Design and Analysis of the Electromagnetic System with an Example, Realization of Electrical Machines with the Principles of Electromagnets. **Unit III: Fundamentals of Designing of AC/DC Machines** Working Principles of the Rotating Machines, Design of Electrical Windings and MMF distribution, DC Machine Windings, AC Machine Windings, AC Machine Windings, AC Machine Windings Examples with Laboratory Prototype, Winding Design for Variable Speed Machines, Importance, Design Factors and Standards of the Electrical Machines, Importance, Design Factors and Standards of the Electrical Machines, Sizing Equations with D2L (Volume) Product, Volume, Power Density. **Unit IV: Induction Motor (IM) Design** Main dimensions, Stator Core Design of IM, Rotor Core Design of IM, Volume and Density of IM, IM Parameters Calculation like Leakage and Magnetizing Inductances, Efficiency Calculations, Design of the Induction Motor for an Electric Vehicle Application. **Unit V: Design of Special Machines** Switched Reluctance Machine (SRM) Sizing Equations, Stator and Rotor Design of SRM, Machine Parameters of SRM, Efficiency Calculations of SRM, Thermal Issues, Limits and Heat Transfer Techniques, Cooling Methods and Design, Thermal Equivalent Circuits, Thermal Design of Electrical Machines.
Course Assessment	Continuous Evaluation - 25% Mid Semester- 25% End Semester - 50%

Course No. EELM 599	Open Course (Y/N)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
Type of the Course	N	N	N	Y
Course Title	**Condition Monitoring and Faults Diagnosis**			
Course Coordinator				
Course Objectives	• Real time condition monitoring (CM) understanding for preventive maintenance • Develop and validate Matlab based mathematical models for online monitoring of IM • Comprehend machine learning model implementation • Learn to use machine condition monitoring			
POs				
Semester	Autumn		Spring	
	Lecture	Tutorial	Practical	Credits
Contact Hours	3	0	0	3
Pre-requisite course code as per proposed course members	Nil	Nil	Nil	0
Prerequisite credits				
Equivalent course codes as per proposed course and old course				
Overlap course codes as per proposed course numbers				
Text Book(s)				
1.	**Title**	Vibration and acoustics		
	Author	C. SUJATHA		
	Publisher	Mc Graw Hill		
	Edition			
2.	**Title**	Neural Network & Learning Machines		
	Author	Simon O. Haykin		
	Publisher	Prentice Hall		
	Edition	2nd Edition		
Reference Book(s)				
1.	**Title**	Soft Computing		
	Author	Saroj Kaushik		
	Publisher	Mc Graw Hill		
	Edition			
2.	**Title**	Applied Machine Learning		
	Author	M. Gopal		
	Publisher	Mc Graw Hill		
	Edition			
3.	**Title**	An Introduction to Genetic Algorithms		
	Author	M. Mitchell		

	Publisher	MIT Press
	Edition	
Content	**Unit I: Introduction** Condition monitoring (CM) , Need of Condition Monitoring, Types of Condition monitoring, **Unit II: Condition Monitoring Techniques** Chemical or Gas Monitoring, Thermal Monitoring, Air-Gap Torque Monitoring, Noise Monitoring, Acoustic Emission Monitoring, Vibration Monitoring, Current Monitoring. **Unit III: Condition based Maintenance** Describe the methods of fault diagnosis, condition checking and inspection and trend monitoring methods. Machine fault identification and its diagnosis. **Unit IV: ANN & Wavelet Transform application to Fault Diagnosis** Introduction to neural network: Single and multi-layer perceptron, Binary classification, Regression by SVM: linear & nonlinear, Decomposing multiclass classification into binary classification, Wavelet transform types and its application using MATLAB. **Unit V: Condition Monitoring for Induction Motor- Programming** Design and Implementation of programs for CM using faults prediction.	
Course Assessment	Continuous Evaluation - 25% Mid Semester- 25% End Semester - 50%	