Government College of Engineering, Aurangabad

Department of Electrical Engineering

NEP Compliant tentative B. Tech structure

& Curriculum of

S.Y. B. Tech. (Electrical) 2024-25 onwards as per NEP2020

PROGRAMME EDUCATIONAL OBJECTIVES (PEO's)

1. Our graduates will excel in professional careers in technology and management with appropriate consideration for safety, culture, energy optimization and environment.
2. Our graduates will excel in higher studies, research and competitive examinations.
3. Our graduates will become successful entrepreneurs.
4. Our graduates will practice good human values, professional ethics and social responsibilities

Approved in XXV IIIth Academic Council
Dated: 25th Jun 2024

Program Outcomes

1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. Design/development of solutions: Design solutions for complex engineering problems and design systems components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural, social and environmental consideration. To use modern engineering IT tools to solve and model electrical engineering problems.
4. Conduct investigations of complex problems: Use research based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.
5. Modern tool usage: Create, select and apply appropriate techniques, resources and modern engineering and IT tools including predictions and modeling to complex engineering activities with an understanding of the limitations
6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and consequent responsibility relevant to the professional engineering practice.
7. Environment and sustainability: Understands the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual and as a member or leader in diverse teams, and multidisciplinary settings.
10. Communications: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentations, make effective presentations and give and receive clear instructions.
11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects multidisciplinary environments.
12. Life-long learning: Recognize the need for and have preparation and ability to engage in independent and life-long learning in the broadest context of technological changes.

Program Specific Outcomes

1. Identify, formulate problems in power system domain and apply subject knowledge to provide solutions
2. Classify, make use of various electrical machines, power electronics circuits and electrical drives for engineering applications and investigate for suitability and troubleshooting
3. Analyze and apply concepts of electronics, control systems and instrumentation for engineering applications

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Total Credits for the completion of B. Tech. in Electrical Engineering:

The total number of credits proposed for the four-year B. Tech Electrical Engineering with 1 Multidisciplinary minor (Compulsory) degree is **170** as per the structure given below**:**

Structure of B. Tech. in Electrical Engineering with multidisciplinary minor:

Semester		**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total Credits**
Basic Science Course	BSC	08	08		--	--	--	--	--	16
Engineering Science Course	ESC	07	07		--	--	--	--	--	14
Program Core Course (PCC)	Program Courses	--	02	14	12	08	13	04		53
Program Elective Course (PEC)	Program Elective	--	--	--	--	06	06	07	-	19
Multidisciplinary Minor (MD M)	Multidisciplinary Courses		-	04	03	04	03			14
Open Elective (OE) Other than a particular program	OE	--	--	03	02	03	--	--	--	08
Vocational and Skill Enhancement Course (VSEC)	Skill Courses	02	02	--	02	--	02	--	--	08
Ability Enhancement Course (AEC -01, AEC-02)	Humanities Social Science and Management (HSSM)		02	--	02	--	--	--	--	04
Entrepreneurship/Economics/ Management Courses		--		02	02	--	--	--	--	04
Indian Knowledge System (IKS)		02			--	--	--	--	--	02
Value Education Course (VEC)		--	--	02	02	--	--	--	--	04
Research Methodology	Experiential Learning Courses	--	--	--	--	--	--		02	02
Comm. Engg. Project (CEP)/Field Project (FP)		--	--	02	--	--	--	-	-	02
Project		--	--	--	--	--	--	04	-	04
Internship/ OJT		--	---			--	--		12	12
Co-curricular Courses (CC)	Liberal Learning Courses	02	02		--	--	--	--	-	04
Total Credits (Major)		**21**	**23**	**27**	**25**	**21**	**24**	**15**	**14**	**170**

Students can opt for any of the following as per the rules and regulations given by institute:

1. B. Tech with one Multidisciplinary Minor = Total 170 Credits
2. B Tech with two Multidisciplinary Minors = Total 184 Credits
3. B. Tech with one Multidisciplinary Minor and Honor = Total 188 Credits
4. B. Tech with one Multidisciplinary Minor and Honor by research = Total 188 credits

MULTIDISCIPLINARY MINOR (MD M) and OPEN ELECTIVE (OE) Other than particular Program

List of Multidisciplinary Minor Courses from other faculties: Total 14 Credits as per GR, Two courses of 4 credits and two courses of 3 credits. Open electives of 8 credits are offered, Two courses of 3 credits and 01 course of 02 credits.

Specialization	Dramatics	Film Making	Fine Art	Music
Multi-disciplinary Minor - 01	Dramatic Theory, Literature	Videography + Cinematography	Applied Art (Digital Art)	Theory of Indian Music
Multi-disciplinary Minor – 02	Acting	Video Editing and Lighting	Painting (Generative Art)	Ancient and Modern Poetry
Multi-disciplinary Minor – 03	Directing	Story telling Story Boarding	Sculpture (3D-Space)	The Evolution of music
Multi-disciplinary Minor – 04	Playwriting	UI/UX and Animation	Visual Communication (Evolutionary Art)	Music and Film
Multi-disciplinary Minor – 05	Applied Interactive Theatre	Art of Visual Communication	Graphics Art (Print & Printing Art)	Introduction to Electronic and Computer Music
Multi-disciplinary Minor - 06	Technical Theatre	Film & TV Directing	Art Culture	Analysis of Tonal Music

Specialization	Management & Finance	Law	Social Science	Journalism
Multi-disciplinary Minor - 01	Micro-economics	Constitutional Law	Indian Economics	Principles of Communication
Multi-disciplinary Minor – 02	Corporate Social Responsibility	Human Rights & International Law	Introduction to Sociology	Fundamentals of Journalism
Multi-disciplinary Minor – 03	Principles of Accounting	Environmental Law	Geo- Informatics	Cyber Journalism
Multi-disciplinary Minor – 04	Business Intelligence	Civil Procedure Code (CPC)	Introduction to Political Sciences	Basics of Design & Graphics
Multi-disciplinary Minor – 05	Marketing Research	Land Laws including ceiling and other local laws	Corporate sociology	Mass Communication: Concepts and Processes
Multi-disciplinary Minor - 06	Corporate Governance and Business Ethics	Cyber Law	Modern India-Political, Economic & Social Ethos	IT and Online Journal

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In addition to above courses following Groups are offered as Multidisciplinary Minor by Electrical Engineering Department

Multidisciplinary Minor-I (Electrical Mobility)

Sr. No.	Course Code	Course Name	Pre-requisite	Credits L-T-P	Offered Semester	Suggested by dept
1	EEMDM2001	Electric Machines for EV Applications	No	3-0-0	III	Electrical Dept
2	EEMDM2010	Power Electronics & Electric Drives	No	3-0-0	IV	Electrical Dept
3	EEMDM2011	Lab-Electric Machines & Power Electronics drives	No	0-0-1	IV	Electrical Dept
4	EEMDM3001	Control & Instrumentation	No	3-0-0	V	Electrical Dept
5	EEMDM3010	Energy storage systems	No	3-0-0	VI	Electrical Dept
6	EEMDM3011	Lab-Control & Instrumentation, Energy Storage	No	0-0-1	VI	Electrical Dept

Multidisciplinary Minor-II (Renewable Energy Systems)

Sr. No.	Course Code	Course Name	Pre-requisite	Credits L-T-P	Offered Semester	Suggested by dept
1	EEMDM2002	Renewable Energy Technology	No	3-0-0	III	Electrical Dept
2	EEMDM2012	Grid Integration of Wind & Solar Systems	No	3-0-0	IV	Electrical Dept
3	EEMDM2013	Lab RET	No	0-0-1	IV	Electrical Dept
4	EEMDM3002	Energy Economics & Marketing	No	3-0-0	V	Electrical Dept
5	EEMDM3010	Energy Storage Systems	No	3-0-0	VI	Electrical Dept
6	EEMDM3012	Lab Energy Systems	No	0-0-1	VI	Electrical Dept

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In addition to above courses following courses are offered as Open Elective Courses (OEC) by Electrical Engineering Department

List of Open Elective courses offered

Sr. No.	Course Code	Course Name	Pre-requisite	Credits L-T-P	Offered Semester	Suggested by dept
1	EEOEC2001	Music Engineering	No	3-0-0	III	Electrical Dept
2	EEOEC2010	Basic Engineering Economics	No	2-0-0	IV	Electrical Dept
3	EEOEC3001	Building Services and Maintenance	No	3-0-0	V	Electrical Dept

HONORS

Student has to choose One Honor program out of the Two Honor groups provided below

A) Electrical Engg with Honors- (Electrical Power Engg)

Sr. No.	Course Code	Course Name	Credits L-T-P	Offered Semester	Suggested by dept
1	EEHNC2010	Electrical Power Distribution Systems	3-1-0	IV	Electrical Dept
2	EEHNC3001	CAPSA	3-1-0	V	Electrical Dept
3	EEHNC3011	FACTs Controller	3-1-0	VI	Electrical Dept
4	EEHNC4001	Power Quality, EMI and EMC	3-1-0	VII	Electrical Dept
5	EEHNC4010	Mini Project/ Power System Simulation Lab	0-0-2		

B) Electrical Engg with Honors- (Advanced Power Electronics and Drives)

Sr. No.	Course Code	Course Name	Credits L-T-P	Offered Semester	Suggested by dept
1	EEHNC2020	Electrical Machine Analysis and Modeling	3-1-0	IV	Electrical Dept
2	EEHNC3020	PWM Techniques for Power Converters	3-1-0	V	Electrical Dept
3	EEHNC3021	Advanced Power Electronics	3-1-0	VI	Electrical Dept
4	EEHNC4020	Control of Electric Drives	3-0-1	VII	Electrical Dept
5	EEHNC4021	Mini Project/ Power System Simulation Lab	0-0-2		

Teaching and Evaluation Scheme from year 2023-24

First Year B. Tech. Program in Electrical Engineering

Semester I

Semester I Courses				Teaching Scheme			Continuous Evaluation in terms of Marks					
Sr No	**Category**	**Course Code**	**Course Name**	**TH**	**T**	**PR**	**Credits**	**ISE I**	**ISE II**	**ISE III**	**ESE**	**Total**
1	BSC	MABSC1002	Mathematics I [For EE and E&TC]	3	1	-	4	15	15	10	60	100
2	BSC	PHBSC1001	Optics, Acoustics and Engineering Materials	3	-	-	3	15	15	10	60	100
3	ESC	MEESC1008	Basics of Mechanical Engineering and Graphics	3	-	-	3	15	15	10	60	100
4	ESC	CSESC1005	Programming for Problem Solving	2	-	-	2	10	10	-	30	50
5	BSC	PHBSC1003	LAB PHYSICS	-	-	2	1	-	-	25	-	25
6	ESC	MEESC1009	Basics of Mechanical Engineering and Graphics	-	-	2	1	-	-	25	-	25
7	ESC	CSESC1006	Lab Programming for Problem Solving	-	-	2	1	-	-	25	-	25
8	AEC-01	INAEC1001	Communication Skills	2	-		2	10	10	-	30	50
9	VSEC-01	ETVSE1002	Engineering Exploration	-	-	4	2	-	-	25	25	50
10	CC-01	INCCC1001	Yoga	-	-	4	2	-	-	50	-	50
Total				**13**	**1**	**14**	**21**	**65**	**65**	**180**	**265**	**575**

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Dated: 25th Jun 2024

Semester II

Semester II Courses				Teaching Scheme			Continuous Evaluation in terms of Marks					
Sr. No	**Category**	**Course Code**	**Course Name**	**TH**	**T**	**PR**	**Credits**	**ISE I**	**ISE II**	**ISE III**	**ESE**	**Total**
1	BSC	INCCC1001	Mathematics II [For EE and E&TC]	3	1	-	4	15	15	10	60	100
2	BSC	INCCC1001	Battery Science, Lubricants and Green Chemistry	3		-	3	15	15	10	60	100
3	ESC	INCCC1001	Fundamentals of Electrical Engineering	3		-	3	15	15	10	60	100
4	ESC	INCCC1001	Basics of Electronic Circuits	3		-	3	15	15	10	60	100
5	BSC	INCCC1001	Lab Chemistry	-	-	2	1	-	-	25	-	25
6	PCC	INCCC1001	Electrical Engineering Practice	1	-	-	1	-	15	10	-	25
7	PCC	INCCC1001	Lab-Electrical Engineering Practice			2	1			25		25
8	ESC	INCCC1001	Lab Basics of Electronics Circuits	-	-	2	1	-	-	25	-	25
9	VSEC-02	EEVSE1001	Electrical Workshop			4	2	-	-	50		50
10	IKS-01	EEIKS1001	Vedic Mathematics	2			2	10	10	-	30	50
11	CC-02	INCCC 1002 INCCC 1003 INCCC 1004	NSS /Sports/ Club Activities	2			2	-	-	50	-	50
	Total			**17**	**1**	**10**	**23**	**70**	**85**	**225**	**270**	**650**

Exit Course

Exit option : Award of UG Certificate in Major with 44 credits and an additional 8 credits from following Exit Courses				
Sr. No	**Course Code**	**Course Title**	**Mode**	**Credits**
1	EEEXC1001	Electrification of building	Online/ Offline certification **courses** Work based vocational courses or internship or apprenticeship during summer vacatio	4
		AND		
2	EEEXC1002	Electrical Panel Design and Implementation		4

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Second Year B. Tech. Program in Electrical Engineering
Semester III

Semester III Courses				Teaching Scheme			Continuous Evaluation in terms of Marks					
Sr No	**Category**	**Course Code**	**Course Name**	**TH**	**T**	**PR**	**Credits**	**ISE I**	**ISE II**	**ISE III**	**ESE**	**Total**
1	PCC	EEPCC2000	Mathematics for Electrical Engineering	3	-	-	3	15	15	10	60	100
2	PCC	EEPCC 2001	Network Analysis	3		-	3	15	15	10	60	100
3	PCC	EEPCC2002	Electrical Machines- I	3		-	3	15	15	10	60	100
4	PCC	EEPCC 2004	Lab Network Analysis	-	-	2	1			25	25	50
5	PCC	EEPCC 2005	Lab Electrical Machines- I			2	1			25	25	50
6	PCC	EEPCC2003	Electrical Measurement & Instrumentation	2	-	-	2	10	10	-	30	50
7	PCC	EEPCC2006	Lab Electrical Measurement & Instrumentation	-	-	2	1		-	25	25	50
8	MD M-1			4			4	15	15	10	60	100
9	OE- I			3	-	-	3	15	15	10	60	100
10	EEM	EEEEM2001	Consumer Psychology	2			2	10	10	-	30	50
11	VEC-I	CEVEC0010	Environmental Studies	2			2	10	10	-	30	50
12	CEP	EECEP2001	Community Engg Project			4	2			50		50
			Total	**22**	**-**	**10**	**27**	**105**	**105**	**175**	**465**	**850**

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Semester IV

Semester IV Courses				Teaching Scheme			Continuous Evaluation in terms of Marks					
Sr. No.	**Category**	**Course Code**	**Course Name**	**TH**	**T**	**PR**	**Credits**	**ISE I**	**ISE II**	**ISE III**	**ESE**	**Total**
1	PCC	EEPCC2011	Electromagnetic Field	3	-	-	3	15	15	10	60	100
2	PCC	EEPCC2012	Electrical Machines- II	3	-	-	3	15	15	10	60	100
3	PCC	EEPCC2013	Power System-I	3	-	-	3	15	15	10	60	100
4	PCC	EEPCC2014	Digital Circuits	2	-	-	2	10	10	-	30	50
5	PCC	EEPCC2015	Lab Electrical Machines- II	-	-	2	1	-	-	25	25	50
6	AEC	EEAEC2010	Technical Communication	2			2	10	10	-	30	50
7	MD -2			3			3	15	15	10	60	100
8	OE- II	EEOEC2012		2	-	-	2	10	10		30	50
9	VSEC-I	EEVSE2010	Lab Digital Circuit	-	-	2	1	-	-	25	25	50
10	VSE	EEVSE2011	Lab Numerical Computational Techniques	1		2	1	-	-	25	25	50
11	VEC	INVEC1001	Universal Human Values	2			2	10	10		30	50
12	EEM	EEEEM2010	Electricity Market and Management	2			2	10	10		30	50
			Total	**23**	**-**	**06**	**25**	**110**	**110**	**115**	**435**	**800**

- **Bridge course of Two credits is mandatory for Direct second year admitted students in IV th semester**

Exit Course

Exit option : Award of UG Diploma in Major with 88 credits and an additional 8 credits from following Exit Courses

Sr. No	Course Code	Course Title	Mode	Credits
1	EEEXC2001	Repairing and maintenance of Electrical Appliances	Online/ Offline certification courses Skill based courses, internship, mini projects etc. offered during summer vacation	4
		And		
2	EEEXC2002	Industrial Electrical systems installation and maintenance		4

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Third Year B. Tech. Program in Electrical Engineering

Semester V

Semester V Course				Teaching Scheme			Continuous Evaluation in terms of Marks					
Sr No	**Category**	**Course Code**	**Course Name**	**TH**	**T**	**PR**	**Credits**	**ISE I**	**ISE II**	**ISE III**	**ESE**	**Total**
1	PCC	EEPCC3001	Control Systems-I	3	-	-	3	15	15	10	60	100
2	PCC	EEPCC3002	Power System -II	3		-	3	15	15	10	60	100
3	PEC-I			3	-	-	3	15	15	10	60	100
4	PEC-II			3	-	-	3	15	15	10	60	100
5	**MD-M-3**			4	-	-	4	15	15	10	60	100
6	OE-III			3	-	-	3	15	15	10	60	100
7	PCC	EEPCC3003	Lab Control Systems	-	-	2	1	-	-	25	25	50
8	PCC	EPCC3004	Lab Power System-II	-	-	2	1	-	-	25	25	50
			Total	**22**	**-**	**04**	**21**	**105**	**105**	**120**	**470**	**800**

❖ For B Tech with single minor and Honors, one theory course of 4 credits will be added in this semester.

Semester VI

Semester VI Course				Teaching Scheme			Continuous Evaluation in terms of Marks					
Sr No	**Category**	**Course Code**	**Course Name**	**TH**	**T**	**PR**	**Credits**	**ISE I**	**ISE II**	**ISE III**	**ESE**	**Total**
1	PCC	EEPCC3010	Control Systems-II	3	-	-	3	15	15	10	60	100
2	PCC	EEPCC3011	Microcontroller & Applications	3	-	-	3	15	15	10	60	100
	PCC	EEPCC3012	Power System Protection	3	-	-	3	15	15	10	60	100
3	PCC	EEPCC3013	Power Electronics	3	-	-	3	15	15	10	60	100
4	PCC	EEPCC3014	Lab-Power System Protection			2	1			25	25	50
5	PEC-III			3	-	-	3	15	15	10	60	100
6	PEC-IV			3	-	-	3	15	15	10	60	100
7	MD M-4			3			3	15	15	10	60	100
8	VSEC	EEVEC3011	Lab Microcontroller & Applications	-	-	2	1	-	-	25	25	50
9	VSEC	EEVEC3012	Lab Power Electronics	-	-	2	1	-	-	25	25	50
			Total	**21**	**-**	**06**	**24**	**105**	**105**	**145**	**495**	**850**

For B Tech with single minor and Honors, one theory course of 4 credits will be added in this semester.

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Exit courses

Exit option : Award of B. Vocational in Major with 132 credits and an additional 8 credits from following Exit Courses				
Sr. No	**Course Code**	**Course Title**	**Mode**	**Credits**
1	EEEXC3001	Installation of Transformer	Online/ Offline certification courses Skill based courses, internship, mini projects etc. offered during summer vacation	4
AND				
2	EEEXC3002	Industrial Electrical Systems		4

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Semester VII

Teaching and Evaluation Scheme from year 2026-27

Semester VII Course				Teaching scheme			Continuous Evaluation in terms of Marks					
Sr No	**Category**	**Course Code**	**Course Name**	**TH**	**T**	**PR**	**Credits**	**ISE I**	**ISE II**	**ISE III**	**ESE**	**Total**
1	PCC	EEPCC4001	Electric Drives	3	-	-	3	15	15	10	60	100
2	PEC-V			3	-	-	3	15	15	10	60	100
3	PEC-VI			3			3	15	15	10	60	100
4	PEC-VII (Lab)			-		2	1	-		25	25	50
5	PCC	EPCC4002	Lab Electric Drives	-	-	2	1	-	-	25	25	50
6	Project				-	8	4	-	-	50	50	100
	Total			**09**	**-**	**12**	**15**	**45**	**45**	**130**	**280**	**500**

- For B Tech with single minor and Honors, one theory course of 4 credits and one mini project of 2 credits will be added in this semester.
- For B Tech with single minor and Honors with research project, 6 credits are added in this semester.

Semester VIII

(One semester long internship in industry **)

B Tech (Electrical with double minors) Total Credits- 170 +14= 184)

Semester VIII Course				Teaching Scheme			Continuous Evaluation in terms of Marks					
Sr No	**Category**	**Course Code**	**Course Name**	**TH**	**T**	**PR**	**Credits**	**ISE I**	**ISE II**	**ISE III**	**ESE**	**Total**
1	RM**		Research Methodology	2			2	10	10	-	30	50
2	INT		Internship			24	12			200	200	400
	Total			**02**		**24**	**14**	**10**	**10**	**200**	**230**	**450***

*Total marks will be 450 plus marks of second minor courses (for 14 credits)

**To be completed online mode or allied courses from MOOCs by the students who wish to go for one semester long internship in Industry/Research Organization. However, normal track students will complete these courses in offline mode in college.

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Semester VIII

(One semester long internship in industry/Research Organisation students**)

B Tech (Electrical with Single minor and with Honors) Total Credits- 170 +18= 188)

Semester VIII Course				Teaching Scheme			Continuous Evaluation in terms of Marks					
Sr No	**Category**	**Course Code**	**Course Name**	**TH**	**T**	**PR**	**Credits**	**ISE I**	**ISE II**	**ISE III**	**ESE**	**Total**
1	RM**		Research Methodology	2			2	10	10	-	30	50
2	INT		Internship			24	12			200	200	400
3	Honors**		Honors									
	Total			**02**		**24**	**14**	**10**	**10**	**200**	**230**	**450***

*Total marks will be 450 plus marks of Honors courses

**To be completed online mode or allied courses from MOOCs by the students who wish to go for one semester long internship in Industry/Research Organization. However, normal track students will complete these courses in offline mode in college.

Semester VIII

(One semester long internship in industry/Research Organisation students**)

B Tech (Electrical with Single minor and Honors with research) Total Credits- 170 +18= 188)

Semester VIII Course				Teaching Scheme			Continuous Evaluation in terms of Marks					
Sr No	**Category**	**Course Code**	**Course Name**	**TH**	**T**	**PR**	**Credits**	**ISE I**	**ISE II**	**ISE III**	**ESE**	**Total**
1	RM**		Research Methodology	2			2	10	10	-	30	50
2	INT		Internship/Academic Project			24	12			200	200	400
3	Research Project		Research Project			24	12			200	200	400
	Total			**02**		**48**	**26**	**10**	**10**	**400**	**430**	**850**

*Total marks will be 450 plus marks of Research Project courses

**To be completed online mode or allied courses from MOOCs

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List of Professional Electives Proposed

Courses	1-Electric Mobility	2- Electrical Machines	3-Power Systems	4-Control Systems	5-Renewable Energy
PE I EEPEC 3001-3005	Electric Mobility	Renewable Energy Technology	Utilization of Electrical Energy	Nonlinear control	Energy Conservation & Management
PE II EEPEC 3006-3010	Industrial Drives	Electrical Machine Design	Power Quality & Its Mitigation	Optimization Techniques	Electrical Power Distribution system
PE III EEPEC 3011-3015	Energy Storage Systems	Reliability & Condition Monitoring	Power Systems Dynamics & Control	Motor Control for EV	
PE IV EEPEC 3016-3020	Converters for EVs	HVDC & FACT	Energized Irrigation System	Machine Learning	Smart Grid Technology
PE V MOOCs EEPEC 4001-4005	Electrical Vehicle	Machine Modeling	High Voltage Engineering		Control and Integration of Renewable Energy Sources
PE VI (LAB) EEPEC 4006-4010	Lab Industrial Electrical Systems	Lab for Special machines	Lab High Voltage Engineering	Lab Internet of Things	Lab Renewable Energy Technology
PE VII EEPEC 4011-4015	Industrial Electrical Systems	Applications of Drives	EHV AC Transmission	Digital Signal Processing	Restructured Power Systems

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Course Category Wise credit distribution

Sr. No.	Course Category	Credits
1	Basic Science Courses (BSC)	16
2	Engineering Science Courses (ESC)	14
3	Program Core Course (PCC)	53
4	Program Elective Course (PEC)	19
5	Open Elective other than particular program (OE)	08
6	Minors (MDM)	14
6	Vocational and Skill Enhancement Course (VSEC)	8
7	Humanities Social Science and Management (HSSM) AEC EEM IKS VEC	 4 4 2 4
8	Experiential Learning (EL) RM CEP/FP Project Internship	- 2 2 4 12
9	Co-curricular And Extracurricular Activities(CCA)	4
10	**Total Credits**	**170**

Approved in XXV IIIth Academic Council
Dated: 25th Jun 2024

Second Year B. Tech. Program in Electrical Engineering (NEP2020)

Semester III

Semester III Courses				Teaching Scheme			Continuous Evaluation in terms of Marks					
Sr No	**Category**	**Course Code**	**Course Name**	**TH**	**T**	**PR**	**Credits**	**ISE I**	**ISE II**	**ISE III**	**ESE**	**Total**
1	PCC	EEPCC2000	Mathematics for Electrical Engineering	3	-	-	3	15	15	10	60	100
2	PCC	EEPCC 2001	Network Analysis	3		-	3	15	15	10	60	100
3	PCC	EEPCC2002	Electrical Machines- I	3		-	3	15	15	10	60	100
4	PCC	EEPCC 2004	Lab Network Analysis	-	-	2	1			25	25	50
5	PCC	EEPCC 2005	Lab Electrical Machines- I			2	1			25	25	50
6	PCC	EEPCC2003	Electrical Measurement & Instrumentation	2	-	-	2	10	10	-	30	50
7	PCC	EEPCC2006	Lab Electrical Measurement & Instrumentation	-	-	2	1		-	25	25	50
8	MD M-1			4			4	15	15	10	60	100
9	OE- I			3	-	-	3	15	15	10	60	100
10	EEM	EEEEM2001	Consumer Psychology	2			2	10	10	-	30	50
11	VEC-I	INVEC	Environmental Studies	2			2	10	10	-	30	50
12	CEP	EECEP2001	Community Engg Project			4	2			50		50
			Total	**22**	**-**	**10**	**27**	**105**	**105**	**175**	**465**	**850**

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Semester IV

Semester IV Courses				Teaching Scheme			Continuous Evaluation in terms of Marks					
Sr. No.	**Category**	**Course Code**	**Course Name**	**TH**	**T**	**PR**	**Credits**	**ISE I**	**ISE II**	**ISE III**	**ESE**	**Total**
1	PCC	EEPCC2011	Electromagnetic Field	3	-	-	3	15	15	10	60	100
2	PCC	EEPCC2012	Electrical Machines-II	3	-	-	3	15	15	10	60	100
3	PCC	EEPCC2013	Power System I	3	-	-	3	15	15	10	60	100
4	PCC	EEPCC2014	Digital Circuits	2	-	-	2	10	10	-	30	50
5	PCC	EEPCC2015	Lab Electrical Machines -II	-	-	2	1	-	-	25	25	50
6	AEC	EEAEC2010	Technical Communication	2			2	10	10	-	30	50
7	MDM-2			3			3	15	15	10	60	100
8	OE- II	EEOEC2012		2	-	-	2	10	10		30	50
9	VSEC -I	EEVSE2010	Lab Digital Circuit	-	-	2	1	-	-	25	25	50
		EEVSE2011	Lab Numerical Computational Techniques	1		2	1	-	-	25	25	50
10	VEC		Universal Human Values	2			2	10	10		30	50
11	EEM	EEEEM2010	Electricity Market and Management	2			2	10	10		30	50
	Total			**23**	**-**	**06**	**25**	**110**	**110**	**115**	**465**	**800**

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EEPCC2000: Mathematics for Electrical Engineering	
Teaching Scheme Lectures : 3 Hrs/Week Tutorial :-0 Total Credits : 03	Examination Scheme ISE I : 15 Marks ISE II-II : 15 Marks ISE III : 10 Marks End Semester Exam : 60 Marks

Course Objective:

This course intends to provide an overview of analytical techniques to solve ordinary and partial differential equations and introduce different Integral Transforms i.e. Laplace Transform, Fourier Transform and Z- Transform, which we apply to solve many Engineering problems.

Course Outcomes:

After completing the course, students will be able to:

CO1	Define linear differential equations (LDE),Cauchy's and Legendre's differential equations, first order partial differential equations, Lagrange's equation, Laplace Transform, Fourier Transform and Z-Transform, region of convergence.
CO2	Summaries the solution of LDE with constant and variable coefficients, solution of homogeneous and non-homogeneous PDE, properties of Laplace Transform, Fourier Transform and Z-Transform.
CO3	Find Laplace Transform of derivative and integration, inverse Laplace Transform using properties, partial fraction method and convolution theorem, Fourier Transform of periodic functions, Z-transform of discrete functions, inverse Fourier Transform and inverse Z-transform.
CO4	Solve linear differential equations with constant and variable coefficients, first order linear and non-linear partial differential equations, second order homogeneous and non homogeneous linear partial differential equations.

Detailed syllabus:

Unit-I	**Linear Differential Equations (LDE):**Linear differential equations (LDE) with constant coefficients, method of variation of parameters, second order linear differential equations with variable coefficients, Cauchy's and Legendre's differential equations.
Unit-II	Partial Differential Equations (PDE): First order linear/nonlinear partial differential equation, Lagrange's equation. Solution to homogeneous and non homogeneous linear partial differential equations of second and higher order by complementary function and particular integral method.
Unit-III	**Laplace Transform** : Definition of Laplace Transform, Properties of Laplace Transform, Laplace Transform of elementary functions, Laplace Transform of derivative of functions, Laplace Transform of integration of functions. Laplace Transform of periodic functions, inverse Laplace Transform using definition, properties and partial fraction, convolution theorem.
Unit-IV	Fourier Transform (FT): Fourier integral theorem, Fourier sine and cosine integrals, Fourier transform pair, Fourier sine and cosine transform pairs, properties of Fourier transform, Fourier transform of simple functions, convolution theorem.
Unit-V	Z Transform: Z transform of elementary functions, region of convergence, properties and theorems of Z transform, inverse of Z transform using convolution theorem, partial fraction method, inversion integral method.

Text and Reference Books

1. Advanced Engineering Mathematics by Erwin Kreyszig, Wiley Eastern Ltd. Mumbai.
2. Higher Engineering Mathematics by B. S. Grewal, Khanna publication, New Delhi.
3. Engineering Mathematics-A Tutorial Approach by Ravish R Singh, Mukul Bhatt.
4. Advanced Engineering Mathematics by H. K. Dass, S. Chand and Sons.
5. Calculus by G. B. Thomas and R. L. Finney, Addison- Wesley, 1996
6. Elements of Partial Differential Equations by I.N. Sneddon
7. Boyce &DiPrima, Elementary Differential Equations and Boundary Value Problems

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1										1
CO2	3	1										1
CO3	3	2	1									1
CO4	3	2										1

1– Low, 2 – Medium, 3 – High

ISE III Assessment: It is of 10 marks based on the following.

1) Home assignments,2) Surprise tests with multiple choice questions, Surprise Test
2. Assignment using Mathematical tools like Mathematica/MatLab or similar. 3.
4. Any other activity suggested by course coordinator

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I (Class Test-1)	ISE II (Class Test-2)	ISE III (TA + Surprise Test)	End Semester Examination
K1	Remember	03	03		
K2	Understand	12	12	10	60
K3	Apply				
K4	Analyze				
Total Marks 100		15	15	10	60

Designed by

Dr. N. J. Phadkule Prof. S. D. Gadhire, Prof. S. P. Attipamulu

Approved in XXV IIIth Academic Council
Dated: 25th Jun 2024

EEPCC 2001 : Network Analysis			
Teaching Scheme		Examination Scheme	
Lectures	: 3 Hrs/Week	ISE I	: 15 Marks
		ISE II	: 15 Marks
Tutorial	: NIL	ISE III	: 10 Marks
Total Credits	: 3	End Semester Exam	: 60 Marks

Course description: The electrical Network analysis is a set of techniques used for quantitative analysis of electrical networks. electrical circuit. This course introduces the transient analysis and steady-state analysis of electrical circuits to the students.

Prerequisites: Nil

Course Objectives:

The objectives of the course are to

1. Provide the student with a comprehensive understanding of the basic law of electric circuit & theories.
2. To make the students capable of analyzing any given electrical network.
3. To learn about the use of mathematics, Laplace Transform & differential equations for network analysis.
4. To make the students learn how to represent an electrical network in terms of different parameters.

Course Outcomes: After completing the course, students will able to:

CO1	Solve Circuits using Topology and circuit reduction techniques.
CO2	Analyze the AC circuit using different network theorems.
CO3	Analyze the circuit for steady state and transient response in time domain
CO4	Analyze and evaluate transient response, Steady state response, network functions in S-domain
CO5	Express given Electrical Circuit in terms of A,B,C,D and Z,Y Parameter model and solve the circuits.

Detailed Syllabus:

Unit 1	**Basic Concepts:** Electrical parameters, Voltage and current sources(Dependent and Independent), Classification of electrical elements, Dot convention for coupled circuits, Concept of duality and dual networks. Network Topology
Unit 2	**Network Theorems:** (Application to networks with all types of sources.) Node, Mesh, Super mesh & Super node analysis, Superposition, Thevenin's and Norton, Reciprocity, Substitution theorems, Millman's Theorem, Maximum power theorem, Compensation Theorem
Unit 3	**Solution of Network Equations:** Initial and final conditions in elements and in networks, steady state and transient solution to RL,RC,RLC circuits. Forced and free response, Time constants, Physical and mathematical analysis of circuit transients
Unit 4	**Applications of Laplace Transform to Electrical Circuits:** Laplace Transformation, Laplace Transforms of Some Important Functions, Properties of Laplace Transform, Laplace Transform of Periodic Functions, Solution of differential equations and network equations using Laplace transform method, Inverse Laplace transform, Transformed networks with initial conditions analysis of electrical circuits with applications of step, impulse and ramp functions, shifted and singular functions, The convolution integral Laplace transform of various periodic and non-periodic waveforms.

Unit 5	**Network Functions:** Driving-Point Functions, Transfer Functions, Analysis of Ladder Networks, Analysis of Non-Ladder Networks, Poles and Zeros of Network Functions, Restrictions on Pole and Zero Locations for Driving-Point Functions, Restrictions on Pole and Zero Locations for Transfer Functions, Two-Port Networks-Z,Y and transmission parameters H parameters, Interrelations between these parameters, Transfer function Interconnection of Two-Port Networks **Trigonometric Fourier Series:** Waveform Symmetry, Exponential Fourier Series, Average and RMS Value of a Periodic Complex Wave, Application of Fourier series to periodic and non- sinusoidal waveforms.

Text Books:

1. William H. Hayt Jr., Jack E. Kemmerly, Steven M. Durbin, Engineering Circuit Analysis, 6th TMH.
2. M.E. Van Valkenburg, Network Analysis, 2nd edition, Prentice Hall.
3. Boylestad Robert L. Charles E., Introduction to Circuit Analysis, Merrill Publishing Company.
4. John R. O Malley, Circuit Analysis, Prentice Hall.

Reference Books:

1. Smarajit Ghosh, Network Theory: Analysis And Synthesis 1st Edition, Phi Learning Pvt. Ltd
2. C. L. Wadhwa, Electrical Circuit Analysis: Including Passive Network Synthesis, 2nd edition, New AGE INTERNATIONAL PUBLISHERS LTD.-NEW DELHI
3. M. Musa, Matthew N. O. Sadiku, Charles K. Alexander, Applied Circuit Analysis, 2nd edition, Mcgraw Hill Education

Mapping of Course outcome with Program Outcomes

Course Outcome	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2	PS O 3
CO1	3	2	1												
CO2	3	1	1												
CO3	3	2	1												
CO4	3	1	1			1	1	1							
CO5	3	2													

1 -Low 2 – Medium 3 – High

ISE III Assessment: It is 10 marks is based on one of the / or combination of few of following , Assignments based on Numerical from exercise (unsolved problems from Textbooks).
Objective type test, solving network problems by MATLAB. solution

Sample Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	Test I	Test II	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	5	5	4	15
K2	Understand	5	5	2	15
K3	Apply	5	5	2	15
K4	Analyze			2	15
Total Marks 100		15	15	10	60

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Sample Assessment Table:

Assessment Tool	K1+K2+k5	K3	K3+K5	K2+K3+K4	K4+K5
	C01	C02	C03	CO6	CO7
ISE I & II (30 Marks)	05	05	05	15	
ISE III (10 Marks)	2	2	2	2	2
ESE Assessment (60 Marks)	06	06	12	24	12

Special Instructions if any: NIL

Designed by
Prof. S. S. Mopari

Approved in XXV IIIth Academic Council
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EEPCC2002 : Electrical Machines-I	
Teaching Scheme Lectures : 3 Hrs/Week Tutorial : 0 Hr/Week Total Credits : 3	Examination Scheme ISE I : 15 Marks ISE II : 15 Marks ISE III : 10 Marks End -Semester Exam : 60 Marks

Course Description:

Electrical Machines-I is a one-semester course compulsory to all second year engineering students of the Electrical Engineering Department Course is aimed to introduce fundamentals of D.C. machines to undergraduate students. The goal of this course is to understand and apply basic principles of D C motor, D C Generator and Transformers with their applications.

Course Objectives:

The objectives of the course are to learn

1. The principles of D.C. machines.
2. Fundamental concepts of Single and three phase transformer
3. The details of construction, operation, Characteristics and applications of dc motor, dc generator and transformer
4. Basic knowledge to develop practical skills

Course Outcomes:

After completing the course, students will able to

CO1.	Understand fundamental principles, performance and applications of three phase and single phase transformer
CO2	Understand fundamental principles, performance and applications of dc motor
CO3	To solve engineering problems of dc motor, dc generator and transformer
CO4	Identify type of Transformer and DC machine
CO5	Evaluate the steady state parameters, basic operating characteristics and performance of transformers and DC Machine.

Detailed Syllabus:

Unit-I	**Magnetic circuits:** Review of magnetic circuits-MMF, Flux, reluctance, inductance, review of Ampere's law and Biot-Savart law, magnetic field produced by a bar magnet and a current carrying coil through air and iron, B-H curve of magnetic materials, flux linkages vs current characteristics of magnetic circuits, energy stored in magnetic circuits
Unit-II	**Single Phase Transformer:** Principle, construction and operation of single phase transformer equivalent circuit phasor diagram, voltage regulation losses and efficiency, open circuit and short circuit test, polarity test, back to back (Sumpner's)test, separation of hysteresis and eddy current losses
Unit -III	**Three phase Transformer:** Three phase transformer construction types of connections and their comparative features, parallel operation of single and three phase transformers, Auto transformers construction, principle, application and comparison with two winding transformer, harmonics in magnetizing current phase conversion Scott connection, three to six phase conversion , Tap changing transformers, no load and on load tap changing, three winding transformers , cooling of transformers, ICT
Unit-IV	**DC Machines** Construction of dc machine, Types of field excitation- separately excited shunt and series characteristics of dc generator, voltage build-up in a shunt generator, armature reaction critical field resistance and critical speed. Induced emf in an armature coil, lap and wave winding, commutation. DC motor principle and working, derivation of torque equation, speed torque characteristics of separately excited shunt and series motors. Modern starters,Speed control, losses and efficiency
Unit-V	**Single Phase Induction Motors:** Construction, Double field revolving theory, Equivalent circuit, Torque slip characteristics, Modern starting methods, speed control types and applications.

Text Books:

1. A. E. Fitzgerald & C. Kingsley & S. D. Umans, "Electric Machinery", TMH, New Delhi, 5th Edition.
2. I. J.Nagrath & D. P. Kothari, "Electric Machines", Tata McGraw Hill, New Delhi, 2nd Edition.
3. Dr. P. S. Bimbhra, Electric Machinery, 5th edition, Khanna Publishers, Delhi.
4.J. B. Gupta,"Theory and Performance of Electrical Machines" Kataria & Sons. 14th Edition Delhi.
5. P. S. Kenjo and S.Nagamori: Permanent Magnet DC motors, Clarendon Press, Oxford, 1985.

Reference Books:

1. Syed A. Nasar, "Electric Machines & Power Systems", Volume I, Tata McGraw Hill
2 Alexander S. Langsdorf, " Theory of Alternating current Machines" Second Edition, TMH, New Delhi
3 George Mcphersion, "An Introduction to Electrical Machines and Transformers", John Wiley NY
4. A. F. Puchstein, T.C. Lloyd, A.G. Conrad, "Alternating current machines", John Wiley and Sons, NY

Mapping Of Course Outcome with Program Outcomes

Course outcome	PO 1	PO 2	PO 3	PO 4	PO5	PO6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15
CO1	3														
CO2	3		1		1				1	1		1	1		
CO3	3		1									1	1		
CO4	3		1									1	1		
CO5	3		1									1	1		

1- Low 2- Medium 3-High

Sample Assessment Table:

Assessment Tool	K1+K2+K3	K1+K2+K3	K5	K5	K1+K2+K5
Course outcomes	CO1	CO2	CO3	CO4	CO5
ISE I & II 30 Marks	10	10	10	05	--
ISE III 10 Marks	2	2	2	2	2
ESE Assessment 60 Marks	12	12	24	06	06

ISE III Assessment: Assessment is based on one of the /or combinations of the few of the following.
Home Assignments, PowerPoint presentation, Develop working models, Surprise written Test with multiple choice questions, Quiz

Sample Assessment Pattern:

Level No.	Knowledge Level	Test	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	05	2	12
K2	Understand	05	3	12
K3	Apply	05	2	06
K4	Analyze			
K5	Evaluate	15	3	30
Total		30	10	60

Designed by Dr. S. M. Shinde & V.P. Dhote

EEPCC2003: Electrical Measurement and Instrumentation			
Teaching Scheme		Examination Scheme	
Lectures	: 2 Hrs/Week	ISE I	: 10 Marks
Tutorial	: NIL	ISE II	: 10 Marks
Total Credits	: 2	ISE III	: -
		End Semester Exam	: 30 Marks

Course Description: Electrical Measurement & Instrumentation is a one-semester course compulsory to all second year engineering students of the department which introduces analog and digital measurement of different electrical and mechanical quantities.

Course Objectives:

The objectives of the course are to

To impart knowledge of principles of measurement of electrical quantities.

To enable students to learn construction and operating principles of electrical instruments.

To enable students to learn static and dynamic characteristics of electrical instruments.

To analyze and minimize errors in measurement.

To impart knowledge of IS codes and be able to do the electrical testing.

Course Outcomes :

After completing the course, students will able to:

CO1	Explain the working principle of different electrical measuring instruments.
CO2	Analyze the bridges for the measurement of Resistance, Inductance and Capacitance.
CO3	Explain construction and working of electrical measuring instruments and compute the errors in CTs and PTs.
CO4	Explain working of measuring instruments for non electrical quantities.
CO5	Compare the digital measuring equipment for measurement of various electrical parameters.

Detailed Syllabus:

Unit-I	**Measurement of circuit parameters using bridges:** Classification of resistance, low resistance, Ammeter voltmeter method, Kelvin's double bridge Medium resistance- Ammeter voltmeter method -Wheatstone's bridge, High resistance- loss of charge method- measurement of earth resistance. Measurement of self inductance-Maxwell's Inductance bridge Measurement of capacitance–Schering's bridge Measurement of frequency-Wien's bridge. Measurement of high ac/dc and impulse voltage and current. DC Hall effect sensors.
Unit -II	**Measuring Instruments:** Measurement standards–Errors-Types of Errors- Statistics of errors, Need for calibration. Essentials of indicating instruments - deflecting, damping, controlling torques. General features of indicating, recording & integrating instruments, Types of instruments, Construction, Principle of operation and torque equation of moving coil, moving iron, electrodynamometer, Induction, and electrostatic type instruments. Shunts and multipliers – extension of range. Principle of operation of the thermoelectric, rectifier type instruments. Power factor meter, errors and their compensation, calibration & testing; Calibration of Ammeter, Voltmeter and Wattmeter using DC potentiometers. IS codes.
Unit -III	**Instrumentation:** Purpose of instrumentation, Classification of instrumentation system, Sensors and Transducers for physical parameters: Transducers classification & selection of transducers, Strain gauges, Inductive & Capacitive transducers, Piezoelectric and Hall-effect transducers, Thermistors, Thermocouples, Photo-diodes & Photo-transistors, Encoder type digital transducers, Signal conditioning and telemetry systems, Measurement of non-electrical quantities such as torque, pressure, vibration, temperature, force, humidity etc., Flow, Speed and Position Sensors.
Unit -IV	**Digital Measurement of Electrical Quantities:** Concept of digital measurement, Study of digital voltmeter, Frequency meter, Power Analyzer and Harmonics Analyzer, Electronic Multimeter, Data Acquisition Systems, Data transmission system, Signal generators and Function generators, CRO and DSO, Introduction to PMU.

Text Books:

1. A.K.Sawhney & Puneet Sawhney, "A Course in Electrical And Electronic Measurements and Instrumentation", 7/e, Dhanpat Rai & Co.(P) Ltd.,2005.

2. Albert D.Helfrick & William D.Cooper, "Modern Electronic Instrumentation and Measurement Technique",Low Price Edition, Pearson Education, 2005.

3. H.S.Kalsi, "Electronic Instrumentation", Technical Education Series, TMH, 2001.

4. Alan S.Morris, "The Essence of Measurement", Eastern Economic Edition,PHI India, 1997.

Reference Books:

1. Ernest O. Doebelin, "Measurement Systems Application and Design", 5th , TMH,2004.

2. Tumanski S., " Principles of Electrical Measurement ", CRC Press, Taylor and Francis, 2006.

3. Morris A. S.," Measurements and Instrumentation Principle", 3rd Edition, Butterworth-Heinemann, 2001 .

Mapping of Course Outcome with Program Outcomes

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	3			1	2								3	1	1
CO2	2	3	1	2	1	1		1	1	1		1	2	3	1
CO3	3	2	2	2	2		1	2	1				3	3	1
CO4	2			1	1		1				1	1	3	1	1
CO5	2				2	1	1			1	1	1	2	1	1

1 – Low 2 – Medium 3 – High

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Sample Assessment Pattern:

Assessment Tool	K1+ K3+K4	K1+K2+K3	K1+K3+K4+K5	K1+K3+K4	K1+K2
Unit wise Course outcomes	CO1	CO2	CO3	CO4	CO5
ISE I 10 Marks	5	5			
ISE II 10 Marks		5	5		
End Semester Exam 30 Marks	6	6	6	6	6

ISE III Assessment: It is based on attendance of the student and any one/two components of the following. However, the course coordinator has to announce assessment components at the beginning of the course.
Model/ circuit for Parameter Measurement, PPT presentation, Multiple Choice Question / Objective type Test / Quiz, Surprise test, Home assignments, Attendance.
Sample Assessment Pattern:

Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	5		6
K2	Understand		5	6
K3	Apply	5	5	6
K4	Analyze			6
K5	Evaluate			6
Total		10	10	30

Designed by: Prof. W. A. Gavhane

EEPCC2004: Lab Network Analysis	
Teaching Scheme Lectures : 2Hrs/Week Tutorial : NIL Total Credits : 01	**Examination Scheme** ISE I : 25 Marks Practical/Oral : 25 Marks

Laboratory Course Outcomes

As an outcome of completing the Laboratory course, students will able to:

CO1	Apply various basic laws and theorems of electrical circuit
CO2	Understand effects of Initial and final conditions on networks.
CO3	Understand and examine behavior of the network for the applications of Step, Impulse and Ramp functions.
CO4	Explain the fundamental principle Fourier transform of Waveform Analysis.
CO5	Analysis of electrical networks using two port networks concept and Concepts of Poles and Zeros.

List of Experiments(any eight or more by simulation or Hardware)

1. Network Theory
2. Verification of Superposition Theorem
3. Verification of Thevenin's Theorem
4. Verification of Maximum Power Transfer Theorem
5. Verification of Reciprocity Theorem
6. Study of Step Response of R-L Network
7. Study of Step Response of R-C Network
8. Study of Time Response of R-L-C Network
9. Waveform Analysis by Fourier Methods
10. Verification of Two Port Network

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2						1	1				1	1	1
CO2	3	2					1	1	1				1	1	1
CO3	3	2						1	1				1	1	1
CO4	3	2	1				1	1	1				1	1	1
CO5	3	2						1	1				1	1	1

1 -Low 2 – Medium 3 - High

Sample Assessment Table :

Assessment Tool	S1	S1	S3	S2	S3
Course Outcomes	CO1	CO2	CO3	CO4	CO5
Term Work (25 Marks)	05	05	05	05	05
Practical Examination & Viva Voce					

Sample Assessment Pattern:

Assessment Pattern Level No.	**Skill Level**	**Term Work**	**Practical Examination & viva voce**
S1	Imitation	10	
S2	Manipulation	05	
S3	Precision	10	
Total		25	

Preparation (S1)	05	
Conduct of Experiment (S2)	10	
Observation and Analysis of Results (S3)	05	
Record (S2)	05	
Total	25	

Approved in XXV IIIth Academic Council
Dated: 25th Jun 2024

Designed by Dr. N. J. Phadkule, Prof. S. S. M

EEPCC2005 : Lab Electrical Machines-I	
Teaching Scheme Practical: 2 Hrs/Week Credit:1	**Examination Scheme** ISE I : 25 Marks Practical Examination & Viva Voce :25 Marks

Course Description: Electrical Machines-I Lab (EE xx) is a one-semester course compulsory to all second year engineering students of the department.

Course Objective: On completion of this Course the student shall be able to

1. To prepare the students to have a basic knowledge of transformers.
2. To prepare the students to have a basic knowledge of D. C. motors.

Course Outcomes: At the end of the course student will have ability to

CO1	Select range of apparatus based on the ratings of DC Machines and Transformers.
CO2	Determine equivalent circuit parameters of transformer by open circuit and short circuit test
CO3	Evaluate the performance and parameters of transformer by analyzing load test results
CO4	Investigate the magnetization characteristics of dc generator and performance of dc motor at no load and full load
CO5	Select and demonstrate various methods to control the speed of D.C. machines for wide speed range

List of Experiments:

Sr. No.	Details
1	Determination of efficiency, regulation of single phase transformer using open circuit & short circuit test
2	Determination of constants of equivalent circuit using open circuit & short circuit test on single phase/ three phase Transformer.
3	Parallel operation of single phase/three phase Transformers
4	To determine Efficiency & regulation of single phase Transformer by direct loading.
5	To perform Sumpner's test on Transformers
6	To perform Scott: connection of single phase Transformers.
7	To verify voltage & current relationships for various Three phase Transformer winding connections
8	To plot Magnetization, external and internal characteristics of a DC generator
9	To control Speed of a DC shunt motor by: (i) armature voltage control (ii) field control method
10	To Study the performance of DC shunt motor by load test.
11	Separation of transformer core loss into eddy current loss and hysteresis loss.
12	To determine equivalent circuit parameters of single phase induction motor
13	Study of conventional and industrial starters for DC Motors
14	Verification and analysis of no load current waveform of single phase transformer

Visit to industry related to any machine or transformer related plant

ISE I :

It consists of submitting a file for a minimum of eight experiments with neatly written records of the study, circuit diagrams, observations, and graphs with results. The term work will be assessed by the course coordinator

Practical Examination:

The Practical Examination will consist of performing the experiment and viva voce on the syllabus. The practical will be assessed by two examiners, one will be the course coordinator and other will be an examiner appointed by DSB.

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Mapping of Course outcome with Program Outcomes

Course outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2					1	1	2	2	2		2		2	
CO2	2	2				1	1	2	2	2		2		2	
CO3	2	2				1	1	2	2	2		2		2	
CO4	2	2				1	1	2	2	2		2		2	
CO5	2					1	1	2	2	2		2		2	

1 – Low 2 – Medium 3 - High

Sample Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**	**Practical Examination & viva voce**
S1	Imitation	05	05
S2	Manipulation	10	10
S3	Precision	10	10
S4	Articulation	00	00
S5	Naturalization	00	00
Total		25	25

Preparation (S1)	05	05
Conduct of Experiment (S2)	05	05
Observation and Analysis of Results (S3)	05	05
Record (S2)	05	05
Presentation/ Viva-Voce (S3)	05	05
Total	**25**	**25**

Sample Assessment Table

Assessment Tool	S1	S2	S3	S4	S5
	C01	C02	CO3	CO4	CO5
ISE I (25 Marks)	05	05	05	05	05
Practical Examination & Viva Voce (25 Marks)	05	05	05	05	05

Prepared by
Prof. V. P. Dhote & Dr. S. M. Shinde

Approved in XXV IIIth Academic Council
Dated: 25th Jun 2024

EEPCC2006: Lab Electrical Measurement and Instrumentation	
Teaching Scheme Lectures : 2Hrs/Week Tutorial : NIL Total Credits : 01	**Examination Scheme** ISE I : 25 Marks Practical/Oral :25 Marks

Laboratory Course Outcomes:

As an outcome of completing the Laboratory course, students will able to:

CO1	Select the suitable type and range of measuring instruments for experiments
CO2	Demonstrate the fundamental principle for measurement of power & Measure reactive power in 3-phase circuit using single wattmeter
CO3	Accurately determine the values of inductance and capacitance using a. c bridges
CO4	Determine and analyze the CT and PT ratio error and phase angle error
CO5	Calibrate various electrical measuring/recording instruments.

List of Experiments:

Sr. No.	Name of the Experiments
	Any 6 experiments from 1-14
1	Measurement of a batch of resistors and estimating statistical parameters.
2	Measurement of L using a bridge technique as well as LCR meter
3	Measurement of C using a bridge technique as well as LCR meter.
4	Measurement of Low Resistance using Kelvin's double bridge.
5	Measurement of High resistance and Insulation resistance using Megger.
6	Current Measurement using Shunt, CT, and Hall Sensor.
7	Calibration and Testing of A.C. single phase / three phase Energy meter
8	Measurement of Power in three-phase circuit using Instrument transformers / wattmeter
9	Measurement of % ratio error and phase angle of given C.T. by Silsbee's method.
10	Measurement of voltage, current and resistance using DC potentiometer
11	Measurement of parameters of a choke coil using 3 voltmeter / 3 ammeter methods.
12	Measurement of reactive power using single wattmeter in three-phase circuit.
13	Measurement of high ac voltage
14	Measurement of High impulse Voltage using Sphere Gap
	Any 4 experiments from 15-23
15	Measurement of different electrical quantities & harmonics using a power analyzer.
16	Measurement of voltage, frequency & phase with the help of CRO
17	Usage of DSO for steady state periodic waveforms produced by a function generator. Selection of trigger source and trigger level, selection of time-scale and voltage scale. Bandwidth of measurement and sampling rate.
18	Download one-cycle data of a periodic waveform from a DSO and use values to compute the RMS values using a C program.
19	Usage of DSO to capture transients like a step change in R-L-C circuit.
20	Measurement of Displacement with the help LVDT
21	Measurement of different ranges of temperatures using i) RTD ii) Thermocouple
22	Measurement of load with the help of strain gauges
23	Experimental set up for measurement of any non electrical quantities

Mapping of Course outcome with Program Outcomes:

Course Outcome	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO7	PO 8	PO 9	PO 10	PO 11	PO1 2	PS O1	PS O2	PS O3
CO1	2	1						2	2	1		3			
CO2	2	1				2		2	2	1		3			
CO3	2	1				2		2	2	1		3			
CO4	2	1						2	2	1		3			
CO5	2					2		2	2	1		3			

1 – Low 2 – Medium 3 – High

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Dated: 25th Jun 2024

Sample Assessment Table :

Assessment Tool	S1	S1	S3	S2	S3
Course Outcomes	CO1	CO2	CO3	CO4	CO5
ISE I (25 Marks)	05	05	05	05	05
Practical Examination & Viva Voce					

Sample Assessment Pattern:

Assessment Pattern Level No.	**Skill Level**	**Term Work**	**Practical Examination & viva voce**
S1	Imitation	10	05
S2	Manipulation	05	05
S3	Precision	10	05
S4	Articulation		05
55	Naturalization		05
Total		25	25

Prepared by: Prof. W. A. Gavhane

Approved in XXV IIIth Academic Council
Dated: 25th Jun 2024

EEEEM 2001: Consumer Psychology			
Teaching Scheme		**Examination Scheme**	
Lectures	: 2 Hrs/Week	ISE I	: 10 Marks
Tutorial	: --	ISE II	: 10 Marks
Total Credits	: 2	End -Semester Exam	: 30 Marks

Pre-requisites: NIL

Course description: - This course Human has basic needs that they fulfill by making transactions in the market. Transactions mostly in the form of monetary exchange for goods and services are very basic for the survival of the human race. The present course is designed to study how consumers behave on the market and what the consequences of various behavior patterns. Additionally, the present course also looks at various psychological factors that shape the behavior and actions of the consumer in the global market

Course Outcomes: After completion of this course students will be able to

CO1	Identify the key terms, concepts, and theories of consumer behavior
CO2	Differentiate the principal theories of consumer behavior; critically assess strengths, limitations and applications
CO3	Apply consumer behavior concepts to real world marketing problems

Detailed Syllabus:

UNIT-I	**Introduction to Consumer Psychology** : Consumer behavior, Marketing and customer orientation, Needs and wants, Consumer decision-making process and steps, Consumer behavior model (Stimulus Response), Individual differences, Cognitive Factors (e.g., attention, learning and memory, self-control, and emotions) . Various models with descriptions.
UNIT-II	**Consumer Decision Making Process:** Need recognition, Information Search, Alternate Evaluation and Choice Consumption and Post-Purchase Behaviour. Heuristics in decision making, Consumer rationality, Factors influencing Consumer Decision Making, Cultural differences, Technology Influence, Marginal Utility.
UNIT-III	The Individual Consumer, Consumer perceptions, Memory and Learning, Mood, Emotion and Involvement, Consumer Attitude, Positioning, Marketing communications, Customer Relationship Management, Influencers.

TEXT BOOKS:

1. Henry Assael, Consumer Behavior and Marketing Action, Cengage Learning
2. Jay Lindquist, Consumer Behavior, Cengage Learning
3, Leon Schiffman, Consumer Behavior, Pearson Press
4, Zubin Sethna, Consumer Behavior

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Dated: 25th Jun 2024

Course outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO 3
CO1						1		2	2	2		1	3		
CO2						1		2	2	2		1	3		
CO3						1		2	2	2		1	3		

1. Low 2. Medium 3. High

Sample Assessment Table:

Assessment Tool	K1+K3	K1+K3	K1+K3
Unit wise Course outcomes	CO1	CO2,CO3	CO3
ISE I, II Test 20 Marks	10	10	-
ESE Assessment 30 Marks	10	10	10

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ESE Examination
K1	Remember	5	5	05
K2	Understand	5	5	10
K3	Apply			15
	Total Marks: 50	10	10	30

ISE III Assessment: Assessment will be based on any ONE of the following:

1. Multiple Choice Objective Test, 2. Assignments/PPT presentation on allotted topics 3. Written Test, 4. Quiz

Designed by Prof. K. C. Raipurkar

Approved in XXV IIIth Academic Council
Dated: 25th Jun 2024

CEVEC0010: Environmental Studies			
Teaching Scheme		**Examination Scheme**	
Lectures	: 2 Hrs/Week	ISE I	: 10 Marks
Tutorial	: --	ISE II	: 10 Marks
Total Credits	: 2	End -Semester Exam	: 30 Marks

Pre-requisites: Nil

Pre-requisites: Nil

Course Objectives:

1. To become aware about the various types of pollution, its sources, effects and control measures
2. To become aware about present environmental issues
3. To become aware of the importance of natural resources and environmental legislation
4. To become aware about environmental biotechnology and bio monitoring
5. To become aware of the biodiversity, conservation methods and factors for the loss of biodiversity

Unit wise Course Outcomes expected:

After completion of this course students will be able to-

CO1. Learn about the basics of environment

CO2. Understand the harmful effects of human activities on environment and their solutions

CO3. Understand the biodiversity, conservation methods and factors for the loss of biodiversity

CO4. Understand the concept of climate change, global warming, acid rain, various disasters and its mitigation measures

Detailed syllabus:

UNIT-I

A) Understanding Environment

- Environment: concept and importance
- Components of environment: Physical, Biological and Social
- Ecosystem Concept, Structure and Function
    - Producers, Consumers and Decomposers
    - Food chain, Food web and Ecological pyramids
    - Energy flow in an Ecosystem.
- Ecosystem services Ecological, economic, social, aesthetic and informational

B) Natural Resources

- Land resources: global land use patterns, concept land degradation and desertification
- Forest resources: Use and consequences of over-exploitation
- Water resources: Use and consequences of over-utilization, concept of water harvesting and watershed management, water conflicts
- Energy resources Renewable and non-renewable energy sources, growing energy needs and alternate energy sources

UNIT-II

A) Biodiversity and its conservation

- Biodiversity definition, levels (genetic, species and ecosystem) and values
- Threats to biodiversity :habitat loss, poaching of wildlife, biological invasions
- Concept of endemism and hot spots of biodiversity
- Conservation of biodiversity: In-situ and Ex-situ concepts

B) Environmental Pollution

-Causes, effects and control measures of Air, water, soil, noise, thermal, nuclear;
-Solid waste management
-Liquid waste management

UNIT-III

Environmental issues, policies and practices

- Global environmental issues: Increase in greenhouse gasses, climate change, Acid rain and stratospheric ozone layer depletion
- Salient features of Environment Protection Act, 1986
- Environmental education: Formal and Informal education
- Environmental Movements (Chipko Movement, Silent valley) and Environmental ethics

Text books & Reference books:

1. A Text Book of Environmental Studies by Bharucha E, University Press (India) Pvt. Ltd, 2005
2. A Text Book of Environmental Studies by Nadaf F. M., Pawaskar V. R., Intellectual Book Bureau, Bhopal,2006
3. Fundamental of Ecology by Odum E. P, Natraj Publishers, Dehradun, 1996
4. Introduction to Environmental Engineering and science by Gilbert M and Wendell P., Pearson Education India, 2015
5. Environmental Science by S.C Santra, New Central Book Agency, 2011
6. Environmental Education by Sharma R. A, 1998

Mapping of Course outcome with program outcomes:

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PO1 3	PO1 4
CO1	3		1											
CO2	3		1											
CO3	3		1											
CO4	3		1											
CO5	3		1											

3- High 2- Medium 1-Low

Designed by Shalini Munde

EECEP 2001: Community Engineering Project	
Teaching Scheme	**Examination Scheme**
Practical : 4 Hrs/Week	ISE I : 25 Marks
Tutorial : --	End -Semester Exam : 25 Marks
Total Credits : 2	

Students will be engaged in engineering field project about rural/urban society/community for

Survey in society regarding various problems faced/ to create awareness in various aspects such as-

1. Electrical safety
2. Power quality issues faced by farmers
3. Use of solar cooker/study of biomass based cook stoves,
4. Study of biogas
5. Study of Electricity bill-domestic, commercial, industrial
6. Use of renewable energy in day to day life and similar activities

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Semester IV

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EEPCC2011: Electromagnetic Field			
Teaching Scheme		Examination Scheme	
Lectures	:03 Hrs/Week	ISE I	: 15 Marks
Tutorial	: 00	ISE II	: 15 Marks
Total Credits	: 3	ISE III	: 10 Marks
		End -Semester Exam	: 60 Marks

Pre-requisites- Nil

Course description: - This course examines electric and magnetic quasi static forms of Maxwell's equations applied to dielectric, conduction, and magnetization boundary value problems.

Course objectives: -

The objectives of the course are to learn

1. Have an ability to determine and describe static and dynamic electric and magnetic fields for technologically important structures: the coil, charge distributions, the dipole, the coaxial cable, dielectric and conducting spheres.
2. Understand the coupling between electric and magnetic fields through Maxwell's equations.
3. Knowledge of, physical interpretation, and ability to apply Maxwell's equations
4. Determine field waves, potential waves, and energy and charge conservation conditions.

Course Outcome:

After completing the course students will able to,

CO1	Apply vector calculus to understand the behavior of static electric fields in standard configurations.
CO2	Apply vector calculus to understand the behavior of static magnetic fields in dielectrics.
CO3	Apply Maxwell's equation to dielectrics, conductors.
CO4	Evaluate displacement current and motion of particles and conductors in time varying fields.
CO5	Describe and analyze electromagnetic wave propagation in free-space ,dielectric.

Detailed Syllabus:

UNIT-I	**Static Electric Field**: Coulomb's law, Electric field intensity due to different charge distribution, Electric flux density, Gauss' law, Divergence and Divergence theorem, Maxwell's first equation Potential and potential difference, Potential field of system of charges, Potential gradient, Dipole, The energy density in electric field. Poisson and Laplace Equation, Uniqueness Theorem
UNIT-II	**Static Electric Field in Dielectrics:** Continuity of current, Conductor properties and boundary conditions Nature of dielectrics, Boundary conditions for perfect dielectric material polarization and its effect in dielectric.
UNIT-III	**Steady Magnetic Field:** Biot-Savart law, Ampere's circuital law Curl, Stokes' theorem, Magnetic flux and magnetic flux density, Nature of magnetic material, Magnetic field and magnetization, Boundary conditions in magnetic field
UNIT-IV	**Time Varying Field:** Faraday's law, displacement current, Maxwell's Equations in point form and integral form
UNIT-V	**Uniform Plane Wave:** Wave propagation in free space, in dielectrics, Pointing vector and power consideration, Wave propagation in good conductor: Skin effect Reflection of uniform plane waves at normal incidence, Standing wave ratio.

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Dated: 25th Jun 2024

Text Books:

1. William H. Hayt, Jr& John A. Buck, Engineering Electromagnetics, 7th edition, Tata McGraw:Hill.
2. D. Kraus, Electromagnetic 5th Edition, McGraw Hill Book Company.
3. Matthew N.O.Sadiku & S.V.Kulkarni, Principles of Electromagnetics, 6th Edition, Oxford University Press

Reference Books:

1. S P Ghosh,"Electromagnetic Field Theory" 1st Edition, Mcgraw Hill Education
2. S.P. Seth,"Elements of Electromagnetic Fields" DhanpatRai & Co. Ltd. Educational & Technical Publishers, 2001.
3.G. S. N. Raju," Electromagnetic Field Theory and Transmission Lines, 1st Edition, Pearson India

Mapping of Course outcome with program outcomes :

Course outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1				1	1	1				2	3	2
CO2	3	2					1	1	1				2	3	2
CO3	3	3											2	3	2
CO4	3	3	1						1				2	3	2
CO5	3	2	1			2	1	1	1				2	3	2

1-Low 2- Medium 3- High

Teaching Strategies:

The teaching strategy is planned through the lectures, tutorials and team based home works. Exercises are assigned weekly to stimulate the students to actively use and revise the learned concepts which also help the students to express their way of solving the problems fluently in written form. Most critical concepts and mistakes are emphasized.

ISE III Assessment: Teacher's Assessment of 10 marks is based on one of the /or combination of the few of the following.

1) Home Assignments , 2) Develop working models, 3) Surprise written Test with multiple choice question

Sample Assessment table:

Assessment Tool	K1+K3+K4+K5	K3+K4+K5	K2+K3+K4	K4+K5	K1+K2+K4
Course outcomes	CO1	CO2	CO3	CO4	CO5
Class Test 30 Marks	10	10	05	05	
Teachers Assessment 10 Marks	03	02	02	02	01
ESE Assessment 60 Marks	18	12	12	12	06

Sample Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	Test 1	Test 2	Teachers Assessment /Assignment	End Semester Examination
K1	Remember	2.5		02	06
K2	Understand	2.5	2.5	03	06
K3	Apply	05	05	03	18
K4	Analyze	05	05	02	18
K5	Evaluate		2.5		12
Total		15	15	10	60

Designed by
Dr. N. J. Phadkule

Approved in XXV IIIth Academic Council
Dated: 25th Jun 2024

EEPCC2012: Electrical Machines-II			
Teaching Scheme		Examination Scheme	
Lectures	: 03 Hrs./Week	ISE	: 15 Marks
Tutorial	: 00	ISE II	: 15 Marks
Total Credits	: 03	ISE III	: 10 Marks
		End -Semester Exam	: 60 Marks

Course Description:

Electrical Machines-II is a one-semester course compulsory to all second year engineering students. The Electrical Engineering Department Course is aimed to introduce fundamentals of A.C. machines to undergraduate students. The goal of this course is to understand and apply the basic principle of induction motor, synchronous motor, alternator and special purpose machines with their applications.

Course Objectives:

The objectives of the course are to learn

1. The principles A.C. machines.
2. Fundamental concepts of induction motor, synchronous motor and alternator.
3. The details of construction, operation, Characteristics and applications induction motor, synchronous motor and alternator
4. Fundamental concepts special purpose machines.
5. Basic knowledge to develop practical skills

Course Outcomes:

After completing the course, students will able to

CO1.	Understand fundamental principles, performance and applications of three phase and single phase induction motor
CO2	Understand fundamental principles, performance and applications of synchronous motor and Alternator
CO3	To solve engineering problems of induction motor, synchronous motor and alternator
CO4	To find regulation of synchronous alternators by various methods & to understand the parallel operation and synchronization of synchronous alternators.
CO5	Understand the operation principles and identify the suitable applications of PMDC, PMSM, BLDC, SR motors and Linear Induction motors.

Detailed Syllabus:

Unit-I	**Three Phase Induction Motors:** Construction, Types, Rotating magnetic field, Principle of operation, Torque equation, Torque slip characteristics, Losses & efficiency, Phasor diagram & equivalent circuit, No load test, Block rotor test, Circle diagram, Speed control & Starting of Induction Motors, EFFECT of Harmonics on I.M. Introduction to Double Cage Induction Motor, Induction Generator and Starters used in industries
Unit-II	**Synchronous Motor:** Principle of operation, Phasor diagram, Methods of starting, Operation at constant power & fixed excitation, Equivalent circuit, Power developed, Effect of excitation, Hunting and methods of suppression, Effect of harmonics, Synchronous condenser
Unit-III	**Synchronous Generator:** Construction, Types, Applications, Winding factors, EMF equation, Armature reaction, Phasor diagram, Load characteristics, Voltage regulation by synchronous impedance method, MMF method, Zero power factor method,
Unit-IV	**Parallel operation of Synchronous Generator**s: Two reaction theory, Slip test. Parallel operation of Synchronous Generators, Methods of synchronization, Synchronization power Synchronizing torque, Operation of Synchronous Generator on infinite bus bar, Effect of load on synchronization power, Effect of unequal voltages

Unit-V	**Special Purpose Machines:** Construction and principle of operation of Permanent magnet DC motors, Brushless DC motors, Permanent Magnet Synchronous Motors, Switched Reluctance Motors, Linear Induction motors and their Applications,

Text Books:

1. A. E. Fitzgerald & C. Kingsley & S. D. Umans, "Electric Machinery", TMH, New Delhi, 5th Edition.
2. I. J.Nagrath & D. P. Kothari, "Electric Machines", Tata McGraw Hill, New Delhi, 2nd Edition.
3.Dr. P. S. Bhimbra, Electric Machinery, 5th edition, Khanna Publishers, Delhi.
4. J.B.Gupta, "Theory and Performance of Electrical Machines" S.K.Kataria& Sons. 14th Edition, Delhi.
5.P.S. Kenjo and S.Nagamori: Permanent Magnet DC motors, Clarendon Press, Oxford, 1985.

Reference Books:

1. Syed A. Nasar, "Electric Machines & Power Systems", Volume I, Tata McGraw Hill, New
2 Alexander S. Langsdorf, " Theory of Alternating current Machines" 2nd Edition, TMHl, New Delhi
3 George Mcpherson ,"An Introduction to Electrical Machines and Transformers", Wiley & Sons, NY

Mapping of Course Outcome with Program Outcomes

Course outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3												1	1	
CO2	3				3				3	3			1	1	
CO3	3	1	1										1	1	
CO4	3	1	1										1	1	
CO5	3	1	1										1	1	

1-Low 2- Medium 3- High

Sample Assessment Table:

Assessment Tool	K1+K2+K3	K1+K2+K3	K5	K5	K1+K2+K5
Course outcomes	CO1	CO2	CO3	CO4	CO5
Class Test 30 Marks	10	10	10	05	--
Teachers Assessment 10 Marks	2	2	2	2	2
ESE Assessment 60 Marks	12	12	24	06	06

ISE III Assessment: It is based on one of the /or combinations of the few of the following.
Home Assignments, PowerPoint presentation, develop working models ,surprise written Test with multiple choice questions, Quiz

Sample Assessment Pattern:

Level No.	Knowledge Level	Test	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	05	2	12
K2	Understand	05	3	12
K3	Apply	05	2	06
K4	Analyze			
K5	Evaluate	15	3	30
Total		30	10	60

Designed by Dr. S. M. Shinde & V. P. Dhote

EEPCC2013: Power System-I	
Teaching Scheme Lectures : 3 Hrs./Week Total Credits : 3	Examination Scheme ISE 1 : 15 Marks ISE II : 15 Marks ISE III : 10 Marks End -Semester Exam : 60 Marks

Course Description: This is a one-semester course compulsory to all second year Electrical Engineering students. It is the fundamental course related to Power System Engineering.

Course Objectives: The objectives of the course are to

1. Introduce Electrical Power System
2. Introduce operation of various power plants, transmission network and distribution network
3. Develop an understanding of the environmental aspects of power generation
4. Develop professional skills required to design electrical power transmission system
5. Provide fundamental knowledge required for modeling and analyzing transmission networks

After completion of this course students will be able to

CO1	Demonstrate working of various power plants
CO2	Explain merits and demerits of high transmission voltage; Compare the conductor costs for various transmission systems
CO3	Illustrate constructional and other aspect related to overhead conductors and underground cables
CO4	Compare various distribution systems, calculate voltages etc. related to distribution systems and describe various aspects related to substation
CO5	Describe fundamentals related to corona and power factor improvement and its impact on power system

Detailed Syllabus

Unit-I	**Introduction:** Typical Layout of an Electrical Power System, Present Power Scenario in India. Generation of Electric Power: Conventional Sources (Qualitative): Hydro station, Steam Power Plant, Nuclear Power Plant and Gas Turbine Plant. Renewable energy Sources (Qualitative): Wind Energy, Fuel Cells, and Solar Energy.
Unit-II	**Economics of Generation**: Introduction, definitions of connected load, maximum demand, demand factor, load factor, diversity factor, Load duration curve, number and size of generator units. Base load and peak load plants. Cost of electrical energy-fixed cost, running cost, Tariff on charge to customer. AC Distribution: Introduction, AC distribution, Single phase, 3-phase, 3 phase 4 wire system, bus bar arrangement, Selection of site and layout of substation.
Unit-III	**Overhead Line Insulators:** Introduction, types of insulators, Potential distribution over a string of suspension insulators, Methods of equalizing the potential, testing of insulators. Insulated Cables: Introduction, insulation, insulating materials, Extra high voltage cables, grading of cables, insulation resistance of a cable, Capacitance of a single core and three core cables, Overhead lines versus underground cables, types of cables.
Unit-IV	**Transmission line Constants and Sag calculation:** The centenary curve, Sag tension calculations, Supports at different levels, Stringing Chart Line Constants: Line conductors, resistance of line, skin effect, proximity effect, inductance and capacitance of single phase and three phase lines with symmetrical and unsymmetrical spacing, GMD and GMR, Composite conductors-transposition, bundled conductors, and effect of earth on capacitance.

Unit-V	**Corona:** Introduction, disruptive critical voltage, corona loss, Factors affecting corona loss and methods of reducing corona loss, Disadvantages of corona, interference between power and Communication lines. Related numerical problems **Power Factor Improvement:** Introduction, Advantages of Power factor Improvement, methods of improving power factor.

Text Books:

1. Grainger John J and W D Stevenson Jr "Power system analysis" Mc-Graw Hill.
2. I. J. Nagrath, D. P. Kothari, "Modern Power System Analysis" 3rd TMH Co Ltd., 2003.
3. W. D Stevenson Elements of Power System Analysis,4th Edition, McGraw Hill, 1984.

Reference Books:

O. I. Elgerd, "Electrical energy systems theory: An introduction" TMH 1999.
Hadi Sadat, "Power system analysis", McGraw Hill International, 1999.
A. R. Bergen and Vijay Vittal, "Power system analysis", 2nd Edition, Pearson Edu. Asia, 2001.
J. D. Glover and M. Sarma ,"Power System Analysis and Design ",3rd Edition, Brooks/ Cole 2002
C.L. Wadhwa Electrical Power Systems, Fifth Edition, New AgeInternational,2009
H. Cotton & H. Barber-The Transmission and Distribution of Electrical Energy, 3rd Edition, ELBS,B.I.Pub.,1985

Mapping Of Course Outcome with Program Outcomes:

Course outcome	PO 1	PO 2	PO 3	PO 4	PO5	PO6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO 12	PS O 1	PSO 2	PS 03
CO1	3					1	1					1			
CO2	3					1	1					1	2		
CO3	3					1	1					1	2		
CO4	3					1	1					1	2		
CO5	3					1	1					1	2		

1 – Low 2 – Medium 3 – High

Sample Assessment Table:

Assessment Tool	K1+ K3+K4	K1+K2+K3	K1+K3+K4+K5	K1+K3+K4	K1+K2
Unit wise Course outcomes	CO1	CO2	CO3	CO4	CO5
ISE I 15 Marks	10	5			
ISE II 15 Marks		5	10		
ISE III 10 Marks	2	3	5	5	5
End Semester Exam 60 Marks	12	12	12	12	12

ISE III Assessment: It is based on attendance of the student and any one component of the following. However, the course coordinator has to announce assessment components at the beginning of the course.

1) Multiple Choice Question Test , 2) PPT presentation,3) Quiz, 4) Surprise test
5) Design and fabrication of working model, 6) Home assignments

Sample Assessment Pattern:

Level No.	Knowledge Level	ISE I	ISE II	ISE III	ESE Examination
K1	Remember	5	5	5	30
K2	Understand			5	
K3	Apply	5	5		12
K4	Analyze	5	5		6
K5	Evaluate				12
Total		15	15	10	60

Designed by
Dr. S P Ghanegaonkar Dr. V A Kulkarni

Approved in XXV IIIth Academic Council
Dated: 25th Jun 2024

EEPCC2014: Digital Circuits	
Teaching Scheme Lectures : 2 Hrs./Week Total Credits : 2	Examination Scheme ISE 1 : 10 Marks ISE II : 10 Marks End -Semester Exam : 30 Marks

Course Description: Digital Circuits is a one-semester course compulsory to all third year engineering students of the department.

Course Objectives:

The objectives of the course are to-

1. Provide the knowledge to understand common forms of number representation, logic gates and families, binary codes and Boolean algebra and to enable student to understand the logical operation of simple digital circuits
2. Enable student to construct combinational logic circuits
3. Design and implement counter circuits
4. Design and implement shift registers, multiplexers and de-multiplexers
5. Explain A/D converters and D/A converters

Course Outcomes: After completion of this course students will be able to

CO1.	Explain digital codes, logical operations and number systems
CO2.	Design combinational logic circuits and also to perform lab work
CO3.	Facilitate the construction of sequential logic circuits like flip-flops, registers, counters

Detailed Syllabus

UNIT-I	**Fundamentals of Digital Systems and logic families** Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL.
UNIT-II	**Combinational Logic Circuits** Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, SOP and POS form Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder IC 7483, excess-3 adder, BCD to seven segment decoder, IC 7447., ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization
UNIT-III	**Sequential circuits and systems** A one-bit memory, the circuit properties of bi-stable latch, the clocked SR flip flop, J- K,T and D-types flip-flops, applications of flip-flops, shift-registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters

Text/References:

1. M. M. Mano, “Digital logic and Computer design”, Pearson Education India, 2016.
2. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.
3. Malvino and Leach, “Digital Principles and Applications”, McGraw Hill Publications

Mapping Of Course Outcome with Program Outcomes:

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3		1	2	1		1		1				1	1
CO2	3	1			2	1		1		1				1	1
CO3	3	2			2	1	1	1		1				1	1

1- Low, 2-Medium,3- High

Sample Assessment Table:

Assessment Tool	K1+ K3+K4	K1+K2+K3	K1+K3+K4+K5
Unit wise Course outcomes	CO1	CO2	CO3
ISE I, II(20 Marks)	05	05	10
End Semester Exam 30 Marks	10	10	10

Teaching Strategies: The teaching strategy is planed through the lectures, tutorials, NPTEL lectures and home Assignments

ISE I, II are compulsory tests.

ISE III Assessment: It is based on attendance of the student and any one component of the following. However, the course coordinator has to announce assessment components at the beginning of the course. 1) Multiple Choice Question Test,2) PPT presentation,3) Quiz

4) Surprise test, 5) Design and fabrication of working model, 6) Home assignments

Sample Assessment Pattern:

Level No.	Knowledge Level	ISE I 1	ISE II	End Semester Examination
K1	Remember	5		6
K2	Understand		5	6
K3	Apply	5		10
K4	Analyze		5	-
K5	Evaluate			08
Total		10	10	30

Designed by Dr. Sandhya Kulkarni

Approved in XXV IIIth Academic Council
Dated: 25th Jun 2024

EEPCC2015 :Lab- Electrical Machines-II	
Teaching Scheme Practical: 2 Hrs./Week Credit : 01	**Examination Scheme** ISE I : 25 Marks Practical Examination & Viva Voce :25 Marks

Course Objectives:

On completion of this course the student shall be able to

1. To prepare the students to have a basic knowledge of induction motor
2. To prepare the students to have a basic knowledge of synchronous machines

Course Outcomes:

At the end of the course student will have ability to

CO1	Have knowledge of various parts of induction motor, synchronous machine
CO2	To conduct experiments on induction motor, synchronous motor and alternator.
CO3	To evaluate the induction motor constants
CO4	To perform various tests on induction motor
CO5	To evaluate regulation of alternator by various methods

List of Experiments:

Term work shall consist of a record of minimum eight experiments performed from the following list.

Sr. No.	Details
1	Effect of variation of applied voltage on the performance of Induction motor
2	Perform No load test and block rotor test on 3-phase Induction motor & Plot Circle diagram of 3-phase Induction motor
2	Determine of equivalent circuit parameters of single phase Induction Motors
3	Determine parameters of equivalent circuit of 3-phase Induction motor
4	Speed Control of slip ring 3-phase Induction motor using cascade connection
5	Perform Load Test on three phase Induction motor
6	Determine regulation of a three phase Synchronous Generator by synchronous impedance method
7	Determine regulation of a three phase Synchronous Generator by MMF method
8	Determine regulation of a three phase Synchronous Generator by ZPF method
9	Determine regulation of a three phase Synchronous Generator by direct loading
10	Determine direct and quadrature axis synchronous reactance by using slip test
11	Plot V and inverted V curves of synchronous motor
12	Study of induction motor starters
13	Study of ISI- standards for Energy efficient motors
14	Synchronizing of alternators: Lamp Methods and use of Synchroscope

Term Work:

The term work will consist of submitting a file for minimum eight experiments with neatly written records of the study, circuit diagrams, observations, and graphs with results. any another experiment can be added by course coordinator except above list of experiment The term work will be assessed by the course coordinator

Practical Examination:

The Practical Examination will comprise of performing the experiment and viva voce on the syllabus

The practical will be assessed by two examiners, one will be the course coordinator and other will be an examiner appointed by DSB.

Mapping of Course Outcome with Program Outcomes:

Course outcome	PO 01	PO 02	PO 03	PO 04	PO 05	PO06	PO 07	PO08	PO09	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3						1	1	1	1		1	1		
CO2	3			2			1	1	1	1		1	1		
CO3	3			2			1	1	1	1		1	1		
CO4	3			2			1	1	1	1		1	1		
CO5	3			2			1	1	1	1		1	1		

Designed by Dr. S. M. Shinde, Prof . V. P. Dhote

Approved in XXV IIIth Academic Council
Dated: 25th Jun 2024

EEVSE2010 :Lab- Digital Circuits	
Teaching Scheme Practical: 2 Hrs./Week Credit : 01	**Examination Scheme** ISE I : 25 Marks Practical Examination & Viva Voce :25 Marks

Course Objectives:

The objectives of the course are to-

1. To expose the students to a variety of practical circuits using various digital ICs.
2. To provide hand-on experience in designing and implementing digital/logic circuits.

Course Outcomes:

After completion of this course students will be able to

CO1	To verify truth-table of various logic gates, Boolean algebra
CO2	Design and implement basic combinational and sequential logic circuits
CO3	Develop technical writing skills important for effective communication
CO4	Write assembly language programs and implement on 8085 microprocessor
CO5	Write assembly language programs and implement on 8085 processor

List of the Experiments:

The student shall perform minimum eight experiments of the following:

Sr. No.	Name of the Experiments
1	To verify truth table and identify IC numbers of basic logic gates
2	To build basic logic gates using universal gates
3	Verification of De Morgan's theorem
4,5	Design and implementation of combinational logic circuits based on examples such as to find the majority of one's, to find numbers exactly divisible by 3 or 4 etc.
6	To design arithmetic circuits such as half and full adder, half and full subtractor
7,8	To verify truth table of different flip-flop ICs
9,10	Design of mod-2, mod-5, mod-7/mod- 8/mod-9, mod-10 and reverse mod-10 counter using IC 7490
11,12	Design of mod n synchronous counter

Mapping of Course Outcome with Program Outcomes:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			2	1		1		1		1		1	1
CO2	3	2		1	2	1		1	1	1		1		1	1
CO3	3	2		1	2	1		1	1	1		1		1	1
CO4	3	2		1	2	1		1	1	1		1		1	1
CO5	3			1	2	1		1	1	1		1		1	1

1 -Low 2 – Medium 3 - High

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Sample Assessment Table:

Assessment Tool	S1	S2	S3	S4	S5
Course Outcomes	CO1	CO2	CO3	CO4	CO5
Term Work (25 Marks)	05	05	05	05	05
Practical Examination & Viva Voce					

Sample Assessment Pattern:

Preparation (S1)	05	
Conduct of Experiment (S2)	10	
Observation and Analysis of Results (S3)	05	
Record (S2)	05	
Total	25	

Designed by Dr. Sandhya Kulkarni

Approved in XXV IIIth Academic Council
Dated: 25th Jun 2024

EEAEC2010 : Technical Communication	
Teaching Scheme Theory: 2 Hrs./Week Credit : 02	**Examination Scheme** ISE I : 10 Marks ISE II : 10 Marks ESE 30 Marks

Course Outcomes (COs):

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

CO1	Understand the nature and objective of Technical Communication relevant for the workplace as Engineers.
CO2	Utilize the technical writing for the purposes of Technical Communication and its exposure in various dimensions
CO3	Imbibe inputs by presentation skills to enhance confidence in the face of a diverse audience.
CO4	Evaluate their efficacy as fluent & efficient communicators by learning the voice-dynamics.

Detailed Syllabus:

Unit I	**Fundamentals of Technical Communication:** Technical Communication: Features; Distinction between General and Technical Communication; Language as a tool of Communication; Dimensions of Communication: Reading & comprehension; Technical writing: sentences; Paragraph; Technical style: Definition, types & Methods; The flow of Communication: Downward; upward, Lateral or Horizontal; Barriers to Communication.
Unit II	**Forms of Technical Communication:** 7 Cs of effective business writing: concreteness, completeness, clarity, conciseness, courtesy, correctness, consideration; Technical Report: Definition & importance; Thesis/Project writing: structure & importance; C.V./Resume writing; Technical Proposal: Types, Structure & Draft. Seminar & Conference paper writing.
Unit III	**Technical Presentation:** Strategies & Techniques Presentation: Forms; interpersonal Communication; Classroom presentation; style; method; Individual conferencing: essentials: Public Speaking: method; Techniques: Clarity of substance; emotion; Humour; Modes of Presentation; Overcoming Stage Fear: Confident speaking; Audience Analysis & retention of audience interest

Unit IV	**Technical Communication Skills and Kinesics & Voice Dynamics:** Interview skills; Group Discussion: Objective & Method; Seminar/Conferences Presentation skills: Focus; Content; Style; Critical thinking; Nuances: Exposition narration & Description; Socio-linguistic competence: Strategic competence: Solution of communication problems with verbal and non verbal means. Definitions; importance; Features of Body Language; Voice Modulation: Quality, Pitch; Rhythm; intonation; Pronunciation; Articulation; stress & accent; Linguistic features of voice control: Vowel & Consonant Sounds.

Text Books:

1. Technical Communication – Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2007, New Delhi.

2. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.

3. Practical Communication: Process and Practice by L.U.B. Pandey; A.I.T.B.S. Publications India Ltd.; Krishan Nagar, 2014, Delhi.

4. Modern Technical Writing by Sherman, Theodore A (et.al); Apprentice Hall; New Jersey; U.S.

5. A Text Book of Scientific and Technical Writing by S.D. Sharma; Vikas Publication, Delhi.

EEVSE2011: Numerical Computational Techniques(Audit Course)	
Teaching Scheme Theory : 1Hrs./Week(Audit course) Total Credits :0	Examination Scheme ISE 1 : 00 Marks ISE III : 00 Marks Total : 00 Marks

Pre-Requisites:
MA1001: Engineering Mathematics- I, MA1002:Engineering Mathematics- II
MA2001: Engineering Mathematics-III, EE2004:Computer Programming
Course Description: Numerical Computational Techniques is a compulsory course to second year electrical engineering students of the department in the Semester –IV.
Course Objective:
This course strives to enable students
1. To provide the necessary basic concepts of a few numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology
2. To emphasize the need of computational techniques and analyze errors involved in the computation.
3.To provide an overview of numerical techniques to solve ordinary and partial differential equations, which we apply to solve many engineering problems of electrical Engineering.
4. To apply various numerical methods to obtain solutions of different types of equations such as transcendental, simultaneous, and also for interpolation, integration and differentiation.
Course Outcomes Expected:
After completion of this course students will be able to

CO1	To demonstrate different types of computational techniques to find the roots of the equations
CO2	Apply appropriate numerical method for solution of Transcendental and polynomial equation
CO3	Apply and compare various numerical methods to solve first and second order ODE
CO4	Apply different numerical methods for interpolation, numerical differentiation and integration.
CO5	To demonstrate the applications of numerical computational techniques to engineering problems drawn from industry and other engineering fields.

Detailed Syllabus

Unit-I	Nonlinear Equations: Bisection Method, Rule of False Position, The Secant Method, Newton–Raphson Method Linear Equations-Matrices-Substitution methods, Gauss elimination method, Gauss Jordan Method, triangularization method, Gauss Seidel iterative method
Unit-II	Curve Fitting: Linear Interpolation, Polynomial Interpolation, Least Squares Approximation
Unit-III	Numerical Differentiation: Method based on interpolation and finite difference Ordinary Differential Equations: Euler's Method, Runge–Kutta Methods, Boundary Value Problems
Unit-IV	Numerical Integration: The Trapezium Rule, Quadrature Rules, Simpson's Rule
Unit -V	Optimization : Introduction to Optimization, Unconstrained Optimization: Golden Search Method, Steepest Descent Method, Newton Method, evolutionary optimization method(any one), Lagrange Multiplier Method

Text/Reference Books:
1. Numerical Methods for Scientific and Engineering Computations – M. K. Jain / S. R. K. Iyengar / R. K. Jain
2.V Rajaraman., " Computer oriented Numerical Methods", Prentice Hall Publication
3.Francis Scheid, "Numerical Analysis", Tata McGraw Hill Publication
4. Calculus of Finite Difference and Numerical Analysis – Gupta / Malik.
5. Numerical Methods for Engineers by Steven Chapra, Raymond P. Canale – Tata McC
6. Numerical Methods, second edition, S. Arumugan, A. Thangapandi Isaac, A. Somasu Publications (India) Pvt. Ltd.

Reference Books:

1. Numerical Mathematical Analysis – J. B. Scarborough.
2. Robert Schilling, Sandra L. Harries, “Applied Numerical Methods for Engineers”, Thomson
3. Numerical Methods – E. Balgurusamy - Tata McGraw Hill Publication
4. Numerical Methods with Programs in C and C++ - T. Veerarajan and T. Ramachandran- TMH.

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Dated: 25th Jun 2024

EEVSE2011: Lab Numerical Computational Techniques	
Teaching Scheme Practical : 2Hrs./Week Total Credits :1	Examination Scheme ISE 1 : 25 Marks ESE : 25 Marks Total 50 Marks

Laboratory Course Outcomes

As an outcome of completing the Laboratory course, students will able to:

CO1	Grasp the basic elements of numerical methods
CO2	Solve linear & nonlinear algebraic equations and curve fitting
CO3	Understand the basics of approximation, integration and differentiation.
CO4	Apply the numerical solution of differential equation
CO5	Apply the numerical solution of optimization

At least two programs(two different methods) on each of the following numerical methods by using Matlab/ C/C++/ Python or any other language

Nonlinear Equations
Linear Equations
Curve Fitting
Numerical Differentiation
Numerical Integration
Ordinary Differential Equations
Optimization

Mapping of Course outcome with Program Outcomes

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15
CO1	3	2						1	1				1	1	1
CO2	3	2					1	1	1				1	1	1
CO3	3	2						1	1				1	1	1
CO4	3	2	1				1	1	1				1	1	1
CO5	3	2						1	1				1	1	1

1 **-Low 2 – Medium 3 - High**

Sample Assessment Table :

Assessment Tool	S1	S1	S3	S2	S3
Course Outcomes	CO1	CO2	CO3	CO4	CO5
Practical Examination & Viva Voce (25 Marks)	05	05	05	05	05

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Sample Assessment Pattern:

Assessment Pattern Level No.	Skill Level	Practical Examination & viva voce
S1	Imitation	10
S2	Manipulation	05
S3	Precision	10
Total		25

Designed by
Dr. S. P. Ghanegaonkar

INVEC1001: Universal Human Values- II Understanding Harmony	
Teaching Scheme Tutorial : 2 Hrs./Week Total Credits :2	Examination Scheme ISE 1 : 10 Marks ISE II : 10 Marks ESE Exam Online : 30 Marks Total 50 Marks

Prerequisites: Nil

Course description:

The objective of the course is fourfold:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

Course Outcomes:

After completing the course, students will able to:

Course Outcomes
By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to- day settings in real life, at least a beginning would be made in this direction. This is only an introductory foundational input. It would be desirable to follow it up by a) faculty-student or mentor-mentee programs throughout their time with the institution b) Higher level courses on human values in every aspect of living. E. g. as a professional

Detailed Syllabus:

Unit 1	**Course Introduction - Need, Basic Guidelines, Content and Process for Value Education** Purpose and motivation for the course, recapitulation from Universal Human Values-I Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration. Continuous Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfill the above human aspirations: understanding and living in harmony at various levels. **Home Work :** Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking
Unit 2	**Understanding Harmony in the Human Being - Harmony in Myself!** Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Health. **Home Work :** Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease
Unit 3	**Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship** 1 Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. **Home Work :** Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss scenarios. Elicit examples from students' lives.
Unit 4	**Understanding Harmony in the Nature and Existence - Whole existence as Coexistence** Understanding the harmony in Nature. Interconnectedness and mutual fulfillment among the four orders of nature recyclability and self regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all pervasive space. Holistic perception of harmony at all levels of existence. **Home Work :** Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc

Unit 5	**Implications of the above Holistic Understanding of Harmony on Professional Ethics** Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. **Some Case Studies can be given as home work** Case studies of typical holistic technologies, management models and production systems Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations Sum up. **Home Work:** Include practice Exercises and Case Studies will be taken up in Practice Sessions eg. To discuss the conduct as an engineer or scientist etc.

Text and Reference Books

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
2. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
3. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004. 3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi 5. Small is Beautiful - E. F Schumacher.
5. Slow is Beautiful - Cecile Andrews
6. Economy of Permanence - J C Kumarappa
7. Bharat Mein Angreji Raj – Pandit Sunderlal
8. Rediscovering India - by Dharampal
9. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
10. India Wins Freedom - Maulana Abdul Kalam Azad
11. Vivekananda - Romain Rolland (English)
12. Gandhi - Romain Rolland (English)

MODE OF CONDUCT

Lectures hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.. While analyzing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting. Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on

basic human values. It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses.

This course is to be taught by faculty from every teaching department, including HSS faculty.

Teacher preparation with a minimum exposure to at least one 8-day FDP on Universal Human Values is deemed essential.

EEEEM2010: Electricity Market and Management	
Teaching Scheme Theory : 2 Hrs./Week Total Credits :2	Examination Scheme ISE 1 : 10 Marks ISE II : 10 Marks End -Semester Exam : 30 Marks Total 50 Marks

Course Objectives: • To impart understanding of trading, auctions and strategic behavior of players in power market.

Unit I	**Basic electricity framework in India** Generation, Transmission, Distribution, National grid, interstate and intrastate transmission network, key stakeholders at national and state level, role and responsibilities of key stakeholders.
Unit II	**National level Energy Policies / Missions** National Energy Plan, National Electricity Policy, Tariff Policy, Energy storage policy, Key provisions of Electricity Act 2003 and Regulations, Provisions related to energy management like role and responsibilities of key stakeholders, electricity grid code,.
Unit III	**Electricity Pricing framework in India** Various provisions of Electricity Act 2003 which governs the electricity pricing, various methodologies for computation of electricity price for conventional generation and renewable energy technologies.
Unit IV	**System operation and Electricity Market** System operation in India at national /regional/state level, real time load-generation balance, electricity scheduling and dispatch process, real time deviation management regulations, Reserve requirement, types of reserves, Ancillary services framework, Security constraint Economic Despatch (SCED) and Security Constraint Unit Commitment (SCUC), Electricity Market in India, Electricity Exchanges, types of electricity markets, Day ahead market (DAM), Real Time Market (RTM), Capacity Market, Market Clearing Price, Area clearing pricing

Reference Books:

1. Energy policy: B.V. Desai (Wiley Eastern).
2. Modeling approach to long term demand and energy implication: J. K. Parikh.
3. Energy Policy and Planning: B.Bukhootsow.
4. International Energy Outlook-EIA annual Publication.
5. Heat and Thermodynamics – M.W. Zemansky (McGraw Hill Publication).
6. BEE Reference book: no.1/2/3/4.
7. Energy Management, Audit and Conservation" by Barun Kumar De [8] Guide to Energy Management" by Barney L

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Multidisciplinary Minor-I (Electrical Mobility)

Sr. No.	Course Code	Course Name	Pre-requisite	Credits L-T-P	Offered Semester	Suggested by dept
1	EEMDM2001	Electric Machines for EV Applications	No	3-0-0	III	Electrical Dept
2	EEMDM2010	Power Electronics & Electric Drives	No	3-0-0	IV	Electrical Dept
3	EEMDM2011	Lab-Electric Machines & Power Electronics drives	No	0-0-1	IV	Electrical Dept
4	EEMDM3001	Control & Instrumentation	No	3-0-0	V	Electrical Dept
5	EEMDM3010	Energy Storage Systems	No	3-0-0	VI	Electrical Dept
6	EEMDM3011	Lab-Control & Instrumentation, Energy Storage	No	0-0-1	VI	Electrical Dept

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EEMDM2001 : Electric Machines for EV Applications	
Teaching Scheme Lectures : 03 Hrs./Week Tutorial : 00 Total Credits : 03	Examination Scheme ISE : 15 Marks ISE II : 15 Marks ISE III : 10 Marks End -Semester Exam : 60 Marks

Course Description:

Electrical Machines-II is a one-semester course compulsory to all second year engineering students. The Electrical Engineering Department Course is aimed to introduce fundamentals of A.C. machines to undergraduate students. The goal of this course is to understand and apply the basic principle of induction motor, synchronous motor, alternator and special purpose machines with their applications.

Course Objectives:

The objectives of the course are to learn

1. The principles A.C. machines.
2. Fundamental concepts of induction motor, synchronous motor and alternator.
3. The details of construction, operation, Characteristics and applications induction motor, synchronous motor and alternator
4. Fundamental concepts special purpose machines.
5. Basic knowledge to develop practical skills

Course Outcomes:

After completing the course, students will able to

CO1.	Understand basic principles of electric motor
CO2	Understand basic terminologies related to electric vehicle drives
CO3	Understand fundamental principles, performance and applications of three phase induction motor
CO4	Understand the operation principles and identify the suitable applications of PMDC, PMSM, BLDC
CO5	Understand the operation principles and identify the suitable applications of SRM motors

Detailed Syllabus:

Unit-I	**Electric motors** Types of Motors, Selection and sizing of Motor, RPM and Torque calculation of motor Controllers Component sizing, Physical locations, Electrical connection of motor.
Unit-II	**Electric Vehicle and HEV Drives** Configurations of Electric Vehicles and HEV, Performance of Electric Vehicles and Hybrid EV, Traction Motor Characteristics, Tractive Effort and Transmission Requirement, Vehicle Performance, Tractive Effort in Normal Driving, Energy Consumption.
Unit-III	**Three Phase Induction Motors:** Construction, Types, Rotating magnetic field, Principle of operation, Starting of Induction Motors, Torque equation, Torque slip characteristics, Losses & efficiency, No load test, Block rotor test, Speed control &, Induction Generator and Starters used in industries
Unit-IV	**Special Purpose Machines:** Construction and principle of operation of Permanent magnet DC motors, Brushless DC motors, Permanent Magnet Synchronous Motors,
Unit-V	**Switched Reluctance Motors** Construction and principle of operation of Switched Reluctance Motors. and their Applications for EV

Text , Reference Books:

1. James Larminie, John Lowry, "Electric Vehicle Technology Explained", WIELY USA, 2012.
2. Chris Mi, M. Abdul Masrur & David Wenzhong Gao , "Hybrid Electric Vehicles: Principles and Applications with Practical Perspective", WILEY, 20

3. Electric Cars The Future is Now!: Your Guide to the Cars You Can Buy Now and What the Future Holds, by Arvids Linde, Veloce Publishing,2010.
4. Abu-Rub, Malinowski and Al-Haddad, "Power Electronics for renewable energy systems, transportation, Industrial Applications", WILEY, 2014.
5. Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", Second Edition (Power Electronics and Applications Series) by CRC Press, 2009
6. Iqbal Husain, "Electric and Hybrid Vehicles – Design Fundamentals," CRC Press, 2010

Mapping of Course Outcome with Program Outcomes

Course outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3												1	1	
CO2	3				3				3	3			1	1	
CO3	3	1	1										1	1	
CO4	3	1	1										1	1	
CO5	3	1	1										1	1	

1-Low 2- Medium 3- High

Sample Assessment Table:

Assessment Tool	K1+K2+K3	K1+K2+K3	K5	K5	K1+K2+K5
Course outcomes	CO1	CO2	CO3	CO4	CO5
Class Test 30 Marks	10	10	10	05	--
Teachers Assessment 10 Marks	2	2	2	2	2
ESE Assessment 60 Marks	12	12	24	06	06

ISE III Assessment: It is based on one of the /or combinations of the few of the following.
Home Assignments, PowerPoint presentation, develop working models ,surprise written Test with multiple choice questions, Quiz

Sample Assessment Pattern:

Level No.	Knowledge Level	Test	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	05	2	12
K2	Understand	05	3	12
K3	Apply	05	2	06
K4	Analyze			
K5	Evaluate	15	3	30
Total		30	10	60

Designed by Dr. S. M. Shinde & V. P. Dhote

Approved in XXV IIIth Academic Council
Dated: 25th Jun 2024

EEMDM2010 : Power Electronics and Drives	
Teaching Scheme Lectures : 03 Hrs./Week Total Credits : 03	Examination Scheme ISE : 15 Marks ISE II : 15 Marks ISE III : 10 Marks End -Semester Exam : 60 Marks

Course Objectives

The objective of the course is to study about the motor & device characteristics & parameters, to know the various electric drive concepts and to gain knowledge of DC/AC drive mechanism. Also, students may understand about drives for special electrical machines.

After completing the course, students will able to:

CO1	Describe structure, characteristics, and applications of power semiconductor devices
CO2	Explain and analyze single and three phase AC-DC converters with different types of load and their control techniques
CO3	Explain and analyze types, operation and control techniques of DC-DC converters
CO4	Explain and analyze induction motor drives and its control
CO5	Discuss and identify industrial applications of electrical drive

Detailed Syllabus

Unit	Contents
1	**Characteristics of Switching Devices** Structure, Principle of operation, and V/I characteristics of power semiconductor devices such as GTO, SiC, Power Transistor, Power MOSFET, IGBT.
2	**AC-DC Converters** Principle & operation of single phase half wave and full wave converters with different types of load, Three phase half and full wave converters, Performance parameters, Use of freewheeling diode
3	**DC-DC Converters** Principle of operation of chopper, Basic principles of step-down and step-up operation, various control techniques, chopper classification, Various commutation methods, voltage, current, load commutated chopper, Buck, Boost, Buck-Boost converters.
4	**Induction Motor Drives:** Performance of 3-phase induction motor drives, Starting, Braking-Regenerative, Dynamic and Plugging, Speed control methods
5	**Industrial Applications:** Solar powered drives, Battery powered vehicles, Important features of Traction drive, Traction motors, Traction drives, Semiconductor converter controlled traction drives, EV applications.

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Dated: 25th Jun 2024

Text and Reference Books:

1. M.H. Rashid, “Power Electronics”, Third Edition, Prentice-Hall of India Pvt. Ltd. 2005
2. Mohan, Undel and, Robbins, "Power Electronics”, Second Edition, John Willey & Sons, 1995
3. B. K. Bose, “Modern Power Electronics and AC Drives”, Prentice-Hall of India Pvt. Ltd. 2006
4. C. W. Lander, “Power Electronics”, Tata McGraw-Hill Publications India 1993
5. P.C. Sen, “Power Electronics", Tata McGraw-Hill Publications India
6. G. K. Dubey, S. R. Doradla, A. Joshi, M. K. Sinha, “Thyristorised Power Controllers", Wiley Eastern Ltd.1987
7. M. Ramamoorthy, ”An Introduction to Thyristor & Their Applications”, East-West Press Pvt. Ltd., New Delhi

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EEMDM2011 :Lab-Electric Machines and Power Electronic Drives	
Teaching Scheme Practical: 2 Hrs./Week Credit : 01	**Examination Scheme** ISE I : 25 Marks Practical Examination & Viva Voce :25 Marks

Course Objectives:

On completion of this course the student shall be able to

1. To prepare the students to have a basic knowledge of induction motor
2. To prepare the students to have a basic knowledge of BLDC, SRM

Course Outcomes:

At the end of the course student will have ability to

CO1	Have knowledge of various parts of induction motor,
CO2	To conduct experiments on induction motor,and evaluate the induction motor constants
CO3	To perform simulation based experiments on SRM, BLDC
CO4	To study characteristics of SCR, IGBT
CO5	To perform experiments on single phase converters

List of Experiments:

Term work shall consist of a record of minimum sixt experiments performed from the following list.

Sr. No.	Details
1	Effect of variation of applied voltage on the performance of Induction motor
2	Perform No load test and block rotor test to calculate efficiency of 3-phase Induction
2	Determine parameters of equivalent circuit of 3-phase Induction motor
3	Speed Control of slip ring 3-phase Induction motor using cascade connection
4	Perform Load Test on three phase Induction motor
5	Study of induction motor starters
6	Study of ISI- standards for Energy efficient motors
7	Simulation based experiments of BLDC
8	Simulation based experiments of SRM
9	Plot Static V-I Characteristics of SCR, IGBT, MOSFET
10	Draw waveforms of load voltages using Forced Commutation methods of SCR.
11	Draw waveforms of load voltages for single phase half wave and full wave Converter with R, RL loads.
12	Draw waveforms of load voltages for single phase half and fully controlled converter with R, RL loads.
13	To study characteristics of Buck converter
14	To study characteristics of Boost converter
15	To study characteristics of Buck- boost converter

Term Work:

The term work will consist of submitting a file for minimum six experiments with neatly written records of the study, circuit diagrams, observations, and graphs with results. any another experiment can be added by course coordinator except above list of experiment The term work will be assessed by the course coordinator

Practical Examination:

The Practical Examination will comprise of performing the experiment and viva voce on the syllabus
The practical will be assessed by two examiners, one will be the course coordinator and other will be an examiner appointed by DSB.

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Mapping Of Course Outcome with Program Outcomes:

Course outcome	PO 01	PO 02	PO 03	PO 04	PO 05	PO06	PO 07	PO08	PO09	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3						1	1	1	1		1	1		
CO2	3			2			1	1	1	1		1	1		
CO3	3			2			1	1	1	1		1	1		
CO4	3			2			1	1	1	1		1	1		
CO5	3			2			1	1	1	1		1	1		

Designed by Prof. V. P. Dhote

Approved in XXV IIIth Academic Council
Dated: 25th Jun 2024

EEMDM 3001: Control & Instrumentation	
Teaching Scheme Theory : 3Hrs./Week Practical 0 Hrs/Week Total Credits :3	Examination Scheme ISE I : 15 Marks ISE II : 15 Marks ISE III : 10 Marks End -Semester Exam :60 Marks Total 100 Marks

Pre-requisites: Nil

Course Description: - Provides the student with basic knowledge of industrial automation. This course introduces the basic concept of process control, building blocks of automation, and various control configurations.

Course Objectives: -The objectives of the course are to

1. Describe various measurement systems using sensors
2. Explain various process control configuration
3. Illustrate various controllers used in industry
4. Explain PLC, SCADA, PDC systems
5. Describe and Illustrate valves used in Industry

Unit wise Course Outcomes expected: Students will be able to

CO1. Use of various sensors for measurement of physical parameters
CO2. Understand terminology used in process control
CO3. Use controller such as P, PI, PID
CO4. Understand the principle and operation of PLC
CO5. Differentiate various actuators

Detail syllabus:

UNIT-I	**Sensors for physical quantity measurement :** Introduction to sensors and measurement systems, Temperature measurement, Pressure and Force measurements , Displacement and speed measurement, Flow measurement techniques, Measurement of level, humidity, pH etc., Signal Conditioning and Processing
UNIT-II	**Introduction to Process Control:** Requirements of Process Control, Classification of Process Variables, Open-loop Vs Closed Loop control, Feedback and Feed forward Control Configuration, Cascade, Feed forward, and Ratio Control, multi loop Cascade Control, Feed forward Control, Feed forward-Feedback control configuration, Ratio Controller
UNIT-III	**Type of Controllers:** Introduction, PID control, Classification of Controllers, Controller Terms, Introduction, Transfer functions of closed loop, Proportional controller in closed loop, Integral controller in closed loop, Proportional-integral controller in closed loop, Proportional derivative controller in closed loop, Proportional-integral-derivative controller in closed loop,
UNIT-IV	**Programmable Logic Controllers** Introduction, Classification of PLCs Basic parts of a PLC, Operation of a PLC, Basic symbols used in PLC realization, Difference between PLC and Hardwired systems, difference between PLC and computer, Relay logic to ladder logic, Ladder commands, Examples of PLC ladder diagram realization,
UNIT-V	**Actuators** Introduction various automation devices used in industry, Control of Machine tools, Electric Drives, Energy Saving with Adjustable Speed Drives.

Text/Reference books:

1. S.K. Singh, "Computer Aided Process Control", PHI
2. D. Popovic, Vijay P**.** Bhatkar, "Distributed Computer Control for Industrial Automation", Dekker Publications.
3. Webb and Reis," Programmable Logic Controllers: Principles and Applications", PHI.
4. Garry Dunning, "Introduction to Programmable Logic Controllers", Thomson Le

5. N. E. Battikha, “The Management of Control System: Justification and Technical Auditing”, ISA
6. Krishna Kant, “Computer Based Process Control”, PHI
7. Fu, Lee, Gonzalez, “Robotic Control, Sensing and Intelligence”, Tata McGraw-Hill

Course outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	1	1	2		1							
CO2	1	1	2		1							
CO3	1	1	2		1							
CO4	1	1	2		1							
CO5	1	1	2		1							

1- Low 2- Medium 3- High

ISE III: This is based on any one or combination of any two of the following schemes.

1. Assignments, 2. Objective type test , 3. Modeling of electrical machines using any electrical software
4. Technical/Industrial visit report / Quiz

3. Assessment table:

Assessment Tool	K1+K2+ K3	K1+K2+ K3	K1+ K2	K2	K1+K3
Course outcomes	CO1	CO2	CO3	CO4	CO5
ISE I & ISE II 30 Marks	10	05	10	05	
ISE III Assessment 10 Marks				05	05
ESE Assessment 60 Marks	12	12	12	12	12

4. Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**ISE I & ISE II**	**ISE III Assessment**	**End Semester Examination**
K1	Remember	10		15
K2	Understand	20	05	40
K3	Apply		05	05
Total		30	10	60

Designed By:
Dr. S. S. Kulkarni

Approved in XXV IIIth Academic Council
Dated: 25th Jun 2024

EEMDM3010 : Energy Storage Systems	
Teaching Scheme Lectures : 03 Hrs./Week Total Credits : 03	Examination Scheme ISE : 15 Marks ISE II : 15 Marks ISE III : 10 Marks End -Semester Exam : 60 Marks

The course aims to identify suitable energy storage systems for Electric Vehicles, compare different energy storage systems and explain use of Energy management systems for Energy Storage systems.

Course Outcomes: Students will be able to:

1. Identify suitable energy storage systems for Electric Vehicles.
2. Compare different energy storage systems.
3. Explain use of Energy management systems for Energy Storage systems.

Detailed syllabus

Unit 1	**Fundamentals** Introduction to Electrochemical battery, battery capacity, Battery Parameters and Comparisons, Battery Pack Discharge Curves and Aging, Battery Models, SOC, SOD, SOH, DOD, Battery technologies used in recent EVs, Lead acid battery, Nickel based battery, Lithium-ion battery, comparison of Battery types.
Unit 2	**Fuel Cells** Electrical characteristics of fuel cells, Overview of key Fuel cell technologies, fuel cell types, electrode materials, electrolytes and other components, working principles, Hydrogen generation and storage, limitations, recent progress in Fuel cell technologies, safety issues vs cost aspects, life cycle analysis.
Unit 3	**Ultra-capacitors** Features, basic working principle, fundamentals of Electrochemical super-capacitors, Electrodes, and electrolyte interfaces and capacitances, charge discharge characteristics, Energy/power density, Design, fabrication, Ultra-capacitor technologies, graphene based Ultracapacitors, Introduction to Flywheel, Hybridization of different energy storage devices.
Unit 4	**EV Charging:** Basic Requirements for Charging System, Charger topologies, Grid Voltages, Frequencies, and Wiring, Charger Functions, Real Power, Apparent Power, and Power Factor, Charging Standards,Wireless Charging,Converters in EV charging
Unit 5	**Battery and Energy Management Systems** Battery Management Systems: Background of Battery Management Systems, Typical Structure of BMSs. Energy management strategies, Optimization techniques used in Hybrid and Electric vehicles for Energy storages, classification of Energy Management strategies, comparison and implementation issues of Energy management strategies.

Text/Reference Books:

1. Electric and Hybrid Vehicles: Design Fundamentals by Iqbal Hussain, CRCPress ,2003.
2. Modern Electric, Hybrid Electric and Fuel Cell Vehicles- Fundamentals, External and applications by Mchrdad Ehsani, Yimi Gao, Sebastian E. gayans Ali Emadi,CRC Press, 2004.
3. Electric Vehicles Technology Explained by james Larminie, John Lowry, Wiley Publications, 2013.
4. Super capacitors- materials, Systems and Applications by F. Beguin and E. Frackowiak, Wiley-VCH VerlagGmbH&Company,2013.
5. Fuel Cells and Hydrogens: From Fundamentals to applied Research by V.Hacker, S. Mitsushima, Elsevier ,2018.
6. Electric Power train: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, By John G. Hayes and G. Abas Goodarzi, Wiley Publication.

Designed by Dr. S. P. Ghanegaonkar & Dr. S. M. Shinde

Approved in XXV IIIth Academic Council
Dated: 25th Jun 2024

EEMDM3011:Lab-Control , Instrumentation and Energy	
Teaching Scheme Practical: 2 Hrs./Week Credit : 01	**Examination Scheme** ISE I : 25 Marks Practical Examination & Viva Voce :25 Marks

Laboratory Course Outcomes:

As an outcome of completing the Laboratory course, students will able to:

CO1	To study characteristics of sensors
CO2	To study signal conditioning of sensors
CO3	Differentiate various control systems,and control system components
CO4	Describe various types of control systems
CO5	Explain operation of industrial controllers

List of Experiments:

Term-work shall consist of minimum 10 experiments from the following:

Sr. No.	Details
1	To study the performance characteristics of various physical sensors
2	To study signal conditioning of sensors
3	To study characteristics of synchro transmitter and synchro receiver
4	To study the speed torque characteristics of a DC servo motor
5	To study the speed torque characteristics of a AC servo motor
6	To study responses(Step and Impulse) of system
7	To study responses of PI,PD and PID for temperature controller
8	To study temperature controller
9	To study the time response of a variety of simulated linear systems and to correlate the studies with theoretical results.
10	To study PLC architecture
11	To study any one industrial controller

Mapping of Course Outcome with Program Outcomes:

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O 2	PSO 3
CO1	3	1				1		1		1		1		1	3
CO2	3	2		1		1	1	1	1	1		1		1	3
CO3	3	2		1		1	1	1	1	1		1		1	3
CO4	3	1		1		1		1	1	1		1		1	3
CO5	3			1		1	1	1	1	1		1		1	3

1 -Low 2 – Medium 3 - High

Sample Assessment Table:

Assessment Tool	S1	S1	S3	S2	S3
Course Outcomes	CO1	CO2	CO3	CO4	CO5
Term Work (25 Marks)	05	05	05	05	05
Practical Examination 25 Marks					

Sample Assessment Pattern:

Preparation (S1)	05	
Conduct of Experiment (S2)	10	
Observation and Analysis of Results (S3)	05	
Record (S2)	05	
Mini-Project / Presentation/ Viva-Voce (S3)		
Total	25	

Designed by
Dr. Sandhya Kulkarni

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Multidisciplinary Minor-II (Renewable Energy Systems)

Sr. No.	Course Code	Course Name	Pre-requisite	Credits L-T-P	Offered Semester	Suggested by dept
1	EEMDM2002	Renewable Energy Technology	No	3-0-0	III	Electrical Dept
2	EEMDM2012	Grid Integration of Wind & Solar Systems	No	3-0-0	IV	Electrical Dept
3	EEMDM2013	Lab RET	No	0-0-1	IV	Electrical Dept
4	EEMDM3002	Energy Economics & Marketing	No	3-0-0	V	Electrical Dept
5	EEMDM3010	Energy Storage Systems	No	3-0-0	VI	Electrical Dept
6	EEMDM3012	Lab Energy	No	0-0-1	VI	Electrical Dept

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EEMDM2002 : Renewable Energy Technology	
Teaching Scheme Lectures : 03 Hrs./Week Total Credits : 03	Examination Scheme ISE : 15 Marks ISE II : 15 Marks ISE III : 10 Marks End -Semester Exam : 60 Marks

Course Description:

In this curriculum, students will be explored in Renewable Energy Technologies such as Wind energy, Solar energy. They will be introduced to concepts of fuel cells and biomass energy.

Course Objectives:

The objectives of the course are to learn

1. Different types of energy sources
2. Various solar PV technologies and its characteristics
3. Various solar thermal technologies and its applications
4. Wind energy technologies and its operations
5. Grid integration of wind energy systems and its associated issues

Course Outcomes:

After completing the course, students will able to

CO1.	Elaborate different types of energy sources
CO2	Explain various solar PV technologies and its characteristics and solve numerical on it
CO3	Describe various solar thermal technologies and its uses in various applications
CO4	Discuss wind energy technologies and explain its operations
CO5	Explain grid integration of wind energy systems and its associated issues

Detailed Syllabus:

UNIT-I	**Basics of Energy:** Energy and Power, Hubert peak, Energy Scenario in India, Environmental impact of fossil fuels, Different types of energy sources - solar, wind, tidal, geothermal, wave energy, Introduction to fuel cells and Biomass
UNIT-II	**Solar PV Technology:** Amorphous mono-crystalline, poly-crystalline, V-I characteristics, Shading impact, PV module, Array, Maximum Power Point Tracking, Grid connected and standalone systems
UNIT-III	**Solar Thermal Technology:** Solar Spectrum, Solar Geometry, Sun Earth angles, Solar radiation at given locations, Flat plate collector, Parabolic trough, Central receiver, parabolic dish, Fresnel, solar pond, solar still
UNIT-IV	**Wind Energy Technology:** History of wind power, types of wind turbines, power in the wind, Betz limit, Tip speed ratio, stall and pitch control, wind speed statistics, probability distribution, wind generator topologies, voltage and reactive power control, power quality standard for wind turbines
UNIT-V	**Grid Integration of Wind Energy:** Wind farms, real and reactive power regulation, voltage and frequency operating limits, wind farm behavior during grid disturbances, power system interconnection, Economic aspects

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Text and Reference Books:

1. Thomas Ackermann, Editor, “Wind Power in Power Systems”, John Willy and sons ltd., 2005,ISBN 0- 470-85508-8.
2. Gilbert M. Masters, “Renewable and Efficient Electric Power Systems”, John Willy and sons,2004,ISBN0-471-28060-7.
3. S. P. Sukhatme, “Solar Energy”, Tata McGrew Hill, second edition, 1996, ISBN 0-07-462453-9.
4. ChetanSingh Solanki, "Solar Photovoltaics", fundamental, technologies and applications, PHI- second edition, 2011.
5. Siegfried Heier, “Grid integration of wind energy conversion systems” John Willy and sons ltd.2006.
6. Mullic and G.N.Tiwari, “Renewable Energy Applications”, Pearson Publications.
7. John A. Duffie, William A. Beckman, “Solar Engineering of Thermal Processes”, Wiley Inter science Publication, 1991

Sample Assessment Table:

Assessment Tool	K1+K2+K3	K1+K2+K3	K2+K3	K2+K3	K4
Course outcomes	CO1	CO2	CO3	CO4	CO5
Class Test 30 Marks	8	7	8	7	
Teachers Assessment 10 Marks	2	2	2	2	2
ESE Assessment 60 Marks	12	12	12	12	12

ISE III Assessment: Teacher’s Assessment is based on one of the following-

1. Assignments
2. Models/ Presentations
3. Multiple choice questions test
4. Quiz

Sample Assessment Pattern:

Level No.	**Knowledge Level**	**Test**	**Teachers Assessment /Assignment**	**End Semester Examination**
K1	Remember	10	02	10
K2	Understand	10	02	20
K3	Apply	10	02	20
K4	Analyze		02	10
K5	Evaluate		02	
Total		30	10	60

Designed by

Dr. S. M. Shinde

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EEMDM2012 : Grid Integration of Wind & Solar Systems	
Teaching Scheme Lectures : 03 Hrs./Week Total Credits : 03	Examination Scheme ISE : 15 Marks ISE II : 15 Marks ISE III : 10 Marks End -Semester Exam : 60 Marks

Course Objective:

The objectives of the course are to introduce and learn

1. Different types of renewable energy sources
2. Various solar PV technologies and its characteristics
3. Various solar thermal technologies and its applications
4. Wind energy technologies and its operations
5. Grid integration of wind energy systems and its associated issues

Course Outcomes: After completing the course, students will be able to:

CO1	Understand different renewable energy sources and storage devices
CO2	Explain various solar PV technologies and its characteristics
CO3	Describe various solar thermal technologies and its uses in various applications
CO4	Discuss wind energy technologies and explain its operations
CO5	Analyze and simulate control strategies for grid connected and off-grid systems

Detailed Syllabus:

Unit 1	**Introduction:** Electric grid, Utility ideal features, Energy Scenario in India, Environmental impact of fossil fuels, Different types of energy sources - solar, wind, tidal, geothermal, wave energy
Unit 2	**Dynamic Energy Conversion Technologies:** Introduction, types of conventional and nonconventional dynamic generation technologies, principle of operation and analysis of hydro and wind based generation technologies, types of wind turbines, power in the wind, Betz limit, Tip speed ratio, stall and pitch control, wind speed statistics, probability distribution, wind generator topologies, voltage and reactive power control, power quality standard for wind turbines
Unit 3	**Static Energy Conversion Technologies:** Principle of operation and analysis of fuel cell, photovoltaic systems and generation technologies; MPPT techniques and its classifications, principle of operation and partial shading effects; Storage Technologies -batteries, flywheels, ultra & super capacitors . Design of stand-alone systems, Amorphous mono-crystalline, poly-crystalline & Thin film solar cell, Introduction to organic Solar PV Cell
Unit 4	**Solar Thermal Technology:** Solar Spectrum, Solar Geometry, Sun Earth angles, Solar radiation at given locations, Flat plate collector, Parabolic trough, Central receiver, parabolic dish, Fresnel, solar pond & solar still
Unit 5	**Grid Integration of Energy** Introduction & importance, sizing, Grid connected Photovoltaic systems classifications, operation, merits & demerits; operation & control of hybrid energy systems, Solar Photovoltaic applications. IEEE & IEC standards for renewable, energy grid integrations.

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Text and Reference Books

1. Gilbert M. Masters, “Renewable and Efficient Electric Power Systems”, JohnWillyandsons,2004,ISBN0-471-28060-7.
2. S. P. Sukhatme, “Solar Energy”, Tata McGrew Hill, second edition, 1996, ISBN0-07-462453-9
3. ChetanSingh Solanki, "Solar Photovoltaics", fundamental, technologies and applications, PHI-second edition
4 S. Chowdhury, S. P. Chowdhury, PCrossley “Microgrids and Active Distribution Networks”, IET Power Electronics Series, 2012.
5. Ali Keyhani Mohammad Marwali and Min Dai “Integration and Control of Renewable Energy in Electric Power System”John Wiley publishing company, 2010, 2nd Edition.
6. John A. Duffie, William A. Beckman, “Solar Engineering of Thermal Processes”, WileyIntersciencePublication, 1991
7.Report on “Large Scale Grid Integration of Renewable Energy Sources - Way Forward” Central Electricity Authority, GoI, 2013.
8. Siegfried Heier, “Grid integration of wind energy conversion systems” John Willy andsons ltd, 2006
9. Bin Wu, Yongqiang Lang, Navid Zargar “,Power Conversion and Control of Wind Energy Systems”IEEE- John Wiley and Sons Ltd. Publishers, 2011,1st Edition.

ISE III Assessment: Teachers Assessment of 20 marks is based on **attendance** of the student and one of the / or combination of few of following.

1.Presentation on latest topics/Real life problems related with the subject
2. Simulations problems
3. Quiz
4. MCQ

Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember			10
K2	Understand	10	10	20
K3	Apply	10	10	20
K4	Analyze			10
Total Marks 100		20	20	60

Assessment Table :

Assessment Tool	K2+K3	K2+K3	K1+K2+K3	K2+K3	K2+K3
	CO1	CO2	CO3	CO4	CO5
Class Test (20 Marks)	10	10			
Teachers Assessment (20 Marks)		5	5	5	5
ESE Assessment (60 Marks)	12	12	12	12	12

Designed by
Dr. S. M. Shinde

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EEMDM2013: Lab Renewable Energy Technology	
Teaching Scheme Practical : 02 Hrs/Week Credits : 01	**Examination Scheme** Term Work : 25 Marks Total : 25 Marks

Term Work shall consist of a record of minimum twelve experiments/assignments using engineering computation software such as MATLAB, PSCAD, ETAP with moderate to high complexity.

Following is the list of experiments is just a guideline (Hardware and Software base)

1. Plot I-V and P-V characteristics of single Solar PV Module with radiation and temperature changing effects
2. Plot I-V and P-V characteristics with series and parallel combination of Solar PV modules.
3. Study effect of shading on output power of Solar PV Module
4. Measure output power of solar PV system with effect of tilt angle
5. Plot charging and discharging characteristics of battery
6. Measure performance parameters of DC load system with and without battery (with variable rated capacity system) in Solar PV stand-alone system.
7. Measure performance parameters of AC load system with and without battery in Solar stand-alone PV system.
8. Measure performance parameters of Combine AC and DC load system with and without battery in Solar stand-alone PV system.
9. Study of biomass plant
10. Identify and measure the parameters of a solar PV Module at Specific location
11. Measure the spectral response of a solar cell and Calculate quantum efficiency
12. Study solar resource assessment station and record associated parameters
13. Simulate characteristics of fuel cell using electrical software
14. Simulate operation of wind turbine and measure associated parameters using electrical software
15. Study of Tri-brid system

EEMDM3002 : Energy Economics & Marketing	
Teaching Scheme Lectures : 03 Hrs./Week Total Credits : 03	Examination Scheme ISE : 15 Marks ISE II : 15 Marks ISE III : 10 Marks End -Semester Exam : 60 Marks

Detailed syllabus

Unit I	**Introduction** Introduction to Energy Economics Energy and Multidimensional Interactions, Energy Basics, How Energy is Defined, Introduction to Energy System, Energy Information, Energy Accounting Framework: Components of Energy Account, Commodity Accounts and Overall Energy Balance, Units, Conversion Factors and Aggregation of Energy Flow. Energy Resources and Energy Commodities; Properties of Energy Resources and Energy Commodities; Law Of Thermodynamics; Energy, economy and environment interactions, role of energy in development and growth
Unit II	**Global Demand for Energy** Causes and Impact of increase in Demand for Energy; World Energy Consumption Energy Consumption by End-use Sector (Buildings Sector, Industrial Sector, Transportation Sector), Global Variations in Energy Use; Understanding and analyzing energy demand: evolution of demand analysis, overview of energy demand decision, economic foundation of energy demand, consumer demand for energy: utility maximization problem, demand models
Unit III	**Energy Supply Analysis** Classify energy on the basis of sources, renewable or nonrenewable; worldwide energy supply by country; sources of energy supply, Fossil fuels (coal, oil, natural gas), economic theory of depletable resources, Trend and patterns of energy production; Social, Economic and Environmental Effects of Energy Production; Life Cycle of Energy Sources. Fossil fuel Supply Models, Supply Forecasting, Economics of Fossil fuel supply, Electricity, oil and gas, coal, strategies for modeling exhaustible resources, economics of energy generation such as power, coal, oil and gas, estimation of supply functions and cost functions.
Unit IV	**Cost versus Return of Investment** Basic pricing model, Pricing Structure of different Energy sources such as short run and long run, peak and off peak, single part and two-part tariffs, Regulated vs market price, Average and Marginal cost pricing, ToD pricing, seasonal, and block pricing.
Unit V	**Energy taxes and subsidies:** Principles of optimal indirect taxation, equity considerations, issues related to numerical determination of a burden, Tax and subsidy structure in Indian Context, Energy pricing in Indian Context (Coal, Gas and Electricity), Different Energy Markets. Case Studies of ONGC, NTPC, GAIL,.HINDALCO(Private thermal power plants)

Textbooks/References

1. SC Bhattacharya: Energy Economics
2. Banks: Energy Economics A Modern Introduction
3. Peter M. Schwarz: Energy Economics
4. CarolA. Dahl, International Energy Markets: Understanding Pricing, Policies and Profits, Tulsa: Pennwell, 2004

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Dated: 25th Jun 2024

EEMDM3010 : Energy Storage Systems	
Teaching Scheme Lectures : 03 Hrs./Week Total Credits : 03	Examination Scheme ISE : 15 Marks ISE II : 15 Marks ISE III : 10 Marks End -Semester Exam : 60 Marks

The course aims to identify suitable energy storage systems for Electric Vehicles, compare different energy storage systems and explain use of Energy management systems for Energy Storage systems.

Course Outcomes: Students will be able to:

1. Identify suitable energy storage systems for Electric Vehicles.
2. Compare different energy storage systems.
3. Explain use of Energy management systems for Energy Storage systems.

Detailed syllabus

Unit 1	**Fundamentals** Introduction to Electrochemical battery, battery capacity, Battery Parameters and Comparisons, Battery Pack Discharge Curves and Aging, Battery Models, SOC, SOD, SOH, DOD, Battery technologies used in recent EVs, Lead acid battery, Nickel based battery, Lithium battery, Grephene battery and comparison of Battery types.
Unit 2	**Fuel Cells** Overview of key Fuel cell technologies, fuel cell types, electrode materials, electrolytes and other components, working principles, Hydrogen generation and storage, limitations, recent progress in Fuel cell technologies, safety issues vs cost aspects, life cycle analysis.
Unit 3	**Ultra-capacitors** Features, basic working principle, fundamentals of Electrochemical super-capacitors, Electrodes, and electrolyte interfaces and capacitances, charge discharge characteristics, Energy/power density, Design, fabrication, Ultra-capacitor technologies, graphene based Ultracapacitors, Introduction to Flywheel, Hybridization of different energy storage devices.
Unit 4	**Battery Charging** Basic Requirements for Charging System, Charger Architectures, Grid Voltages, Frequencies, and Wiring, Charger Functions, Real Power, Apparent Power, and Power Factor, Charging Standards and Technologies, Wireless Charging, Boost Converter for Power Factor Correction: The Boost PFC Power Stage, Sizing the Boost Inductor, Average Currents in the Rectifier, Switch and Diode Average Currents, Switch, Diode, and Capacitor RMS Currents, Power Semiconductors for Charging, Examples.

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Unit 5	**Battery and Energy Management Systems** Battery Management Systems: Background of Battery Management Systems, Typical Structure of BMSs, Key Points of BMSs in Future Generation. Energy management strategies, Optimization techniques used in Hybrid and Electric vehicles for Energy storages, classification of Energy Management strategies, comparison and implementation issues of Energy management strategies.

Text/Reference Books

1. Electric and Hybrid Vehicles: Design Fundamentals by Iqbal Hussain, CRCPress ,2003.
2. Modern Electric, Hybrid Electric and Fuel Cell Vehicles- Fundamentals, External and applications by Mchrdad Ehsani, Yimi Gao, Sebastian E. gayans Ali Emadi,CRC Press, 2004.
3. Electric Vehicles Technology Explained by James Larminie, John Lowry, Wiley Publications, 2013.
4. Supercapacitors- materials, Systems and Applications by F. Beguin and E. Frackowiak, Wiley-VCH VerlagGmbH&Company,2013.
5. Fuel Cells and Hydrogens: From Fundamentals to Applied Research by V.Hacker, S. Mitsushima, Elsevier ,2018.
6. Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, By John G. Hayes and G. Abas Goodarzi, Wiley Publication.

Designed by Dr. S. P Ghanegaonkar & Dr. S. M. Shinde

EEMDM3012: Lab Energy	
Teaching Scheme	**Examination Scheme**
Practical : 02 Hrs/Week	Term Work : 25 Marks
Credits : 01	Total : 25 Marks

Term Work shall consist of a record of minimum twelve experiments/assignments using any engineering computation software such as MATLAB, PSCAD, ETAP with moderate to high complexity.

Following is the list of experiments is just a guideline (Hardware and Software base)

1. Plot charging and discharging characteristics of battery
2. To study the characteristics of Li Ion Battery
3. To study the electrical characteristics of Fuel cell
4. To study the characteristics of Ultracapacitor/ supercapacitor
5. To study the characteristics of Li Ion Battery
6. To study the hybrid energy storage with battery and ultracapacitor for EV application
7. To study battery management system and record associated parameters
8. To study Tribrid system

Designed by Dr. S. M. shinde and Prof. V. P. Dhote

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List of Open Electives

Sr. No.	Course Code	Course Name	Pre-requisite	Credits L-T-P	Offered Semester	Suggested by dept
1	EEOEC2001	Music Engineering	No	3-0-0	III	Electrical Dept
2	EEOEC2010	Basic Engineering Economics	No	2-0-0	IV	Electrical Dept
3	EEOEC3001	Smart Building Services	No	3-0-0	V	Electrical Dept

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EEOEC2001 : Music Engineering	
Teaching Scheme Lectures : 03 Hrs./Week Total Credits : 03	Examination Scheme ISE : 15 Marks ISE II : 15 Marks ISE III : 10 Marks End -Semester Exam : 60 Marks

This course is a study of the physical production, transmission, and perception of sound. The focus is on the characteristics of sounds which we interpret as music. To understand what distinguishes music from other sounds, we will have to learn the basic relationships which govern all vibrations and waves. In this course these ideas will be applied to the major families of musical instruments, including the voice. We will also consider how music is affected by the environment (acoustics) and how sound is physically and physiologically registered and psychologically perceived.

Detailed Syllabus

Unit I	**Vibrations waves and Sound** Draw a diagram of a wave labeled with amplitude and wavelength, difference between transverse and longitudinal waves, the wave equation ($v = f \lambda$), and the relationship between period and frequency, draw a diagram of a standing wave labeled with node and antinode, State that standing waves arise due to the superposition of a wave with its reflection, difference between time domain and frequency domain.
Unit II	**Sound and Music** Sound wave characteristics, schematic diagram of the human ear and explain the functions of the different parts, the range of human hearing, propagation of sound waves by the musical instruments,, the relationship between measured wave quantities and perceived sound (loudness/amplitude, pitch/fundamental frequency, timbre/spectrum+envelope). Hearing. Sound Pressure, Power, and Loudness., Pitch and Timbre, Combination Tones and Harmony, Musical Scales and Temperament., basis of musical scales, just intonation " and & quot just interval &quot, the pythagorean scale, and the pythagorean comma, temperament, the difference between a diatonic and chromatic scale, the advantages and disadvantages of the 12-EDO scale.
Unit III	**Musical Instruments** Explain timbre in terms of spectrum and envelope, For each class of instrument (stringed, wind, brass, voice and percussion), Draw a diagram illustrating the means of sound production, Describe the way in which sound is produced, Discuss the differences between instruments in the class, (eg single vs double reeded, bowed vs plucked) , Measure and discuss the dynamic range and timbre of instruments using smart phone app and computer software, Explain how sound is generated in an electric guitar, Give examples of the methods of generating sounds in electronic instruments, Discuss the differences between acoustic and electronics instruments
Unit IV	**Architectural Acoustics** State and use the formula giving the decibel difference between two sounds of a given intensity ratio, and define the Sound Pressure Level of a sound, Measure the SPL of a range of sounds using a meter, smartphone app or computer, Define the reverberation time of a room, Discuss the acoustical properties desirable in buildings (eg Concert halls, Opera houses, lecture rooms), Measure the reverberation time for a room by using a smartphone app, or meter.

Unit V	**Recording and Measurement** Draw a diagram of a loudspeaker and explain how it works, Explain the difference between analogue and digital recording, Draw a diagram illustrating the conversion of an analogue to digital signal, Discuss the advantages and disadvantages of digital and analogue recording, Discuss the relative environmental impact of listening to a track on vinyl and in lossless digital format. Demonstrate the use of audio measurement software tools on Android and Computer, Discuss the difference between systematic and statistical errors in measurement, Write a report of a workshop project

Text/References books

1. Thomas D. Rossing, F. Richard Moore, and Paul A. Wheeler, The Science of Sound (3rd Edition), Addison Wesley (2002)
2. Kyle Forinash and Wolfgang Christian, "Sound: An Interactive eBook". https://www.compadre.org/books/SoundBook
3. Harvey E. White, Donald H. White, "Physics and Music: The Science of Musical Sound", Dover Books on Physics, (2014)
4. Laboratory Manual for Science of Sound, Jim Fiore, Professor Emeritus, Electrical Engineering Technology, Mohawk Valley Community College, USA
5. Charles E. Speaks, "Introduction to Sound-Acoustics for the Hearing and Speech Sciences", (4th Edition), Plural Publishing, Inc (2017)
6. William M. Hartmann, Principles of Musical Acoustics, (1st Edition), Springer New York (2013)
7. Richard E. Berg, David G. Stork, "The Physics of Sound", (3rd Edition) Pearson (2005)
8. Richard Brice, "Music Engineering", (2nd Edition), Newnes (2001)
9. Dan Hosken, "An Introduction to Music Technology" (2nd Editon), Routledge (2014)
10. https://phys.libretexts.org/Bookshelves/Waves_and_Acoustics/Laboratory_Manual_-
11. _The_Science_of_Sound_(Fiore)

Designed by

Dr. S. M. Shinde, Shri Ajay Chole

EEOEC2010:Basic Engineering Economics	
Teaching Scheme Lectures : 02 Hrs./Week Total Credits : 02	Examination Scheme ISE : 10 Marks ISE II : 10 Marks End -Semester Exam : 30 Marks Total marks :50 marks

Detailed syllabus

Unit I	**Basic Concepts of Economics:** Definitions, Overview of Micro and Macro Economics, Explanation of theories of demand, supply and market equilibrium and Economics Basics – Cost, efficiency and scarcity, Opportunity Cost
Unit II	**Micro-Economics** Differences and Comparison, Theories of Utility and Consumers Choice, Competition and Market Structures, Markets and Prices, Market Failures, Income Distribution and Role of Government **Macro Economics** Aggregate Demand and Supply, Economic Growth and Business Cycles, The role of the Nation in economic activity, New Economic Policy in India, Fiscal Policy, GDP and Inflation, Consumption, savings and investments, Commercial and Central banking
Unit III	**Industrial Economics** Behavior of firms: Strategies with regard to entry, pricing, advertising, and R & D and innovation. The development of Firms and Market and Industrial Structure: Stochastic models of firm growth, and market structure, inter-industry differences in growth rate variance, economies of scale, technical change, mergers and market concentration. Development of Competitive capabilities: Role of Technology and Skills, FDI and Technology Transfer, Technological Spillovers, Globalization and Technology Intermediation.

Text, Reference books

1. Baumol, William J., Economic Theory and Operations Analysis, [Prentice Hall India Ltd.] Fourth Edition, 1985.
2. Sloman, John H., Economics [Prentice Hall India Ltd.] Second Edition, 1994.
3. Varian, Hal, ` Intermediate Microeconomics: A Modern Approach, Fifth Edition [Norton, 1999].
4. P.A. Samuelson & W.D. Nordhaus, Economics, McGraw Hill, New York, 1995.
5. Koutsoyiannis, Modern Microeconomics, Macmillan, 1975.
6. R. Pindyck and D.L. Rubinfeld, Microeconomics, Macmillan Publishing Company, New York, 1989.
7. R.J. Gordon, Macroeconomics 4th Edition, Little Brown & Co., Boston, 1987.
8. William F. Shughart II, The Organization of Industry, Richard D. Irwin, Illinois, 1990. (Chapter 3).

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EEOEC3001 : Smart Building Services	
Teaching Scheme Lectures : 03 Hrs./Week Total Credits : 03	Examination Scheme ISE : 15 Marks ISE II : 15 Marks ISE III : 10 Marks End -Semester Exam : 60 Marks

Course Description:

The course is prepared to provide detailed understanding of smart building services in industry.

Unit I	**Fire fighting System:** Introduction to Fire System, fire EXTINGUISHER as per NPFA 10 & NBC, sprinkler system NPFA 13 & NBC, standpipe system NPFA 14 & NBC, fire pump & fire tank NFPA 20 & NBC, fire pump & fire tank NFPA 7
Unit II	**Heating Ventilation and Air conditioning system:** Introduction of HVAC, Fundamentals of Heat Transfer, Air-Conditioning System and Equipment, Refrigerants, Cooling Load Calculation, Heating System and Heating Load Calculation, Air Distribution System, Ducting and Air Terminals, Fans, Water Distribution System-Pipes and Valves, Pumps, Cooling Tower, Heat Exchanger, VRV/VRF System, Ventilation System
Unit III	**Plumbing System:** Introduction to Plumbing, Plumbing Hydraulics, Sanitary Fixtures, Plumbing System, Formula for flow through pipes, Cold and Gray Water Supply System, Pump, Hot Water Supply System , Garden Water Supply System and Fountain System External Water Supply for Building's, Drainage System, External Foul Water Drainage, Storm Water Drainage in Building ,Mix Topics
Unit IV	**Electrical System:** Introduction to Electrical System, Lighting Design, Calculation and Luminaries Selection, Power Services, Cables, Cables Trays, Conduit and Trunking, Short Circuit, Switch Gears, Panel Boards, Transformer, Capacitor Bank, Bus Bar, Single Line diagram, Earthing
Unit V	**Building Security Systems** Security appliances, alarm,Cameras,Barriers, Bolards, Turnstile gates, X-Ray Scanner etc and their communication

Text, Reference books:

1. ASHRAE Handbook series, Part No. 90, 62.1, and 55
2. NBC Part 4, Fire and Safety
3. NFPA, National Fire Protection Association
4. NBC Part 9,2016, Plumbing
5. B. L. Theraja, "Electrical Design", Khanna Publisher

Designed by Shri Vinchurkar

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