University of Mumbai

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विद्याविषयक प्राधिकरणे
सभा आणि सेवा विभाग(ए.ए.एम.एस)
रूम नं. १२८ एम.जी.रोड, फोर्ट,
मुंबई – ४०० ०३२
टेलिफोन नं. – ०२२ – ६८३२००३३

(नॅक पुनर्मूल्यांकनाद्वारे ३.६५ (सी.जी.पी.ए.) सह अ++ श्रेणी
विद्यापीठ अनुदान आयोगाद्वारे श्रेणी १ विद्यापीठ दर्जा)

क्र.वि.प्रा.स.से./आयसीडी/२०२५-२६/३७ दिनांक : २७ मे, २०२५

परिपत्रक:-

सर्व प्राचार्य/संचालक, संलग्नित महाविद्यालये/संस्था, विद्यापीठ शैक्षणिक विभागांचे संचालक/ विभाग प्रमुख यांना कळविण्यात येते की, राष्ट्रीय शैक्षणिक धोरण २०२० च्या अमंलबजावणीच्या अनुषंगाने **शैक्षणिक वर्ष २०२५-२६** पासून **पदवी व पदव्युत्तर अभ्यासक्रम** विद्यापरिषदेच्या दिनांक २८ मार्च २०२५ व २० मे, २०२५ च्या बैठकीमध्ये मंजूर झालेले सर्व अभ्यासक्रम मुंबई विद्यापीठाच्या www.mu.ac.in या संकेत स्थळावर NEP २०२० या टॅब वर उपलब्ध करण्यात आलेले आहेत.

मुंबई – ४०० ०३२
२७ मे, २०२५

(डॉ. प्रसाद कारंडे)
कुलसचिव

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7	The Deputy Registrar, PRO, Fort, (Publication Section), Pro@mu.ac.in
8	The Deputy Registrar, Executive Authorities Section (EA) eau120@fort.mu.ac.in He is requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to the above circular.
9	The Deputy Registrar, Research Administration & Promotion Cell (RAPC), rapc@mu.ac.in
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4	P.A to all Deans of all Faculties
5	P.A to Finance & Account Officers, (F & A.O), camu@accounts.mu.ac.in

To,

1	The Chairman, Board of Deans pvc@fort.mu.ac.in
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AC – 20/5/2025
Item No. – 6.51 (N)

As Per NEP 2020

University of Mumbai

Syllabus for Major Vertical – 1, 4 & 6		
Name of the Programme – B.E. Electrical & Computer Engineering		
Faculty of Engineering		
Board of Studies in Electrical Engineering		
U.G. Second Year Programme	**Exit Degree**	**U.G. Diploma in Electrical & Computer Engineering**
Semester		**IV**
From the Academic Year		**2025-26**

University of Mumbai

(As per NEP 2020)

Sr. No.	Heading	Particulars
1	**Title of program** **O:**_____	**B.E. Electrical & Computer Engineering**
2	**Exit Degree**	**U.G. Diploma in Electrical & Computer Engineering**
3	**Scheme of Examination** **R:** _____	NEP 40% Internal 60% External, Semester End Examination Individual Passing in Internal and External Examination
4	**Standards of Passing** **R:** _____	**40%**
5	**Credit Structure** **R. TEU-680C** **R. TEU-680D**	**Attached herewith**
6	**Semesters**	**Sem. IV**
7	**Program Academic Level**	**5.00**
8	**Pattern**	**Semester**
9	**Status**	**New**
10	**To be implemented from Academic Year**	**2025-26**

Sd/-	**Sd/-**	**Sd/-**
Dr. B. R. Patil	**Dr. Deven Shah**	**Prof. Shivram S. Garje**
BoS-Coordinator-Electrical Engineering	**Associate Dean**	**Dean**
Faculty of Technology	**Faculty of Science & Technology**	**Faculty of Science & Technology**

Preamble

To meet the challenge of ensuring excellence and NEP 2020 policy in engineering education, the issue of quality needs to be addressed, debated, and taken forward systematically. Accreditation is the principal means of quality assurance in higher education. The major emphasis of the accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Science and Technology (in particular Engineering) of the University of Mumbai has taken the lead in incorporating the philosophy of NEP 2020 education in the process of curriculum development.

The second-year engineering course is a core training program to impart scientific and logical thinking training to learners in general, with a choice of course selection from the program core course, multidisciplinary minor, and vocational skill-enhanced course. Simultaneously, the objectives of NEP 2020 demand nurturing the core program and skills required for the 'Electrical & Computer Engineering Branch' of engineering in the learner. Keeping this in view, a pool of courses is offered in Core Courses covering fundamentals required to understand core and modern engineering practices and emerging trends in technology. Considering the shift in pedagogy and the convenience of a stress-free learning process, a choice-based subject pool is offered in the coursework under the heads of 'Electrical & Computer Engineering' in Engineering for open electives and multidisciplinary minor courses in the third and fourth semesters. Essentially, to give a glimpse of trends in the industry under vocational and enhanced skill practices, the pool is offered to nurture and develop creative skills in contemporary industrial practices. Criteria met in the structure is the opportunity for learners to choose the course of their interest in all disciplines.

Program Core Course Cover 'Electrical & Computer Engineering' core courses. Also, OE and MDM where a pool of subjects are given for selection. Considering the present scenario, diverse choices need to be made available to fulfill the expectation of a learner to aspire for a career in the field of current trends of Technology and interdisciplinary research. Ability enhancement can be achieved in Undergraduate training by giving an objective viewpoint to the learning process and transitioning a learner from a rote learner to a creative professional. for the purpose Design Thinking is introduced in the First Semester to orient a journey learner to become a skilled professional. Considering the NEP-2020 structure of award of Certificate & Diploma at multiple exit-point pools of Vocational skills is arranged for giving exposure to the current Industry practices.

The faculty resolved that course objectives and course outcomes are to be clearly defined for every course so that all faculty members in affiliated higher education institutes understand the depth and approach of the course to be taught, which will enhance the learner's learning process. NEP 2020 grading system enables a much-required shift in focus from teacher-centric to continuous-based learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation, which will enhance the quality of education. Credit assignment for courses is based on a 15-week teaching-learning process for NEP 2020, however, the content of courses is to be taught in 12-13 weeks, and the remaining 2-3 weeks are to be utilized for revision, tutorial, guest lectures, coverage of content beyond the syllabus, etc.

There was a concern that in the present system, the second-year syllabus must not be heavily loaded to the learner and it is of utmost importance that the learner entering into the second year of an engineering course should feel at ease by lowering the burden of syllabus and credits. This is necessary for a learner to get accustomed to the new environment of a college and to create a bond between the teacher and the learner. The present curriculum will be implemented for the Second Year of Engineering from the academic year 2025-26. Subsequently, this system will be carried forward for Third Year and Final Year Engineering in the academic years 2026-27, and 2027-28, respectively.

Sd/-	**Sd/-**	**Sd/-**
Dr. B. R. Patil	**Dr. Deven Shah**	**Prof. Shivram S. Garje**
BoS-Coordinator-Electrical Engineering	**Associate Dean**	**Dean**
Faculty of Technology	**Faculty of Science & Technology**	**Faculty of Science & Technology**

Under Graduate Diploma in Engineering- Electrical & Computer Engineering.

Credit Structure (Sem. III & IV)

	R. TEU-680C								
Level	**Semester**	**Major**		**Minor**	**OE**	**VSC, SEC (VSEC)**	**AEC, VEC, IKS**	**OJT, FP, CEP, CC,RP**	**Cum. Cr. / Sem.**	**Degree/ Cum. Cr.**
		Mandatory	**Electives**							
5.0	III	PCC301:3 PCC302:3 PCC303:3 PCC304:3 PCL301: 1 PCL302:1	--	--	OE:2	--	VEC: 2 HSL: 2	CEP: 2	22	**UG Diploma 45**
	R. TEU-680D									
	IV	PCC401:3 PCC402:3 PCC403:3 PCL401:1 PCL402:1	--	MDM: 4	OE:2	VSEC:2	VEC: 2 EEM:2	--	23	
	Cum Cr.	25	--	4	4	2	*2+2+2+2*	2	45	

Exit option: Award of UG Diploma in Major and MDM with 90 credits and additional 4 credits core **one** theory subject with 3 credits and **one** lab with 1 credit from one third year from where they want to take Exit degree. Along with theory and practical course student must compulsorily do internship for **one month or 160 hours** which internship is equal to 4 credits.

[Abbreviation - OE – Open Electives, VSC – Vocation Skill Course, SEC – Skill Enhancement Course, (VSEC), AEC – Ability Enhancement Course, VEC – Value Education Course, IKS – Indian Knowledge System, OJT – on Job Training, FP – Field Project, CEP – Continuing Education Program, CC – Co-Curricular, RP – Research Project]

S.E. ‘Electrical & Computer Engineering’ Scheme

Program Structure for Second Year of 'Electrical & Computer Engineering'

UNIVERSITY OF MUMBAI (With Effect from 2025-2026)

SEMESTER IV

Course Code	Course Description	Teaching Scheme (Contact Hours/Week)			Credit Assigned			
		Theory	Practical	Tutorial	Theory	Tutorial	Practical	Total Credits
2214111	Engineering Mathematics for Signals and Systems	2	--	1	2	1	–	3
2214112	Electromagnetic Field and Waves	3	–	--	3	–	–	3
2214113	Power Electronics Devices and Circuits	3	--	--	3	–	–	3
MDC401	Multidisciplinary Minor	3#	–	--	3	–	–	3
OEC401	Open Elective	2#	–	--	2	–	–	2
2214114	Electromagnetic Field and Waves Lab.	–	2	–	–	–	1	1
2214115	Power Electronics Devices and Circuits Lab.	–	2	–	–	–	1	1
MDL401	Multidisciplinary Minor	–	2#	–	–	–	1	1
2214411	Electrical Workshop (Mini Projects)	–	2*+2	–	–	–	2	2
2994511	Business Model Development	–	2*+2	–	–	–	2	2
2994512	Design Thinking	–	2*+2	–	–	–	2	2
Total		**13**	**18**	**01**	**13**	**01**	**09**	**23**

* Two hours of practical class to be conducted for full class as demo/discussion.

Theory / Tutorial 1 credit for 1 hour and Practical 1 credit for 2 hours

Students must select course for Open Elective from Science/Commerce/Management stream bucket provided by the University of Mumbai.

#Institute shall offer a course for Multidisciplinary Minor (MDM) from other Engineering Boards.

Course Code	Course Description	Examination Scheme							
		Internal Assessment Test (IAT)			End Sem. Exam Marks	End Sem. Exam Duration (Hrs)	Term Work (TW)	Oral / Pract.	Total
		IAT-I	IAT-II	Total (IAT-I) + IAT-II)					
2214111	Engineering Mathematics for Signals and Systems	20	20	40	60	2	25	--	125
2214112	Electromagnetic Field and Wave	20	20	40	60	2	--	--	100
2214113	Power Electronics Devices and Circuits	20	20	40	60	2	--	--	100
MDC401	Multidisciplinary Minor	20	20	40	60	2	--	--	100
OEC401	Open Elective	20	20	40	60	2	--	--	100
2214114	Electromagnetic Field and Wave Lab.	--	--	--	--	--	25	25	50
2214115	Power Electronics Devices and Circuits Lab.	--	--	--	--	--	25	25	50
MDL401	Multidisciplinary Minor	--	--	--	--	--	25	--	25
2214411	Electrical Workshop (Mini Projects)	--	--	--	--	--	50	25	75
2994511	Business Model Development	--	--	--	--	--	50	--	50
2994512	Design Thinking	--	--	--	--	--	50	--	50
Total		**100**	**100**	**200**	**300**	**10**	**250**	**75**	**825**

Sem. - IV

Vertical – 1
Major

Course Code	Course Name	Examination Scheme				
		Theory Marks		Term	Exam.	Total
		Internal Assessment Test	End			

Course Code	Course Name	IAT-I	Teaching Scheme (Contact Hours/Week) IAT-II			Sem. Exam Marks		Work Duration (in Hrs.)		Credits Assigned		Marks
			Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total			
				IAT-II (Total)								
2214111	Engineering Mathematics for Signals and Systems		2	--	1	2	-	1	3			
2214111	Engineering Mathematics for Signals and Systems	20	20	40	60	25	2		125			

Course Objectives: The course is aimed

1. To understand the basic properties of signals & systems.
2. To familiarize with the Fourier Series and Fourier Transform of various functions.
3. To acquaint with the concept of Z-Transform and Inverse Z-Transform.
4. To analyze discrete time signals and system in *Z*-Transform domain.
5. To learn frequency domain analysis of signals and systems.
6. To develop the concept of Realization of Linear Systems.

Course Outcomes: At the end of the course, students will be able to

1. Discriminate continuous and discrete time signals and systems along with classifications.
2. Expand the periodic function by using Fourier series for real life problems and complex
3. Understand the transformation of discrete time signal to *Z* domain.
4. Apply the concept of *Z*-Transform and inverse *Z*-Transform to solve the real integrals in engineering problems.
5. Apply transforms to do frequency domain analysis of signal and Systems.
6. Understand the basic structures of FIR and IIR Systems

Detailed Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
---	Prerequisite	Solution of linear constant coefficient difference equation, zero input and zero state response.	---	---
I	Introduction to Signals and Systems	Definition of basic signals such as impulse, unit step, unit ramp, Analog to digital conversion of signal, basic discrete time signals. Sampling Theorem (Derivation is not Required). Classification of signals, Signal operations. Concept of a Continuous time (CT) and Discrete time (DT) system, properties and classification of systems, Convolution in DT domain (Matrix Method only)	04	**CO1**
II	Fourier Series and Fourier Transform	Introduction, Trigonometric and exponential Fourier Series, Parseval's theorem for Fourier Series, Power Spectrum and Power Spectral Density of a Periodic Function. Fourier Transform, Properties of Fourier Transform. Energy spectrum and Energy Spectral Density. System analysis of CT system, frequency response of a CT system, Introduction to DTFS and DTFT.	04	**CO2**

III	Z-Transform	Introduction, Definition, one sided and two-sided z-transform, ROC, Properties of ROC, Properties of z-transform. Inverse z- Transform using methods such as long division, partial fraction expansion and residue method.	05	**CO3**
IV	Analysis of DT-LTI systems using z-Transform	Pole-zero plot in DT domain. Transfer Function of LTI System. Solution of linear constant coefficient difference equation using method of z-Transform, transfer function, impulse response and step response.	05	**CO4**
V	Frequency domain analysis of DT -LTI systems.	Relation between Fourier Transform and Z-Transform. Systems classification on pass band frequency, Low Pass, High Pass, Band Pass, Band reject, All Pass. System classification based on phase response and location of zeros. Introduction of IIR and FIR System.	04	**CO5**
VI	Realization of Linear Systems	Basic realization block diagram of CT and DT system. Basic structures of FIR Systems Basic structures for IIR Systems: Direct form – I, direct form – II, series, parallel.	04	**CO6**

Note: Numerical should be covered in Tutorials.

Text Books:

1. Salivahan S.," Digital Signal Processing", TMH Publication,2012
2. Alan V. Oppenheim, Alan V. Willsky and S.Hamid Nawab, "Signals and Systems", Prentice-Hall India.
3. Haykin S and Van Veen B., "Signal & Systems", Wiley Publication, 2nd Ed.,2002.
4. Hwei P. Hsu, SCHAUM'S OUTLINES OF "Theory and Problems of Signals and Systems", McGraw-Hill International.
5. Mrinal Mandal and Amir Asif, "Continuous and Discrete Time Signals and Systems",
6. Linder D.K.," Introduction to Signal & System," McGraw Hill International, 1999.

References:

1. Proakis J.G. and Manolakis D. G., "Digital Signal Processing: Principles, Algorithms and applications", PHI publications (1995).
2. Nagrath I. J., Sharan S. N. and Ranjan R., "Signal & Systems", 2nd Ed., 2010.
3. Narayan Iyer, "Signal & Systems", Cengage Learning, 2011.
4. Lindner D.K., "Introduction to Signal & Systems", McGraw-Hill International Edition,1999.
5. Lathi B.P., "Signal & Systems", Oxford University Press, second edition, 1998.

Online References:

Sr. No.	Website Name
1.	NPTEL Course: Principles of Signals And Systems By Prof. Ravindra Arora , Dept. of Electrical Engineering, IIT Kanpur: - Web link- https://nptel.ac.in/courses/108/104/108104100/
2.	NPTEL Course: Signals And Systems By Prof. Kushal K. Shah, Dept. of Electrical Engineering, IISER Bhopal:- Web link- https://nptel.ac.in/courses/108/106/108106163/

Course Code	Course Name	Teaching Scheme (Contact Hours/Week)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2214112	Electromagnetic Fields and Waves	3	--	-	3	-	-	3

Term Work:

- Term work: Term work consists of minimum eight tutorials (at least one on each module) and Assignments (min. 2).
- The distribution of the term work shall be as follows:
  Tutorials: 15 marks
  Assignments: 05 marks
  Attendance (Theory and Tutorial) :05 marks
  The final certification and acceptance of term-work ensures the minimum passing in the Term Work.

Internal Assessment (IA):

- IA will consist of Two Compulsory Internal Assessment Tests (Each Test of 20 Marks). Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

Question Paper Format:

- Question Paper will comprise of a total of **six questions each carrying 15 marks. Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining questions** will be **mixed in nature** [part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules].
- A total of **four questions** needs to be answered.

Course Code	Course Name	Examination Scheme			
		Theory Marks			Total
		Internal Assessment (IAT)	End	Exam	

		IAT-I	IAT-II	IAT-I + IAT-II (Total)	Sem. Exam	Duration (in Hrs.)	
2214112	Electromagnetic Fields and Waves	20	20	40	60	2	100

Course Objectives: This course is aimed

1. To provide the students with a solid foundation in engineering fundamentals required to solve problems and also to pursue higher studies.
2. To acquire the knowledge of Electromagnetic field theory that allows the student to have a solid theoretical foundation to be able in the future to design emission, propagation and reception of Electro -magnetic wave systems.
3. To acquire the knowledge of time varying Electric Wave that allows the student to have a solid theoretical foundation to be able in the future to design emission, propagation and reception of Electric field
4. To acquire the knowledge of time varying magnetic that allows the student to have a solid theoretical foundation to be able in the future to design emission, propagation and reception of Magnetic field
5. Apply mathematical techniques and electromagnetic field theory to analyze and design simple electromagnetic system
6. Recognize common sources of EMI, including natural and man-made sources.

Course Outcomes: At the end of the course, students will be able to

1. Apply vector calculus concepts along with physical principles and properties to effectively solve problems encountered in everyday life.
2. Solve the electrostatic problems using coulombs law and gauss's law.
3. Understand the concept conductors, dielectrics, boundary conditions and capacitance
4. Solve the magnetic field problems using the laws of magnetism and vector calculus
5. Apply the Maxwell's equations to understand the electromagnetic wave propagation
6. Explain EMC regulation and methods of eliminating interferences

Detailed Syllabus:

Sr. No.	Name of the Module	Detail Content	Hours	CO Mapping
---	Prerequisite	Basic Electrical Engineering and Basic Vectors	---	---
1	Vector Analysis	Vector analysis, Cartesian, Cylindrical and Spherical coordinate systems, Relationship between the coordinate systems, Properties of coordinate system, Introduction to Gradient, divergence, and curl of a coordinate system	4	CO1
2	Electrostatics	Coulomb's law and its applications, Electric field intensity, Electric flux densities for various charge distributions such as line, surface, and volume - Gauss's law and its applications - Electrostatic potential, Divergence theorem - Convection and Conduction current - Electric field in free space, conductors, and dielectrics, Electrostatic boundary value problems: Poisson's and Laplace's equations and solutions	8	CO2

3	Electrostatics Applications	Current and current density - continuity of current - conductor properties and boundary conditions - the nature of dielectric materials - boundary conditions for perfect dielectric materials -capacitance - different types of capacitances – energy density in electric field	7	CO3
4	Magnetostatic Fields	Magnetic field intensity - Bio Savart's law - Ampere's circuit law - Magnetic flux and Magnetic flux density, Magnetic flux density in free space, conductor, and magnetic materials - Magnetic force, Magnetic Vector potential - Stroke's theorem.	7	CO4
5	Maxwells Equations and Electromagnetic Waves	Faraday's laws- Faraday's law - Lenz's law - Maxwell's equations in differential and integral forms - displacement current - Electromagnetic wave equations – wave parameters - velocity, intrinsic impedance, propagation constant - waves in free space, lossy and lossless dielectric, conductors-skin depth –Poynting Theorem	8	CO5
6	Applications of Electromagnetic Waves	EMI / EMC, EMI Sources - Effects of EMI – Testing Methods for EMI/EMC, Methods to suppress EMI-Grounding and shielding. EMC standards - Practical issues of EMI/EMC non compliances, biological effects of EMI / EMC – ESD – EMP	5	CO6

Textbooks:

1. William H. Hayt, John A. Buck, Jaleel M. Akhtar, "Engineering Electromagnetics", McGraw Hill India, 2020 (Ninth Edition).
2. Mathew O Sadiku, "Elements of Electromagnetics", Oxford University Press, 2014 (Sixth Edition).
3. NPTEL Course: https://archive.nptel.ac.in/courses/108/104/108104087/

References:

1. Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, 2010.
2. Joseph. A.Edminister, 'Schaum's Outline of Electromagnetics, Third Edition (Schaum's Outline Series), Tata McGraw Hill, 2010

3. Saroj K. Dash, Smruti R. Khuntia., "Fundamentals of Electromagnetic Theory", Prentice Hall, 2011 (Second Edition)
4. R K Shevgaonkar, "Electromagnetic Waves", McGraw Hill India, 2006.
5. Edward C. Jordan, Keith G. Balmain, "Electromagnetic Waves and Radiating Systems", Pearson India, 2015(Second Edition).

Online References:

Sr. No.	Website Name
1.	NPTEL Course: https://archive.nptel.ac.in/courses/108/104/108104087/
2.	Coursera Course: https://www.coursera.org/specializations/electrodynamics

Assessment:

Internal Assessment Test (IAT) for 20 marks each:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

End Semester Theory Examination:

- **Question paper format**
  - Question Paper will comprise a total of **six questions each carrying 15 marks. Q.1 will be compulsory** and should **cover the maximum contents of the syllabus**
  - **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules).
  - A total of **four questions** needs to be answered

Course Code	Course Name	Examination Scheme					
		Theory Marks				Exam Duration (in Hrs.)	Total Marks
		Internal Assessment (IAT)			End Sem. Exam		
		IAT-I	IAT-II	IAT-I + IAT-II			

Course Code	Course Name	Teaching Scheme (Contact Hours/Week)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2214113	Power Electronics Devices and Circuits	20	20	40	60	2		100
2214113	Power Electronics Devices and Circuits	3	--	-	3	-	-	3

Course Objectives: This course is aimed

1. To enhance the knowledge of fundamentals of various semiconductor devices, their operation and characteristics & selection of power devices.
2. Analyze phase-controlled rectifiers for different loads.
3. The basic topology, switching techniques and analysis of various types of DC-DC converters.
4. The basic topology, analysis using performance parameters of single and three phase AC-DC converters with various loads.
5. To explain the need & operation of drive circuits and snubber circuits & heat sinks.

Course Outcomes: At the end of the course, students will be able to

1. Understand the basic operation and characteristics of various semi controllable and fully controllable devices.
2. Analyze phase-controlled rectifiers for different loads.
3. Apply the knowledge of power electronics in the analysis of DC –DC converters.
4. Analyze DC –AC converters & control their operation using PWM techniques.
5. Identify various auxiliary circuits and requirements in power electronics applications.

Detailed Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Thyristors (Silicon Controlled Rectifier)**	Modes of operation of silicon-controlled rectifier, Static V-I characteristics, gate control, Two transistor Analogy, Thyristors voltage & current rating, Firing circuits (R, RC, Ramp triggering using UJT), Protection circuit of SCR.	**06**	**CO1**
II	**Power Semiconductor Devices**	Characteristics of Power diodes, Power BJTs, Power MOSFETs & IGBTs, Safe Operation Area (SOA) for each device, Comparison of Power BJT, PMOSFET & IGBT, Wide band gap devices (Silicon Carbide SiC and GaN), ON state (Conduction) and switching losses, numericals on losses, understanding of MOSFET & IGBT Data sheet.	**08**	**CO1**
III	**Controlled Rectifiers (AC to DC Converter)**	Single phase full wave-controlled rectifiers (mid-point and bridge configuration) for R and R-L load, Numerical for Calculation of output voltage, Rectification and inversion mode of single phase fully controlled rectifier, single phase dual converter, three phase full converter with R load, Single phase PWM rectifier, basic working principle, Applications	**08**	**CO2**

IV	**DC-DC switched Mode Converters**	Basic principle of step-down operation & PWM control of DC-to-DC convertor, Analysis of Buck, Boost, Buck-Boost, converters (All with resistive load and only CCM mode), Output voltage ripple. Comparison of non-isolated converters, Bidirectional dc to dc converters Applications: Power Factor Correction Circuits, LED lamp driver, **Numerical included**.	**06**	**CO3**
V	**DC-AC Converter (Inverter)**	Principle of operation of single-phase half and full bridge inverters, Voltage control in single phase inverters, Pulse width modulated inverters, Multiple PWM, Sinusoidal PWM, three phase VSI (120° and 180° conduction mode), Single phase current source inverters (CSI), comparison of VSI and CSI. Application of inverters	**06**	**CO4**
VI	**Auxiliary Circuits**	Need for Snubber circuit, Function and Types of Snubber Circuits, Turn-Off Snubber, Requirement of gate driver circuits, Gate drivers for Power MOSFET & IGBT, level shifters, bootstrap drivers, isolated drivers, Heat sinks & examples on heat sink calculation	**05**	**CO5**

Text Books:

1. M. H. Rashid, Power Electronics: Circuits, Devices, and Applications, Pearson Education, 2009.
2. Dr. P. S.Bhimbra, Power Electronics, Khanna publication.
3. N. Mohan and T. M. Undeland, Power Electronics: Converters, Applications and Design, John Wiley & Sons, 2007.

References:

1. "Power Electronics", Landers, McGraw Hill
2. P.C. Sen, "Modern Power Electronics", Wheeler Publishing Co, First Edition, New Delhi, 1998.
3. R.W. Erickson and D. Maksimovic, Fundamentals of Power Electronics, Springer Science & Business Media, 2007.
4. P.C Sen., Modern Power Electronics, Wheeler publishing Company, 1st Edition, 2005
5. Alok Jain, Power Electronics: Devices, Circuits and Matlab Simulations, Penram Int. 2010
6. L Umanand, Power Electronics, Essentials & Applications, Wiley publications
7. B. Jayant Baliga, Silicon Carbide Power Devices, World Scientific, 2005.

Online References:

Sr. No.	Website Name
1.	**http://nptel.iitm.ac.in: "Power Electronics" web-course**
2.	**NPTEL/ Swayam Course: Power Electronics By Prof. G. Bhuvaneshwari (IIT Delhi)**https://swayam.gov.in/nd1_noc20_ee97/preview
3.	**Course: Advance Power Electronics And Control – Prof. Avik Bhattacharya (IIT Roorkee)**https://nptel.ac.in/courses/108/107/108107128/

Course Code	Course Name	Teaching Scheme (Contact Hours/Week)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2214114	Electromagnetic Fields and waves Lab	-	2	-	-	1	-	1

Assessment:

Internal Assessment (IA):

- IA will consist of Two Compulsory Internal Assessment Tests (each of 20 Marks). Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➢ **Question paper format**

- Question Paper will comprise of a total of **six questions each carrying 15 marks. Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** [part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules]
- A total of **four questions** needs to be answered

Course Code	Course Name	Examination Scheme			
		Theory Marks	Term	Oral	Total

		Internal assessment (IAT)			End Sem. Exam	Work	Exam.	Marks
		IAT-I	IAT-II	IAT-I +IAT-II (Total)				
2214114	Electromagnetic Fields and waves Lab	--	--	--	--	25	25	50

Lab Objectives: The Lab course is aimed to

1. To develop students' ability to apply vector analysis techniques to solve problems in various engineering
2. To understand the concept of charge concentration and its relation to electric field strength.
3. To relate the fundamental principles of electrostatics to real-world applications.
4. To explore the magnetic fields generated by various current configurations (straight wires, loops, solenoids).
5. To design and conduct experiments to demonstrate the generation, propagation, and properties of EM waves.
6. Understanding EMI/EMC Fundamentals

Lab Outcomes: At the end of the Lab course, students will be able to

1. Describe the relationship between vectors and coordinate systems.
2. Design simple experiments to investigate electrostatic phenomena.
3. Predict the behavior of charged particles in various electrostatic devices.
4. Calculate the magnetic field produced by simple current configurations using Biot-Savart Law or Ampere's Law.
5. Recall Maxwell's equations in integral and differential form.
6. Solve simple EMI/EMC problems.

Detailed Syllabus:

The Syllabus is same as the Theory Course “Electromagnetic Fields and Waves (Course Code: 2214112)”.

List of Experiments:

Expt. No	Name of the Experiments	Hours
1	Represent vectors in various Coordinate system using MATLAB/SCILAB	**2**
2	Sketch the Surface in Cartesian Coordinates, Cylindrical Coordinates and Spherical Coordinates using MATLAB/SCILAB	**2**
3	Translate vectors between coordinate systems using MATLAB.	**2**
4	Find electric field Intensity due to point charges, line, surface, and volume charge density using MATLAB/SCILAB.	**2**
5	Find Electric flux density due to point charges, line, surface, and volume charge density using MATLAB/SCILAB.	**2**
6	Plot magnetic field lines around a current-carrying wire using MATLAB/SCILAB.	**2**

7	Visualise Maxwell's equations using MATLAB.	**2**
8	Simulate the propagation of an electromagnetic wave using MATLAB/SCILAB	**2**
9	Simulate the effect of EMI on a signal using MATLAB	**2**
10	Display the charge distribution of Parallel plate capacitor computed by using MATLAB/SCILAB	**2**
11	Find the Poynting vector of a standing wave and compute the power of plane waves from the pointing vector using MATLAB/SCILAB	**2**
12	Compute dielectric-dielectric boundary conditions between medium1 and 2 using MATLAB/SCILAB	**2**
13	Analyse EMI/EMC of cables using MATLAB.	**2**

References for lab experiments:

1. Electromagnetic Fields with MATLAB and Scilab Programs, R. Senthilkumar, Yes Dee Publishing 2022.

Online Resources:

Sr. No.	Online Resource
1	SCILAB: https://scilab.in/textbook_run/42/40/5
2	MATLAB: https://in.mathworks.com/help/pde/electromagnetics.html

Sr. No.	List of Assignments / Tutorials	Hrs
01	Numerical on Coordinate System.	1
02	Numerical on Coulomb's law and Electric field due to various Charge Distribution.	1
03	Numerical on Ampere's Circuital law, Biot-savarts law and its application.	1
04	Numerical on Poisons and Laplace equation and Electromagnetic Field	1
05	Numerical on wave equation	1

Assessment:

Term Work: Term Work shall consist of at least 8 practicals based on the above list. Also, Term work Journal must include at least 2 assignments/tutorials.

Term Work Marks: 25 Marks
(Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) +5 Marks (Attendance)

Oral Exam.: An Oral examination will be held based on the above syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours/Week)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2214115	Power Electronics Devices and Circuits Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral Exam.	Total Marks
		Internal assessment (IAT)			End Sem. Exam			
		IAT-I	IAT-II	IAT-I +IAT-II				

				(Total)				
2214115	Power Electronics Devices and Circuits Lab	--	--	--	--	25	25	50

Lab Objectives: The Lab course is aimed to

1. To impart knowledge about various power semiconductor devices related to its characteristics, ratings, protection and to select semiconductor devices for various applications.
2. To introduce different methods of power conversion such as ac to dc, dc to dc, dc to ac the underlying principles of converter operation and hence to analyze different converter circuits for power conversion.
3. To keep abreast with the latest technologies and research going on in different domains related to power electronics

Lab Outcomes: At the end of the Lab course, students will be able to

1. Draw V-I characteristics of power electronic devices and analyze the firing circuit of SCR
2. Analyze various single phase and three phase power converter circuits and understand their applications.
3. Analyze DC to DC & DC to AC converter circuits and their applications
4. Identify and describe various auxiliary circuits and requirements in power electronics applications such as gate driver circuit, snubber circuits and heat sinks
5. Simulate the performance of power electronic conversion systems

Detailed Syllabus:

The Syllabus is same as the Theory Course "Power Electronics Devices and Circuits (Course Code: 2214113)".

Suggested List of Laboratory Experiment:

Sr No	List of Experiments	Hrs
Group-A - Hardware Based Experiments		
01	Plot I-V characteristics of Thyristors (SCR) experimentally	2
02	Analyze the Firing Circuit of SCR	2
03	Study of switching characteristics of Power BJT/ Power MOSFET/ IGBT	2
04	Single phase half or full wave-controlled rectifier circuit	2
05	Three phase half /fully controlled rectifier circuit with R /RL Load	2
06	Design and Implementation of DC-DC Buck converter	2
07	Design and Implementation of DC-DC Boost converter	2
08	Single phase Inverter (IGBT/MOSFET based)	2
09	Three phase Inverter (IGBT/MOSFET based)	2
10	Design and implementation of snubber circuit	2
11	Design and implementation of IGBT gate driver circuit	2

12	Implementation and testing of LED driver circuit	2
Group-B- Simulation Based Experiments		
1	Three phase half /fully controlled rectifier circuit with R & RL load	2
2	Three phase VSI (120° and 180° conduction mode)	2
3	SPWM or any other PWM Voltage source Inverter	2
4	Single Phase PWM Rectifier	2
6	Bidirectional DC-DC Converter	2
7	DC-DC Buck/Boost/Buck Boost converter in CCM	2
9	Power factor correction in converters	2

Any other experiments based on syllabus which will help students to understand topic/concept.

Sr No	List of Assignments / Tutorials
01	Assignments/Tutorials should be based on the entire course of Power Electronics Devices and Circuits as per the mentioned Modules.

Virtual Lab Website Reference:

1. http://vlab.co.in/broad-area-electrical-engineering
2. http://vlab.co.in/broad-area-electronics-and-communications

Assessment:

Term Work: Term Work shall consist of at least 6 experiments & 2 Simulations based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: - The distribution of marks shall be as follows:

- Performance: 05 marks
- Journal: 10marks
- Assignments: 05 marks
- Attendance (Theory and Practical): 05 marks

The final certification and acceptance of term work ensures the minimum passing in the term work

Practical & Oral Examination: A Practical & Oral examination will be held based on the above syllabus.

Vertical - 4

Course Code	Course Name	Teaching Scheme (Contact Hours/Week)		Credits assigned		
		Theory	Pract. / Tut.	Theory	Pract./Tut.	Total
2214411	Electrical Workshop (Group Project)		2*+2	--	2	2

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Prese-ntation/ Oral Exam.	Total Marks
		Internal Assessment			End Sem. Exam.	Exam. Duration in Hrs.)			
		Test 1	Test 2	Total					
2214411	Electrical Workshop	-	-	-	-	-	50	25	75

	(Group Project)								

Note: * Two hours of practical class to be conducted for full class as demo/discussion/theory.

Lab objective:

1. To learn electrical safety protocols, fire prevention measures, and the proper use of electrician tools and accessories.
2. To understand the working principles of electrical measuring instruments and develop skills in accurate measurement techniques.
3. To interpret electrical diagrams, apply standard symbols, and create schematic and wiring layouts.
4. To gain knowledge of wiring standards, earthing techniques, and power factor improvement methods
5. To troubleshoot and repair common electrical appliances, ensuring proper functionality and safety.
6. To use CAD software for electrical circuit design, wiring layouts, and simulations.

Lab outcome:

1. Demonstrate electrical safety practices, proper use of fire extinguishers, and effective handling of tools and accessories.
2. Identify, operate, and interpret readings from electrical measuring instruments for accurate analysis.
3. Interpret and analyze electrical schematics, prepare single-line diagrams for electrical systems, and apply standard symbols and conventions to develop electrical drawings.
4. Implement wiring and earthing systems, measure earth resistance, and apply power factor correction techniques.
5. Identify faults in household electrical appliances, carry out necessary repairs, test the repaired devices for safe operation, and ensure their proper functioning.
6. Design and simulate electrical wiring layouts using CAD software and create panel board diagrams with industry-standard accuracy.

Detailed Syllabus:

Module No.	Name of Module	Detail Contents	Hours	LO Mapping
1	Electrical Safety, Accessories & Tools	*Safety:* IE safety rules, fire safety, types of fire extinguishers, and personal protective equipment (PPE). *Electrical Accessories:* Switches and their Types, Lamp Holders and their Types, Ceiling Rose, Pin Plug, Socket and Adopter, Precautions for using Aluminium Cables, Difference between	8	LO1

		Insulated Wires and Cables, Measurement of Wires, Types of Wires, and Types of Cables. *Electrician Tools:* Plier Insulated, Plier Side Cutting, Screw Driver, Neon Tester, Hammer, Pincer, Chisel, Hand Drill Machine, Allen Key, Grease Gun, Out Side Micrometer, Motorised Bench Grinder, Rawl plug tool and bit, Crimping Tool, Wire stripper, Try Square, Outside and Inside Divider Calliper, Pliers flat nose, Pliers round nose, Tweezers, Spanner, Gauge, wire imperial, file set, Soldering Iron. **Suggested Lab Activities:** 1. Identify and explain the meaning of various safety signs used in electrical labs and installations. 2. Experiment on the fire extinguishers. 3. Use tools like pliers, screwdrivers, wire strippers, and crimping tools for various tasks. Identify and demonstrate the use of switches, sockets, lamp holders, plugs, and adapters.		
2	Use of Lab Equipments	*Standard Lab Equipments:* Multi-meter, Power Supply, Function Generator, Tachometer, thermometer, clamp-on meter, DSO etc. **(Study all the equipments)** *Special Measuring Equipments:* True RMS multi-meter, Lux meter, Megger, LCRQ meter, Power Meter, Thermal Analyser, Anemometer, Humidity Meter, Earthing Resistance meter, Insulation Resistance meter etc. **(Study at least 3 such equipments)** *Special Lab Equipments:* High Power DC Supply, Isolated DSO, Power Analyser, Emulators etc. **(Study at least one of such equipments)** **Lab Activities:** Students should be trained to use these classes of lab equipments with good expertise achieved. Students should clearly understand and differentiate the situations in which use of each of these equipments is best suitable.	4	LO2
3	Electrical Drawing & Schematics	Importance and applications of electrical drawings in installations and maintenance, Types of electrical drawings: Schematic diagrams, Wiring diagrams, Interconnection diagram, Single-line diagrams, Layout diagrams. Overview of standards and codes for electrical drawings (e.g., IS, IEC standards). Electrical Symbols and Conventions **Lab Activities:** 1. Prepare list of electrical symbols. 2. Students should study the actual electrical supply	8	LO3

		system on institute campus, prepare SLD for the network and detailed report on actual ratings of the complete system. **3.** Analyze a single-line diagram for an industrial substation.		
4	Practical Aspects of Wiring, Earthing, and Power Factor Correction	Wiring materials, wire selection, conductor sizing, and wiring standards (IS-732, section 4). Importance of Earthing in Electrical Installations, Types of Earthing: Plate Earthing, Pipe Earthing, and Rod Earthing, Earth Resistance and Its Measurement, Basics of Power Factor and Its Importance, Power Factor Improvement Methods, Types of Energy Meters and Their Installation Procedures **Lab Activities:** Students should perform following experiments (Any five) 1. Identify different types of cables/wires, switches and their uses. 2. Wiring of simple light circuit for controlling light/fan point (PVC conduit wiring and wiring accessories). 3. Wiring of fluorescent lamps and light sockets (6 A). 4. Wiring of Power circuit for controlling power device (16A socket) 5. Design of Staircase wiring / Go-down wiring / Tunnel wiring 6. Measurement of Earthing resistance. 7. Installation and testing of an energy meter. 8. Measuring power factor using a power meter. Checking load distribution in a domestic circuit.	12	LO4
5	Repair and Maintenance of House-hold Appliances and Machines	Testing, fault finding, Dismantling, assembling and testing after repairs of house hold appliances like standard fan and regulator, BLDC fan, heater, geyser, mixer, washing machine, microwave oven, LED lamps/tubes, Induction Cooker, Air cooler etc. **Lab Activities:** Check the fault finding and repair of electrical appliances. (Minimum three such appliances must be studied)	4	LO5
6	Electrical CAD & Circuit Simulation	Basics of Electrical CAD Software, Importance of CAD in Electrical Drawings, Understanding Electrical Symbols and Components in CAD, Single-Line and Schematic Diagrams, Drawing Electrical Wiring Layouts in CAD, Understanding Panel Board Diagrams, Power and Lighting Circuit Design in CAD Lab Activities: 1. Drawing basic electrical symbols in CAD software. 2. Creating a simple domestic wiring diagram using CAD. 3. Simulating a basic electrical circuit in CAD.	16	LO6

		4. Creating a detailed wiring diagram for a small house/shop using CAD. 5. Designing a simple panel layout in CAD. Generating a bill of materials (BOM) for the designed circuit.		

Suggested List of Capstone Projects:

1. **Home Wiring & Power Management –** Design and implement a house/shop wiring system with CAD diagrams, sockets, lighting, and power factor analysis.
2. **Smart Switchboard with Indicators –** Develop a switchboard with LED indicators for load status, overload protection, and CAD-based design.
3. **Industrial Panel Wiring Simulation –** Create a scaled industrial panel, design in CAD, and test three-phase wiring with safety measures.
4. **Household Appliance Repair & Testing –** Diagnose and repair three appliances (fan, heater, mixer), test insulation resistance, and document faults.
5. **Earthing System & Safety Compliance –** Install and test plate/pipe earthing, measure resistance, and compare methods with IS-732 standards.
6. **CAD-Based Electrical Wiring Layout –** Design a complete electrical wiring plan for a facility, including lighting, sockets, and BOM.
7. **Fire Safety & Electrical Hazard Kit –** Demonstrate fire extinguisher use, short circuit scenarios, and electrical safety compliance.
8. **Smart Energy Metering & Power Factor Correction –** Install an energy meter, analyze load variations, and implement capacitor banks.
9. **Electrical Network Survey & Report –** Study campus/building power distribution, create SLD in CAD, and suggest efficiency improvements.
10. **Automated Lighting & Power Control –** Implement a timer-controlled circuit for energy-efficient lighting and fan control.

Note: Faculty can offer any other project based on the syllabus which will help students to understand the topic/concept and implement it for real-life application.

Suggested Software Tools to be Used:

- Students should be encouraged to use open source softwares such as AutoCAD Electrical (Student Version), QElectroTech, KiCad, FreeCAD (with Electrical Workbench), 3D CAD with electrical features, and TinyCAD for carrying out the experiments.
- Use of Professional Licensed versions of softwares like AutoCAD Electrical, SolidWorks Electrical, EPLAN Electric P8, SEE Electrical, ETAP, and OrCAD is also allowed/

Text Books:

1. J. B. Gupta, Electrical Installation Estimating & Costing, S. K. Kataria & Sons, 2009
2. Raina Bhattachraya, Electrical Design Estimating and Costing, New Age International,
3. Sham Tickoo, AutoCAD Electrical 2021: A Tutorial Approach, 2nd Edition, CADCIM Technologies
4. K B. Bhatia, Electrical Appliances and Devices, Khanna Publications

Reference Books:

1. K B. Bhatia, Fundamentals of Maintenance of Electrical Equipments, Khanna Publications
2. BIS SP 30:National Electrical Code
3. Electricity Act 2003

Online Resources:

1. https://www.falstad.com/circuit/
2. https://www.autodesk.com/education/edu-software/overview?sorting=featured&p%20age=1
3. https://www.ti.com/tool/TINA-TI
4. https://www.proficad.com/
5. https://www.kicad.org/

Assessment:

Term Work shall consist of at least 10 to 12 practicals' based on the above syllabus. Also, student need to submit a capstone project based on the above syllabus.
Journal: 15 marks
Experiment: 20 marks
Attendance: 5 marks
Capstone Project: 10 marks

Final Presentation & Practical/Oral Examination: 25 Marks

Students will present their project, including:

- Problem Statement and Clarity
- Innovativeness of the Solution
- Cost-effectiveness and Societal Impact
- Functionality of the Working Model
- Effective Use of Engineering Norms & Standards
- Individual Contribution and Teamwork
- Clarity in Written and Oral Communication

Letter Grades and Grade Points:

Semester GPA/ Programme CGPA Semester/ Programme	% of Marks	Alpha-Sign/ Letter Grade Result	Grading Point
9.00 - 10.00	90.0 – 100	O (Outstanding)	10
8.00 - < 9.00	80.0 - < 90.0	A+ (Excellent)	9
7.00 - < 8.00	70.0 - < 80.0	A (Very Good)	8
6.00 - < 7.00	60.0 - < 70.0	B+ (Good)	7
5.50 - < 6.00	55.0 - < 60.0	B (Above Average)	6
5.00 - < 5.50	50.0 - < 55.0	C (Average)	5
4.00 - < 5.00	40.0 - < 50.0	P (Pass)	4

Below 4.00	Below 40.0	F (Fail)	0
Ab (Absent)	-	Ab (Absent)	0

Sd/-

Dr. B. R. Patil
BoS-Coordinator- Electrical Engineering
Faculty of Technology

Sd/-

Dr. Deven Shah
Associate Dean
Faculty of Science & Technology

Sd/-

Prof. Shivram S. Garje
Dean
Faculty of Science & Technology