MAHENDRA ENGINEERING COLLEGE
Autonomous| Accredited by NAAC with 'A++' Grade (Cycle-2)
Accredited by NBA Tier-I (WA) UG : CSE, ECE, EEE
Mahendhirapuri, Mallasamudram (W), Namakkal (Dt) - 637 503, Tamil Nadu
04288-288 500 / 521 / 522 | www.mahendra.info

Under Graduate Curriculum and Syllabi

B.E. Electrical and Electronics Engineering

Regulations 2024

Head of the Department
Dept. of Electrical & Electronics Engineering
Mahendra Engineering College
Mahendhirapuri, Mallasamudram
Namakkal Dt-637 503

B.E Electrical and Electronics Engineering

INSTITUTION

Vision

- To be an internationally recognized institute for engineering education and research with ethical values

Mission

- To ensure the effective use of resources to mould the students as professionals and entrepreneurs
- To enhance the industry institute interaction for innovative technology practice
- To encourage the faculty and students advanced research
- To inculcate the ethical values among the faculty members and students

DEPARTMENT

Vision

- To produce globally competent Electrical and Electronics Engineers, Entrepreneurs conversant with cutting edge technologies.

Mission

- To impart good quality technical education through effective teaching-learning process.
- To enhance the students' employability through mentoring and skill development.
- To promote innovation and research activities with analytical skills to face global challenges.
- To enable students imbibe ethical and enterprising characteristics to become socially-responsible engineers.

Programme Educational Objectives (PEOs)

The graduates of Electrical and Electronics Engineering will be able to:

- Excel in professional career by applying the knowledge and skills to meet the real-time challenges.
- Apply Electrical and Electronics expertise and research to solve interdisciplinary problems.
- Exhibit soft skills, professional ethics and an ability for life-long learning to resolve societal issues.

Program Outcomes (POs)

Engineering Graduates will be able to:

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 system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

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 prediction 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 the consequent responsibilities relevant to the professional engineering practice

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

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 in multidisciplinary settings

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

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 and in multidisciplinary environments

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Programme Specific Outcomes (PSOs)

- Apply specific domain knowledge of automation and control for industrial systems.
- Develop software skills required for professional engineering practices leading to successful employment
- Apply innovative solutions in renewable energy for specific requirements

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DEPARTMENT OF
ELECTRICAL AND ELECTRONICS ENGINEERING

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I Semester

Sl. No.	Course code	Course Title	L	T	P	C	Category
THEORY							
1	24MA12101	Engineering Mathematics I	3	1	0	4	BS
2	24PY12001	Engineering Physics	3	0	0	3	BS
3	24CS13001	Problem Solving Techniques using C	3	0	0	3	ES
4	24EE13001	Basics of Electrical and Electronics Engineering	3	0	0	3	ES
5	24HS11002	Heritage of Tamils	1	0	0	1	HS
		Induction Program	-	-	-	-	MC
PRACTICAL							
6	24PY22001	Physics Laboratory	0	0	3	1.5	BS
7	24CS23001	Problem Solving Techniques using C Laboratory	0	0	3	1.5	ES
8	24GE23001	Engineering Practices Laboratory	0	0	3	1.5	ES
		TOTAL	**13**	**1**	**9**	**18.5**	

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	DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING						
Regulations 2024							
II Semester							
Sl. No.	**Course code**	**Course Title**	**L**	**T**	**P**	**C**	**Category**
THEORY							
1	24MA12201	Engineering Mathematics II	3	1	0	4	BS
2	24CY12001	Engineering Chemistry	3	0	0	3	BS
3	24HS11001	Communicative English	3	0	0	3	HS
4	24GE33201	Engineering Graphics and Design	2	0	0	2	ES
5	24EE14201	Electric Circuit Analysis	2	1	0	3	PC
6	24HS11003	Tamils and Technology	1	0	0	1	HS
PRACTICAL							
7	24CY22001	Chemistry Laboratory	0	0	3	1.5	BS
8	24HS21001	Personality Development Practice	0	0	2	1	HS
9	24EE24201	Electric Circuits Laboratory	0	0	3	1.5	PC
		TOTAL	**13**	**2**	**8**	**20**	

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III Semester

Sl. No.	Course code	Course Title	L	T	P	C	Category
THEORY							
1	24MA12301	Transforms and Partial differential Equations	3	1	0	4	BS
2	24EE14301	Analog Electronics	3	0	0	3	PC
3	24EE14302	Electromagnetic Fields	3	1	0	4	PC
4	24EE14303	Electrical Machines I	3	0	0	3	PC
5	24EE14304	Fundamentals of Python Programming	1	0	0	1	ES
6	24HS11006	Universal Human Values	2	1	0	3	HS
7		Open Elective I	3	0	0	3	OE
PRACTICAL							
8	24EE24301	Analog Electronics Laboratory	0	0	3	1.5	PC
9	24EE24302	Electrical Machines I Laboratory	0	0	3	1.5	PC
		TOTAL	**18**	**3**	**6**	**24**	

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IV Semester

Sl. No.	Course code	Course Title	L	T	P	C	Category
THEORY							
1	24MA12404	Numerical Methods	3	1	0	4	BS
2	24EE14401	Digital Electronics	2	1	0	3	PC
3	24EE14402	Electrical Machines II	2	1	0	3	PC
4	24EE14403	Electrical Measurements and Instrumentation	3	0	0	3	PC
5	24EE14404	Low voltage Switchgear	1	0	0	1	PC
6	24CY11001	Environmental Science and Sustainability	2	0	0	-	BS
7		Open Elective II	3	0	0	3	OE
8		Open Elective III	3	0	0	3	OE
PRACTICAL							
9	24EE24401	Digital Electronics Laboratory	0	0	3	1.5	PC
10	24EE24402	Electrical Machines II Laboratory	0	0	3	1.5	PC
11	24HS21002	Professional Communication Skills	0	1	2	2	EEC
		TOTAL	**19**	**4**	**8**	**25**	

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V Semester

Sl. No.	Course code	Course Title	L	T	P	C	Category
THEORY							
1	24EE14501	Power Electronics	3	0	0	3	PC
2	24EE14502	Control Systems	3	1	0	4	PC
3	24EE14503	Transmission and Distribution Systems	3	1	0	4	PC
4		Program Elective I	3	0	0	3	PE
5		Open Elective IV	3	0	0	3	OE
6		Open Elective V	3	0	0	3	OE
PRACTICAL							
7	24EE24501	Power Electronics Laboratory	0	0	3	1.5	PC
8	24EE24502	Control and Instrumentation Laboratory	0	0	3	1.5	PC
9	24HS21003	Interview Skills and Soft Skills	0	1	2	2	EEC
10	24EE36501	Internship	0	0	2	1	EEC
		TOTAL	**18**	**3**	**10**	**26**	

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VI Semester

Sl. No.	Course code	Course Title	L	T	P	C	Category
THEORY							
1	24EE14601	Solid State Drives	3	0	0	3	PC
2	24EE14602	Microcontroller based System Design	3	0	0	3	PC
3	24EE14603	Power System Operation and Analysis	3	1	0	4	PC
4	24EE14604	Electric Vehicles	3	0	0	3	PC
5	24HS11004	Constitution of India	3	0	0	-	MC
6		Program Elective II	3	0	0	3	PE
7		Program Elective III	3	0	0	3	PE
PRACTICAL							
8	24EE24601	Electrical Drives Laboratory	0	0	3	1.5	PC
9	24EE24602	Microcontroller Laboratory	0	0	3	1.5	PC
10	24EE36601	Mini Project	0	0	3	1.5	EEC
		TOTAL	**21**	**1**	**9**	**23.5**	

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VII Semester

Sl. No.	Course code	Course Title	L	T	P	C	Category
THEORY							
1	24EE14701	Power System Control and Protection	2	1	0	3	PC
2	24EE14702	Embedded Systems	3	0	0	3	PC
3		Principles of Management	3	0	0	3	HS
4		Program Elective IV	3	0	0	3	PE
5		Program Elective V	3	0	0	3	PE
6		Program Elective VI	3	0	0	3	PE
PRACTICAL							
7	24EE24701	Power System Simulation Laboratory	0	0	3	1.5	PC
8	24EE24702	Embedded Systems Laboratory	0	0	3	1.5	PC
9	24EE36701	Project Work Phase -I	0	0	6	3	EEC
		TOTAL	**17**	**1**	**12**	**24**	

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VIII Semester

Sl. No.	Course code	Course Title	L	T	P	C	Category
1	24EE36801	Project Work Phase -II	0	0	12	6	EEC
		TOTAL	**06**	**0**	**12**	**6**	

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Program Electives

Sl. No.	Course code	Course Title	L	T	P	C	Category
1	24EE15001	Electrical Safety	3	0	0	3	PE
2	24EE15002	Power Quality	3	0	0	3	PE
3	24EE15003	Electric Power Utilization and Conservation	3	0	0	3	PE
4	24EE15004	Control Systems Engineering	3	0	0	3	PE
5	24EE15005	Design of Electrical Machines	3	0	0	3	PE
6	24EE15006	High Voltage Engineering	3	0	0	3	PE
7	24EE15007	EV Batteries and Charging Systems	3	0	0	3	PE
8	24EE15008	Biomedical Instrumentation	3	0	0	3	PE
9	24EE15009	Control Engineering	3	0	0	3	PE
10	24EE15010	Industrial Automation and Control	3	0	0	3	PE
11	24EE15011	Power System Security	3	0	0	3	PE
12	24EE15012	Energy Management and Auditing	3	0	0	3	PE
13	24EE15013	EV Standards and Testing	3	0	0	3	PE
14	24EE15014	Power Systems Stability	3	0	0	3	PE
15	24EE15015	Digital Signal Processing	3	0	0	3	PE
16	24EE15016	EHV AC and DC Transmission	3	0	0	3	PE
17	24EE15017	Intelligent Controllers	3	0	0	3	PE
18	24EE15018	Green Energy Technologies	3	0	0	3	PE
19	24EE15019	Disaster Management	3	0	0	3	PE

20	24EE15020	Renewable and Non-Renewable Energy Sources	3	0	0	3	PE
21	24EE15021	Power System Restructuring	3	0	0	3	PE
22	24EE15022	Automotive Electronics	3	0	0	3	PE
23	24EE15023	Power Systems Dynamics and control	3	0	0	3	PE
24	24EE15024	Smart Grid Technologies	3	0	0	3	PE
25	24EE15025	Industry 4.0	3	0	0	3	PE
26	24EE15026	Power Plant Engineering	3	0	0	3	PE
27	24EE15027	Flexible AC Transmission Systems	3	0	0	3	PE
28	24EE15028	Distributed generation and Micro grid	3	0	0	3	PE
29	24EE15029	IoT in EV Applications	3	0	0	3	PE
30	24EE15030	Artificial Intelligence	3	0	0	3	PE
31	24EE15031	Building Management System	3	0	0	3	PE
32	24EE15032	Machine Learning	3	0	0	3	PE

Semester wise Credit distribution R2024

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	18.5	20	24	25	26	23.5	24	6	167

Category distribution

S.No.	Subject Category	Semester								Credits Total
		I	II	III	IV	V	VI	VII	VIII	
1	HS	1	5	3	-	-	-	3	-	12
2	BS	8.5	8.5	4	4	-	-	-	-	25
3	ES	9	2	1	-	-	-	-	-	12
4	PC	-	4.5	13	13	14	16	9	-	69.5
5	PE	-	-	-	-	3	6	9		18
6	OE	-	-	3	6	6	-	-	-	15
7	MC	IP	-	-	-	-	CoI	-	-	-
8	EEC	-	-	-	2	3	1.5	3	6	15.5
Total Credits		18.5	20	24	25	26	20.5	21	12	167

MAHENDRAENGINEERINGCOLLEGE (Autonomous)							
Regulations 2024							
Department	**MATHEMATICS**		**Programme Code**			1051	
SEMESTER– I							
Coursecode	**Course Name**	**Hours/week**				**Credit**	**Maximum marks**
		L	**T**	**P**		**C**	
24MA12101	**ENGINEERINGMATHEMATICS-I (Common to all Branches)**	3	1	0		4	**100**
Objectives	To enable the students to: • Learn the types of matrices and linear algebrain a comprehensive manner. • Familiarize with functions of several variables and its applications to engineering. • Define the geometric aspects of curvature, radius of curvature, evolutes and envelopes as application of differential calculus. • Explain various techniques of integration. • Learn double and triple integrals and give their representation as area and volume.						
Outcomes	At the end of the course the students will be able to: • Determine the rank of a matrix, eigen values, eigen vectors and inverse of a given matrix and diagonalize symmetric matrix by orthogonal transformations, solve system of linear equations. • Determine maxima and minima of functions of several variables. • Apply the concepts of differential calculus in physical problems. • Apply different methods of integration in solving practical problems. • Compute the area and volume by using multiple integrals.						
UNIT – I	**MATRICES**						**9+3**
Matrix and its types – Rank of matrix –Solving system of linear equations - Characteristic equation - Eigenvalues and Eigenvectors of the matrix - Cayley-Hamilton Theorem, Diagonalization of real andsymmetricmatrices byOrthogonal transformation– Reducethe quadraticform to canonicalform.							
UNIT – II	**DIFFERENTIALCALCULUSOFSEVERAL VARIABLES**						**9+3**
Differentiationofimplicitfunctions–Partialderivatives–Totalderivative–Euler'stheorem–Jacobianandproperties–Taylor'sseriesforfunctionsoftwovariables–Maxima and minima of functionsof two variables– Lagrange's method of undetermined multipliers.							
UNIT – III	**APPLICATIONSOFDIFFERENTIALCALCULUS**						**9+3**
Curvature in Cartesian co-ordinates–Centre and radius of curvature–Circle of curvature–Evolutes–Envelopes–Evolute as envelope of normals and their properties.							
UNIT – IV	**INTEGRALCALCULUS**						**9+3**
DefiniteandIndefiniteintegrals-Substitutionrule-TechniquesofIntegration:Integrationbyparts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions- Improper integrals – Applications to Engineering problems.							

UNIT – V	MULTIPLEINTEGRALS	9+3
Double integrals in Cartesian co-ordinates–Changeoforderofintegration–Areaasdoubleintegral–Tripleintegralin Cartesian co-ordinates–Volume as triple integral–Change of variables in double integrals. Applications to Engineering problems.		
	Total	**(L:45+T:15):60Periods**

TEXT BOOK:	
1	B.S.Grewal, Higher Engineering Mathematics, KhannaPublishers, 2017.
2	James Stewart,Calculus with Early Transcendental function, Cengage, 2013.

REFERENCES:	
1	Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley&Sons,2016.
2	Ray Wylie,Louis C.Barrett, Advanced Engineering Mathematics, McGraw-Hill,2013.
3	Ben Orlin, Change is the Only Constant: The Wisdom of Calculus in a Madcap World, Pearson 2018.

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO2	3	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO3	3	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO4	3	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO5	3	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**-**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)-Syllabus			R 2024
DEPARTMENT:	SCIENCE & HUMANITIES	Programme Code & Name	ENGINEERING PHYSICS

SEMESTER-I&II

COURSE CODE	COURSE NAME	HOURS/WEEK			CREDIT	MAXIMUM MARKS
		L	T	P	C	
24PY12001	ENGINEERING PHYSICS (FOR ALL BRANCHES)	3	0	0	3	100

Objective(s)	➢ To provide fundamental knowledge about lasers, Ultrasonic's, Properties of Matter, Quantum Physics and different kinds of Engineering Materials. ➢ To correlate the principles with application oriented Engineering studies.
Outcome(s)	After completing the course the students ➢ Understand the basics of Laser, Fiber Optics and its types with its applications in various fields. ➢ Gain knowledge about Ultrasonic's their applications in various engineering fields. ➢ Have the necessary understanding on Properties of materials and their uses. ➢ Get Knowledge on basics concepts of Quantum Physics with their Applications. ➢ Understand the properties of SMA, metallic glasses, bio materials and their applications.

UNIT I	**LASER AND FIBER OPTICS**	9 (Hrs)

Introduction – Principle of spontaneous emission, stimulated absorption and emission – Einstein's coefficient (derivation) – Types of lasers - CO_2, Nd: YAG – Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibers (material, refractive index and mode) – losses associated with optical fibers - fiber optic sensors: pressure and displacement.

UNIT II	**ULTRASONICS**	(9 Hrs)

Introduction – Production – magnetostriction effect - magnetostriction generator – piezoelectric and inverse piezoelectric effect- piezoelectric generator – properties – Cavitations - Velocity measurement – acoustic grating – SONAR - Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C –scan displays-Industrial Applications and medical applications-medical endoscope.

UNIT-III	**PROPERTIES OF MATTER**	(9 Hrs)

Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment - I-shaped girders - stress due to bending in beams.

UNIT-IV	**QUANTUM PHYSICS**	(9 Hrs)

Black body radiation – Planck's theory (derivation) –wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box– scanning tunneling microscope- electron tunneling microscope.

UNIT-V	**ADVANCED ENGINEERING MATERIALS**	(9 Hrs)

Smart materials: Shape-memory alloys: Martensite, Austenite, Two way shape memory, characteristics and applications –Metallic glasses – Origin – Preparation – Structure, mechanical and electrical properties.

Biomaterials: First, second and third generation biomaterials – Classification – Metals and

alloys – Polymers – Hydrogels – Applications in medicine: Skin and Blood interfacing implants.	
Total hours to be taught	(45 Hrs)

Text book :	
1.	Dr. G.Senthilkumar- Engineering Physics-VRB Publication & Co, Chennai- Latest edition 2022.
2.	Dr. P.K. Palanisamy, "Engineering Physics", Scitech Publications, Chennai, 2022.
3.	Biomaterial Science and Engineering- JB Park- Plenum Press, NewYork(2014).
4.	M N Avadhanulu, A Textbook of Engineering Physics (2008), S. Chand Publishing, New Delhi.
5.	Bhattacharya, D.K. &Poonam, T. ―Engineering Physics. Oxford University Press, 2015.
REFERENCES:	
1.	Pillai S O, "Engineering Physics" (2014), New Age International Publishers, New Delhi.
2.	Karl F Renk, Basics of Laser Physics (2017)-Springer International Publishing, Switzerland.
3.	Introduction to Quantum Mechanics- J Griffiths-2nd edition(2016).
4.	Halliday.D, Resnick.R. &Walker.J, Principles of Physics (2020), Wiley.
5.	Serway, R.A. & Jewett, J.W. ―Physics for Scientists and Engineers. Cengage Learning, 2010.
6.	William T. Silfvast, Laser Fundamentals (2014), Cambridge University Press.

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO2	2	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO3	2	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO4	2	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO5	2	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO	**2**	-	-	-	-	-	-	-	-	1	-	1	-	-	-
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus						
Department	**Computer Science and Engineering**			**Programme Code**	**1041**	
I Semester						
Course code	**Course Name**	**Hours/week**			**Credit**	**Maximum marks**
24CS13001	**PROBLEM SOLVING TECHNIQUES USING C**	**L**	**T**	**P**	**C**	**100**
		3	0	0	3	
Objective(s)	The student should be made to: • Understand the basics of computer and algorithm • Learn the basic concepts of C Programming. • Know the arrays and functions in C • Be familiar with pointers and structures in C • Learn the file handling techniques and preprocessors in C					
Outcome(s)	Upon completion of this course , students will be able to • Illustrate algorithms for real time problems through various problem solving techniques • Explain the syntax of C Programming • Summarize the concept of arrays and functions in C • Apply the concepts of pointers and structure • Develop the concepts of files and preprocessors in C					
UNIT-I	**PROBLEM SOLVING ASPECTS**					**9**
Computers: Hardware – Software – Processor – Memory – I/O devices – Interface – Programming Languages Problem Solving Aspects: Algorithms Pseudo code, Flowchart-Steps in Problem Solving – simple strategies for developing algorithms (iteration, recursion) – Steps for Creating and Running programs -Illustrative problems: Exchanging The Values – Find minimum in a list - Factorial Computation - Fibonacci Sequence						
UNIT-II	**C PROGRAMMING BASICS**					**9**
Introduction to C programming – Header files – Structure of a C program – compilation and linking processes – Constants, Variables – Data Types – Expressions-, Expression Evaluation, Type conversion Statements – operators – Input and Output operations – Decision Making and Branching – Looping statements- Programming Examples						
UNIT-III	**ARRAYS AND FUNCTION**					**9**
Arrays: Introduction – One-Dimensional Arrays – Two and multi-Dimensional Arrays - Strings: Operations of Strings. Function – definition of function – Declaration of function – Function prototype – Types of functions- user defined functions – Pass by value – Pass by reference – Recursion - Programming Examples						
UNIT-IV	**POINTERS AND STRUCTURES**					**9**
Pointers - Definition – Initialization - Pointer variables, Pointer arithmetic, Pointers to Pointers, Pointers with Arrays, Pointers with Functions- Introduction to Structure – structure definition – Structure declaration – Structure within a structure-Structures fusion with Arrays- Unions – Storage classes						
UNIT-V	**FILE PROCESSING**					**9**
Files: File modes – File functions – Types of file processing: Sequential access, Random access – Text and binary files - Command line arguments – C Preprocessor directives: Macros – Definition – Types of Macros - Creating and implementing user defined header files						

	Total hours	**45**
TEXT BOOK :		
1	Anita Goeland Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India)Pvt. Ltd. Pearson Education, 2016.	
REFERENCES:		
1	Dromey R.G, "How to Solve it by Computer" Prentice Hall of India, Delhi., 2010.	
2	E Balagurusamy, "Computer Programming", First Edition, Tata McGraw Hill Education (India) Private Ltd, New Delhi., 2013.	
3	PradipDey, Manas Ghosh, " Computer Fundamentals and Programming in C", 2nd Edition, Oxford University Press.,2013.	
4	M.Rajaram and P.UmaMaheshwari" Computer Programming with C", Pearson Education., 2013.	
5	NPTEL course, Problem Solving Through Programming in C, https://nptel.ac.in/courses/106105171	
6	NPTEL course, Introduction to Programming in C, https://nptel.ac.in/courses/106104128	

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	1	-	-	-	-	1	-	1	-	1	-
CO2	2	-	-	-	1	-	-	-	-	1	-	1	-	1	-
CO3	2	-	-	-	1	-	-	-	-	1	-	1	-	1	-
CO4	3	-	-	-	1	-	-	-	-	1	-	1	-	1	-
CO5	2	2	3	-	1	-	-	-	-	1	-	1	-	1	-
CO	**2.2**	**2**	**3**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**-**	**1**	**-**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Regulations 2024						
Department	**Electrical and Electronics Engineering**				**Programme Code**	**1051**
I Semester						
Course Code	**Course name**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE13001	**BASICS OF ELECTRICAL ANDELECTRONICS ENGINEERING**	**3**	**0**	**0**	**3**	**100**
Objective(s)	• To study the basic concepts of electrical circuits and measuring instruments • To understand the operation of magnetic circuits and electrical machines • To study the concepts of semiconductor devices • To acquire knowledge on the concepts of integrated circuits • To impart knowledge on the basic concepts of communication systems					
Outcome(s)	At the end of the course, students will be able to: 1. Summarize the concepts of electrical circuits and measuring instruments 2. Illustrate the constructional features and working principle of Electrical machines 3. Explain the operation of semiconductor devices 4. Interpret the concepts of integrated circuits 5. Discuss the basic concepts of Communications systems					
UNIT I	**ELECTRICAL CIRCUITS AND MEASUREMENTS**					**(9)**
-Ohm's Law – Kirchhoff's Law- Voltage and Current Sources- Basics of Resistance, Inductance, and Capacitance- Series and Parallel circuits- Average value and RMS value – Power and Power Factor- Classification of Instruments – Moving coil and Moving Iron Instruments – Energy Meter-Residential wiring - Earthing.						
UNIT II	**ELECTRICAL MACHINES**					**(9)**
Introduction to Magnetic circuits, Faraday's law, Lenz's Law, Fleming's Left-Hand and Right-Hand Rule- Construction and Working Principle: DC Machines -Single phase Transformer – Three phase Squirrel Cage Induction motor- Single phase Induction motor (Qualitative treatment only).						
UNIT III	**SEMICONDUCTOR DEVICES**					**(9)**
PN Junction Diode –Characteristics – Half wave and Full wave Rectifiers –Zener diode- Characteristics-Voltage Regulator-Bipolar Junction Transistor,FET, JFET-Characteristics.						
UNIT IV	**DIGITAL ICs and MICROCONTROLLER**					**(9)**
Boolean Algebra - Logic gates - Demorgan's Theorem - Combinational circuits: Adder, Subtractor, Multiplexer, Demultiplexer - Pin Details and Architecture of Microprocessor (8086) and Microcontroller (8051).						
UNIT V	**COMMUNICATION SYSTEMS**					**(9)**
Types of Signals: Analog and Digital Signals – Modulation and Demodulation: Principles of Amplitude and Frequency Modulations (Qualitative Treatment). Communication Systems: TV, Modem, Microwave, Satellite and Mobile communication (Block Diagram Approach only)						
					Total	**45 Hours**
TEXT BOOKS						

1.	V.K Mehta and Rohit Mehta, "Principle of Electrical Engineering and Electronics" S Chand & Company, Third Edition, 2016.
2.	S. Salivahanan, N. Suresh kumar and A. Vallavanraj, "Electronic Devices and Circuits", Tata McGraw Hill, Second Edition, 2011.
3.	Edward Hughes, "Hughes Electrical and Electronic Technology", Pearson Education, tenth Edition 2008.
4.	David A. Bell, "Electronic Devices and Circuits", Oxford University Press, Fifth Edition, 2008.
REFERENCES	
1.	Robert T. Paynter, "Introducing Electronics Devices and Circuits", Pearson Education, Seventh Education, 2006.
2.	William H. Hayt, J.V. Jack, E. Kemmebly and steven M. Durbin, "Engineering Circuit Analysis", Tata McGraw Hill, Sixth, Edition, 2002.
3.	J. Millman&Halkins, SatyebrantaJit, "Electronic Devices & Circuits", Tata McGraw Hill, Second Edition, 2008.
4.	**NPTEL :** **Prof. L. Umanand, Basic Electrical Technology, IISc Bangalore** https://nptel.ac.in/courses/108108076 **Prof. M.B. Patil Basic Electronics IIT Bombay** https://onlinecourses.nptel.ac.in/noc21_ee55/preview

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	1	-	-	-	1	-	1	1	-	-
CO2	3	-	-	-	-	1	-	-	-	1	-	1	1	-	-
CO3	2	-	-	-	-	1	-	-	-	1	-	1	1	-	-
CO4	3	-	-	-	-	1	-	-	-	1	-	1	1	-	-
CO5	2	-	-	-	-	1	-	-	-	1	-	1	1	-	-
CO	**2.4**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**-**	**1**	**1**	**-**	**-**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE

Autonomous| Accredited by NAAC with 'A++' Grade (Cycle-2)
Accredited by NBA Tier-I (WA) UG : CSE, ECE, EEE
Mahendhirapuri, Mallasamudram (W), Namakkal (Dt) - 637 503, Tamil Nadu
04288-288 500 / 521 / 522 | www.mahendra.info

Regulations 2024

Semester - I
(Common to all B.E./B.Tech. Programmes)

Course Code	Course Name	Periods/Week			Credit	Maximum Marks
		L	T	P	C	
24HS11002	தமிழர் மரபு	1	0	0	1	100

அலகு 1	மொழிமற்றும் இலக்கியம்	3

இந்தியமொழிக் குடும்பங்கள்–திராவிடமொழிகள்–தமிழ்ஒருசெம்மொழி–தமிழ்செவ்வியக்கங்கள்–சங்கஇலக்கியத்தின் சமயச் சார்பற்றதன்மை–சங்கஇலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில்மேலாண்மைக் கருத்துக்கள்–தமிழ்க் காப்பியங்கள், தமிழகத்தில்சமணபௌத்தசமயங்களின் தாக்கம் –பக்திஇலக்கியம், ஆழ்வார்கள்மற்றும் நாயன்மார்கள்– சிற்றிலங்கியங்கள்–தமிழில்நவீனஇலக்கியத்தின் வளர்ச்சி –தமிழ்இலக்கிய வளர்ச்சியில்பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு 2	மரபு–பாறைஓவியங்கள்முதல்நவீனஓவியங்கள்வரை–சிற்பக் கலை	3

நடுகல்முதல்நவீனசிற்பங்கள்வரை–ஐம்பொன் சிலைகள்–பழங்குடியினர் மற்றும் அவர்கள்தயாரிக்கும் கைவினைப் பொருட்கள்,பொம்மைகள்–தேர் செய்யும் கலை–சுடுமண் சிற்பங்கள்–நாட்டுப்புறத் தெய்வங்கள்– குமரிமுனையில்திருவள்ளுவர் சிலை–இசைக் கருவிகள்–மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூகபொருளாதாரவாழ்வில்கோவில்களின் பங்கு.

அலகு 3	நாட்டுப்புறக் கலைகள்மற்றும் வீரவிளையாட்டுகள்	3

தெருக்கூத்துகரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு 4	தமிழர்களின் திணைக் கோட்பாடுகள்	3

தமிழகத்தின் தாவரங்களும் விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்கஇலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள்–தமிழர்கள்போற்றிய அறக்கோட்பாடு–சங்ககாலத்தில்தமிழகத்தில்எழுத்தறிவும் கல்வியும் – சங்ககாலநகரங்களும் துறைமுகங்களும் – சங்ககாலத்தில்ஏற்றுமதிமற்றும் இறக்குமதி– கடல்கடந்தநாடுகளில்சோழர்களின் வெற்றி.

அலகு 5	இந்தியதேசியஇயக்கம் மற்றும் இந்தியபண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு	3

இந்தியவிடுதலைப்போரில்தமிழர்களின் பங்கு–இந்தியாவின் பிறப்பகுதிகளில்தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதைஇயக்கம் – இந்தியமருத்துவத்தில்,சித்தமருத்துவத்தின் பங்கு–கல்வெட்டுகள்,கையெழுத்துப்படிகள்– தமிழ்ப் புத்தகங்களின் அச்சுவரலாறு.

TOTAL – 15 PERIODS

MAHENDRA ENGINEERING COLLEGE(Autonomous) Syllabus			R 2024
DEPARTMENT:	SCIENCE & HUMANITIES	Programme Code	1051

SEMESTER –I & II

COURSE CODE	COURSE NAME	HOURS/WEEK			CREDIT	MAXIMUM MARKS
		L	T	P	C	
24PY22001	PHYSICS LABORATORY (FOR ALL BRANCHES)	0	0	3	1.5	100

Objective(s)	To provide exposure to the students with hands on experience on various basic Physics practices for all branches.
OUTCOMES	• The hands on exercises undergone by the students will help them to apply physics principles • Principles of optics and Liquid to evaluate engineering properties of materials.

1. (a) Determination of Wavelength, and particle size using Laser
(b)Determination of acceptance angle in an optical fiber.
2. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
3. Determination of Thickness of a thin wire-Air Wedge
4. Determination of wavelength of mercury spectrum – spectrometer grating
5. Determination of Young's modulus by Non uniform bending method
6. Determination of viscosity of liquid – Poiseuille's method
7. Determination of Rigidity modulus -Torsional Pendulum
8. Determination of Band gap of a semiconductor-PN Diode
9. Determination of Young's modulus by Uniform bending method

(Choose Any 7 Experiments)

REFERENCES

1.	Physics Laboratory Manual(2023), Department of Physics, Mahendra Engineering College, Namakkal.
2	GeetaSanon, B.Sc Practical Physics, 5thEdn. (2015), R. Chand & Co.
3	C. L. **Arora**B.Sc. Practical Physics (2001), S. Chand and Company Limited, NewDelhi.
4	Indu Prakash and Ramakrishna, A. K. Jha(2012), A Text Book of Practical Physics, KitabMahal, NewDelhi.
5	D. P. Khandelwal, A Laboratory Manual of Physics: For Undergraduate Classes (1985), VaniEducational books, New Delhi.

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	1	-	-	-	1	1	-	1	-	-	-
CO2	2	-	-	-	1	-	-	-	1	1	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO	**2**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**-**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus						
Department	**Computer Science and Engineering**		**Programme Code**		**1041**	
I Semester						
Course Code	**Course Name**	**Hours/Week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
24CS23001	**PROBLEM SOLVING TECHNIQUES USING C LABORATORY (Common to All Branches)**	**0**	**0**	**3**	**1.5**	**100**
Objective(s)	The student should be made to: ● Understand developing applications using Office package. ● Formulate problems and implement algorithms using Scratch and Raptor tool ● Make use of arrays and functions in C. ● Learn how to use pointer concepts. ● Know the concepts of structures, unions and files					
Outcome(s)	Upon completion of this course , students will be able to ● Demonstrate the applications of Office Packages ● Solve the real world problems using Scratch and Raptor Tool ● Develop programs using arrays and functions in C. ● Illustrate the working of pointers in C ● Develop the concepts using structures, unions and files in C					

LIST OF EXPERIMENTS	
1	Prepare A bio-data Using MS Word With Appropriate Page ,Text And Table Formatting Options And Send The Same To Recipients Using Mail Merge
2	Create budget planning of your family with cell referencing, formulae, conditional formatting using Excel
3	Create a Program flow to illustrate the use of Variables and Constants using Scratch Tool
4	Construct flowchart to find the Factorial for a given number Using Raptor
5	Students mark generation using decision statements
6	Calculator using switch statement
7	Prime number generation and to check whether the given number is armstrong or not using looping
8	Greatest number using array (one dimensional)
9	Matrix multiplication using array (two dimensional)
10	Check the given string is palindrome or not.
11	Write a C Program to swap two numbers using two functions one using pointer and other one without using pointer
12	Factorial calculation and Fibonacci series using function
13	Student mark sheet using structures
14	Copy text from one file to other File
	Total hours **30**

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	3	-	-	-	1	1	-	1	-	1	-
CO2	3	-	-	-	3	-	-	-	1	1	-	1	-	1	-
CO3	2	2	3	-	3	-	-	-	1	1	-	1	-	1	-
CO4	3	-	-	-	3	-	-	-	1	1	-	1	-	1	-
CO5	2	2	3	-	3	-	-	-	1	1	-	1	-	1	-
CO	**2.6**	**2**	**3**	**-**	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**1**	**-**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Regulations 2024						
Department	**Electrical and Electronics Engineering**				**Programme Code**	**1051**
I Semester						
COURSE CODE	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24GE23001	**ENGINEERING PRACTICES LABORATORY**	**0**	**0**	**3**	**1.5**	**100**
Objectives	• To learn the concepts of electrical wiring and power measurements. • To study the concepts of electronic devices					
Outcomes	At the end of the course, students will be able to: 1. Demonstrate the domestic wiring and power measurements. 2. Demonstrate the operation of Electric Circuits and PN Junction Diode					

LIST OF EXPERIMENTS		
1	Residential House Wiring using Switches, Fuse, Indicator, Lamp and Energy meter	
2	Two way, CFL and LED Lamp Wiring	
3	Measurement of Voltage, Current and Power	
4	Measurement of Energy using Single Phase Energy Meter	
5	Soldering Practice –Assembly of Electronic Components	
6	Verification of Logic Gates	
7	V-I Characteristics of PN Junction and Zener Diode	
8	Half Wave and Full Wave Rectifiers	
	Total	**45 Hours**

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	1	-	-	-	1	1	-	1	-	-	-
CO2	3	-	-	-	1	-	-	-	1	1	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO	**3**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**-**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRAENGINEERINGCOLLEGE(Autonomous)							
Syllabus						Regulations2024	
Department	MATHEMATICS		Programme Code				
SEMESTER –II							
Course code	Course Name	Hours/week				Credit	Maximum marks
24MA12201	ENGINEERING MATHEMATICS- II (Common to all Branches)	L	T	P		C	100
		3	1	0		4	
Objectives	To enable the students to: • Define vector function, operators and working procedure to evaluate line, surface and volume integrals. • Explain different types of higher order ordinary differential equations with variable coefficients and various methods to solve the equations. • Learn Laplace transform, inverse Laplace transform and its properties to solve differential equations. • Know about functions of complex variables, properties and problems involving conformal mapping. • Learn about Taylor's and Laurent's series expansion of complex functions and the process of evaluating complex integrals.						
Outcomes	At the end of the course the students will be able to • Solve problems related to vector differentiation, line, surface and volume integrals and theorems involving them. • Solve higher order differential equations with variable coefficients. • Describe Laplace transform and its properties inverse Laplace transform and the solution of linear differential equation using Laplace transform techniques. • Solve Analytic functions, harmonic functions, conformal mapping and its applications. • ExpandthefunctionsasTaylor'sandLaurent'sseriesandevaluatethecomplex integrals.						
UNIT-I	VECTORCALCULUS						9+3
GradientDivergenceandCurl–Directionalderivative–Irrotationalandsolenoidalvectorfields–Vectorintegration–Green's theoreminaplane,GaussdivergencetheoremandStokes'theorem(excluding proofs).Verificationand applicationinevaluatingline,surfaceandvolume integrals.							
UNIT -II	ORDINARYDIFFERENTIAL EQUATIONSOFHIGHER ORDERS						9+3
Second and Higher order linear differential equations with constant coefficients– Method of variation ofparameters – Cauchy Euler equation, Legendre's type differential equations – System of simultaneouslineardifferential equations with constant coefficients.							
UNIT-III	LAPLACETRANSFORM						9+3
Transform,PropertiesofLaplaceTransform,Laplacetransformofperiodicfunctions.Findinginverse Laplacetransformbydifferentmethods,convolutiontheorem,solvingInitialvalueproblemsbyLaplaceTransform method.							
UNIT-IV	ANALYTICFUNCTIONS						9+3

Functionsofacomplexvariable,Cauchy-Riemannequations–Analyticfunctions– Harmonicandorthogonalpropertiesofanalyticfunction–Harmonicconjugate– Constructionofanalyticfunctions– Conformalmapping:w=z+c,cz,1/z,andBilineartransformation.		
UNIT -V	**COMPLEXINTEGRATION**	**9+3**
Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integralformula(withoutproof)–TaylorandLaurentexpansions–TypesofSingularities-Singularpoints– Residues–Residuetheorem(withoutproof)–Applicationofresiduetheoremtoevaluaterealintegrals– Contourintegration.		
Total		**(L:45+T:15):60Periods**

TEXTBOOK:	
1	B.S.Grewal,HigherEngineeringMathematics,KhannaPublishers,2017.
2	ErwinKreyszig,AdvancedEngineeringMathematics,JohnWiley&Sons, 2018.
REFERENCES:	
1	MichaelD.Greenberg,AdvancedEngineeringMathematics,Pearson2013.
2	LokenathDebnathandDambaruBhatta,"IntegralTransformsandTheirApplications,CRC Press2015.
3	DennisG.ZillandWarrenS.Wright"Advanced EngineeringMathematics",JonesandBartlett2014.

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	1	-	-	-	-	-	1	-	-	-
CO2	3	-	-	-	-	1	-	-	-	-	-	1	-	-	-
CO3	2	-	-	-	-	1	-	-	-	-	-	1	-	-	-
CO4	3	-	-	-	-	1	-	-	-	-	-	1	-	-	-
CO5	2	-	-	-	-	1	-	-	-	-	-	1	-	-	-
CO	**2.6**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**

Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

MAHENDRA ENGINEERING COLLEGE (Autonomous)-Syllabus						R 2024
DEPARTMENT:	SCIENCE &HUMANITIES		Programme Code & Name			CY&CHEMISTRY
SEMESTER – I (For Non Circuit Branches & ECE) & SEMESTER – II (For Circuit Branches & Except ECE)						
COURSE CODE	COURSE NAME	HOURS/WEEK			CREDIT	MAXIMUM MARKS
		L	T	P	C	
24CY12001	ENGINEERING CHEMISTRY	3	0	0	3	100

Objectives	To make the students familiar with: 1. The treatment of water used for domestic and industrial purpose. 2. Various types of polymers in our day today life. 3. The basic principle and preparation methods of Nanomaterials. 4. The Construction and applications of different types of batteries. 5. The preparation, properties and combustion method of fuels.
Outcomes	At the end of the course the student will be able to 1. Explain the various water quality parameters and theirtreatments fordomestic and industrial applications. 2. Classify the reaction mechanism, synthesis and application of polymers. 3. Develop the essential concepts of nanoscience and nanotechnology in designing the nanomaterial for Engineering. 4. Compare the working principles of batteries and super capacitors. 5.Illustrate the suitable fuels for engineering processes and applications.

UNIT-I	**WATER TECHNOLOGY**	9

Types of water- Alkalinity,types and determination- Hardness,types andEstimationby EDTA method. Domestic water treatment – disinfection methods (Chlorination, ozonation, UV treatment) – Boiler feed water – requirements – Decreased efficiency of using hard water in boilers – external conditioning – demineralization process, Electro dialysis process, reverse osmosis - Internal conditioning (phosphate, calgon and carbonate conditioning methods) – Conservation of Water using 3R method– WHO and BIS guidelines for drinking water.

UNIT-II	**POLYMER CHEMISTRY**	9

Introduction - Classification of polymers – Natural and synthetic - Thermoplastic and Thermosetting - Functionality – Degree of polymerization - Types and mechanism of polymerization: Addition (Free Radical); condensation and copolymerization - Preparation, properties & applications of selected commodity and engineering polymers (Polyester, Polystyrene, PVC, Nylon, Teflon, Bakelite and Epoxy resin).

UNIT-III	**NANOCHEMISTRY**	9

Basic -Distinction between molecules, nanoparticles and bulk materials - size-dependent properties (optical, electrical, mechanical and magnetic) - Types of nanomaterials: Definition, properties and uses of – nanoparticles ,nanocluster, nanorod, nanotube and nanowire - Synthesis of nanomaterials: laser ablation, Sol gel, Synthesis of Carbon nano tubes by CVD Method- SWCNT and MWCNT- Applications (Medicine, Agriculture and Electronics).

UNIT-IV	**ENERGY STORAGE DEVICE**	9

Types of batteries - Primary battery - dry cell - Secondary battery - Construction and application of lead acid battery and Lithium ion batteries – Battery used in EV application – Nuclear energy – Fissionand

Fusionreactions –Light water nuclear reactor for power generation (block diagram only) - Fuel cell (H_2-O_2) - Super Capacitors.		
UNIT-V	**FUELS AND COMBUSTION**	9
Introduction - classification of fuels - Coal - analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - Petroleum - manufacture of synthetic petrol (Bergius process) - calorific value - higher and lower calorific values- theoretical calculation of calorific value - ignition temperature - spontaneous ignition temperature - flue gas analysis (ORSAT Method).		
	Total Hours	**45**
TEXT BOOK :		
1.	Jain P.C. and Monica Jain, "Engineering Chemistry", DhanpatRai Publishing Company (P) Ltd., New Delhi, 2022.	
2.	Kannan P., Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2021.	
3.	Dara S.S, Umare S.S, "Engineering Chemistry", S. Chand & Company Ltd., New Delhi 2019.	
4.	Lindsay S.M., "Introduction to Nanoscience" Oxford University, 2009.	
REFERENCES		
1.	Dr.C.K.Charles and Dr.G.Ramachandran, "Applied Chemistry", CARS Publishers,Chennai,2015	
2.	Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company, Ltd., New Delhi, 2012.	
3.	Linden's "Handbook of Batteries", Thomas B. Reddy, Fourth Edition McGraw-Hill, New York, 2011.	
4.	ShikhaAgarwal,"Engineering Chemistry-Fundamental and Application",Cambridge University press,Delhi,Second Edition,2019.	

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	1	-	-	-	-	1	-	-	-
CO2	2	-	-	-	-	-	1	-	-	-	-	1	-	-	-
CO3	2	2	3	-	-	-	-	-	-	-	-	1	-	-	-
CO4	3	-	-	-	-	-	1	-	-	-	-	1	-	-	-
CO5	3	-	-	-	-	-	1	-	-	-	-	1	-	-	-
CO	**2.4**	**2**	**3**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

SYLLABUS - REGULATION - 2024

SEMESTER – I (Non-Circuit Branches)SEMESTER- II (Circuit Branches)

Course Code	Course Name	Hours / Week			Credit	Maximum Marks
		L	T	P	C	
24HS11001	**COMMUNICATIVE ENGLISH** (Common to all B.E/B.Tech Degree Programmes)	3	0	0	3	100

Objectives	• To help learners to improve their knowledge of grammar • To enable them to use vocabulary appropriately in different academic and professional contexts • To support learners to acquire listening and speaking skills • To facilitate them to develop their reading skills by familiarizing different types of reading strategies • To equip them with writing skills needed for academic as well as professional context
Outcomes	At the end of the course, the learners will be able to • Develop listening and reading skills and comprehend the academic articles in English • Develop vocabulary skills and use words appropriately in different academic contexts. • Analyze and interpret the data with correct usage of grammar • Demonstrate effective LSRW skills with emerging technology • Create strong communication skills in both personal and professional life

UNIT I **9Hrs**

Listening- Listening to Short Conversations (Formal and Informal)
Speaking – Introducing Oneself and Others
Reading – Skimming and Scanning-Reading Comprehension Passages and Answering Multiple Choice Questions
Writing - Leave/On Duty application, Bonafide Certificate-requisition, Check list, Instructions
Grammar & Vocabulary – Parts of Speech, Articles, Prefixes and Suffixes

UNIT II **9Hrs**

Listening – Listening to Telephonic Conversations
Speaking –Word Building Activity
Reading – Short stories
Writing- Recommendations, Composing E-Mail(Formal & Informal), Letter Writing- Letter to the Editor
Grammar & Vocabulary – Sentence Pattern, Tenses, British Terms and American Equivalents

UNIT III **9Hrs**

Listening - Listening to TED Talks and Note taking
Speaking – Role Play
Reading –Cloze Reading and Fill up the Gaps
Writing - Letter Writing – Permission Letter(In-Plant Training/Industrial Visit), Business letters-Calling for Quotation and Placing Order
Grammar & Vocabulary – Modal Verbs,Voice- Active Voice, Passive Voice and Impersonal

Passive, Numerical Expressions	
UNIT IV	**9Hrs**
Listening - Listening to Audio Lectures **Speaking** – Taking part in Casual Conversation **Reading** - Reading Advertisements **Writing** – Poster Making, and Job Application **Grammar & Vocabulary** – Cause and Effect Expressions, Question tags, Gerunds and Infinitives, One word substitution	
UNIT V	**9Hrs**
Listening – Listening to Academic lectures **Speaking** – Describing Objects **Reading** – Transcoding (Conversion of Flow Chart, Bar chart, Pie chart into a paragraph) **Writing** –Review writing (Films & Books), Essay Writing **Grammar & Vocabulary**– If Conditionals,Concord, Same Word used as Noun and Verb, Nominal Compounds	
Total Hours	**45**

Textbook:	
1	Murphy, Raymond, *English Grammar in Use*, Fifth Edition. Cambridge University Press, New Delhi, 2019
2	N.P.Sudharshana and C.Savitha, *English For Technical Communication*, Cambridge University Press, New Delhi, 2016
Reference Books:	
1	Lewis Norman, *Word Power Made Easy,*Goyal Publishers: New Delhi. 2020.
2	Ashraf Rizvi.*Effective Technical Communication*, Tata McGraw Hill, 2017.
3	Jack C. Richards with Jonathan Hull and Susan Proctor, *Interchange*. 4th Edition, Cambridge University Press, New Delhi, 2016
Extensive Reading:	
1	Khera, Shiv. *You can Win*. Macmillan, Delhi. 2014
Websites:	
1	http://www.englishclub.com
2	http://www.talkenglish.com
3	https:// www.ted.com/talks
4	https://nptel.ac.in/

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	1	1	1	1	3	-	2	-	-	-
CO2	-	-	-	-	-	1	1	1	1	3	-	2	-	-	-
CO3	-	-	-	-	-	1	1	1	1	3	-	2	-	-	-
CO4	-	-	-	-	-	1	1	1	1	3	-	2	-	-	-
CO5	-	-	-	-	-	1	1	1	1	3	-	2	-	-	-
CO	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**1**	**3**	**-**	**2**	**-**	**-**	**-**

Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

MAHENDRA ENGINEERING COLLEGE
(Autonomous)

II Semester

Course Code	Course Name	Hours / Week			Credit	Maximum marks
		L	T	P	C	
24GE33201	**ENGINEERING GRAPHICS AND DESIGN** (Common to circuit Branches)	2	0	0	2	**100**

Objective(s)

- Increase ability to communicate with engineers through drawing skills as per the standard,
- Learn to sketch and take field dimensions,
- Learn to take data and transform it into graphic drawings,
- Learn basic Autocad skills,
- Learn basic engineering drawing formats.

Examination Pattern: Theoretical Mode

UNIT -I Plane Curves and Free Hand Sketching — **HOURS 12**

Introduction to engineering drawing and standards, Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloid –involutes, define tangents and normal.

Free Hand Sketching:

Representation of Three Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement – First angle projection – layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

UNIT- II Projection of Points, Lines and Plane Surfaces — **HOURS 12**

Projection of points and straight lines located in the first quadrant – Determination of true lengths and true inclinations – Projection of polygonal surface and circular lamina inclined to both reference planes.

Examination Pattern: Practical Mode

UNIT- III Introduction to CADD — **HOURS 12**

Basics of CADD- Working with drawing –Editing, Modifying commands and Layers.

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.

UNIT- IV Section of Solids and Development of Surfaces — **HOURS 12**

Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – Obtaining true shape of section. Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones –Development of lateral surfaces of solids with cylindrical cutouts, perpendicular to the axis.

UNIT -V Isometric and Perspective Projections — **HOURS 12**

Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones. Perspective projection of prisms, pyramids and cylinders by visual ray method.

Total hours 60

Outcome(s)

- Students ability to indicate proper dimensions on drawings will improve.
- Students ability to perform basic sketching techniques will improve.
- Students will become familiar with office practice and standards.
- Students will become familiar with Autocad two dimensional drawings.
- Students will be able to improve their visualization skills so that they can apply these skills in developing new products.

LIST OF EQUIPMENTS(for a batch of 30 students)	
List of Equipments: 1. Computer systems-30 No 2. Licensed software for Drafting and Modeling. - 30 Licenses 3. Laser Printer or Plotter to print / plot drawings - 1 No	
TEXT BOOKS:	
1.	Bhatt,N.D; Panchal,V.M "Engineering Drawing:Plane and solid Geometry" Charotar Publishing House Pvt. Ltd.Charotar Publishing House Pvt. Ltd.Gujarat 388001
2.	N S Parthasarathy and Vela Murali, "Engineering Drawing" Oxford University Press 2015.
3.	K. Venugopal& V. Prabhu Raja, "Engineering Graphics", New Age International (P) Limited, 2011
4.	K. V. Natrajan, "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2012
REFERENCES:	
1.	M.B. Shah and B.C. Rana, "Engineering Drawing", Pearson Education 2005.
2.	K. R. Gopalakrishnana, "Engineering Drawing" (Vol.I&II), Subhas Publications 1998.
3.	Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
4.	DhananjayA.Jolhe, "Engineering Drawing with an introduction to AutoCAD" Tata McGraw Hill Publishing Company Limited 2008.

COURSE ARTICULATION MATRIX::

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	1	1	1	-	1	-	1	-	1	-
CO2	2	-	-	-	-	1	1	1	-	1	-	1	-	1	-
CO3	2	-	-	-	3	1	1	1	-	1	-	1	-	1	-
CO4	2	-	-	-	3	1	1	1	-	1	-	1	-	1	-
CO5	2	-	-	-	3	1	1	1	-	1	-	1	-	1	-
CO	**2**	**-**	**-**	**-**	**3**	**1**	**1**	**1**	**-**	**1**	**-**	**1**	**-**	**1**	**-**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Regulations 2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**	**1051**	
II Semester						
Course Code	**Course name**	**HOURS/WEEK**			**CREDIT**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE14201	**ELECTRIC CIRCUIT ANALYSIS**	**2**	**1**	**0**	**3**	**100**
Objective(s)	• To impart basic knowledge of electrical terminology • To study the concepts of Network theorems • To impart knowledge on series and parallel Resonance circuits • To explore the concepts of steady state and transient response for RLC circuits • To learn the concepts of balanced and unbalanced three phase circuits					
Outcome(s)	At the end of the course, students shall be able to 1. Apply circuit theory concepts for DC and AC circuits 2. Apply theorems and reduction methods for electrical networks 3. Analyze the frequency response of resonance circuits 4. Estimate the transient response of RL, RC & RLC circuits 5. Determine the parameters of three phase circuits					
UNIT I	**BASICCIRCUITS ANALYSIS**					**(9)**
Basics of R, L, and C elements, Dependent and Independent sources-complex impedance-real and reactive power- Formation of matricesfor complex circuits using mesh-current and nodal-voltage methods.						
UNIT II	**NETWORK REDUCTION AND NETWORK THEOREMSFOR DC AND AC CIRCUITS**					**(9)**
Network reduction - voltage and current division, source transformation – star delta conversion. Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem and Reciprocity Theorem.						
UNIT III	**RESONANCE AND COUPLED CIRCUITS**					**(9)**
Resonant circuits-series, parallel, series-parallel circuits-effect of variation of Q on resonance. Relations between circuit parameters- Q, resonant frequency and bandwidth. Inductively coupled circuits-single tuned and double tuned circuits - bandwidth and frequency response.						
UNIT IV	**TRANSIENTS**					**(9)**
Transient response of RL, RC and RLC circuits with DC excitation-Natural and forced responses - AC transients –Solutions using Laplace transform for transient solution.						
UNIT V	**THREE PHASE CIRCUITS**					**(9)**
Three phase balanced/unbalanced voltage sources phase sequence – Analysis of three phase 3 wire and 4 wire circuits with star and delta connected loads, balanced & un balanced loads - power and power factor measurements in three phase circuits.						
					Total	**L:30 T:15:45 Hours**

TEXT BOOKS

1. Charles K. Alexander and Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", McGraw-Hill, Fifth edition 2018.
2. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis",Tata McGrawHill.2013
3. Joseph Edministor and Nahvi (Mohmood), 'Theory & Problems of Electric Circuits', Fifth edition, McGraw Hill, 2011

REFERENCES	
1.	Murthy K.V.V., Kamath M.S., "Basic Circuit Analysis", Jaico Publishing House, Second Edition,2015
2.	William H. Hayt, Jr Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis", Tata MC GrawHill, Seventh edition, 2010
3.	David E. Johnson, Johny R. Johnson and John L. Hilburn, "Electric Circuit Analysis", Prentice-Hall Int., Second Edition, 2016.
4.	Chakrabati A, "Circuits Theory-Analysis and synthesis)",DhanpathRai& Sons, New Delhi, Seventh Edition, 2021.
5.	**NPTEL :** **Prof. S.C. Dutta Roy, "Circuit Theory", IIT Delhi**https://nptel.ac.in/courses/108/102/108102042/ **Prof. Ankush Sharma, "Basic Electric Circuits", IIT Kanpur** https://nptel.ac.in/courses/108/104/108104139/

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	1	1	-	1	-	1	1	-	1
CO2	3	-	-	-	-	-	1	1	-	1	-	1	1	-	1
CO3	2	3	-	-	-	-	1	1	-	1	-	1	1	-	1
CO4	2	3	-	-	-	-	1	1	-	1	-	1	1	-	1
CO5	3	-	-	-	-	-	1	1	-	1	-	1	1	-	1
CO	**2.6**	**3**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**1**	**1**	**-**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE

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Accredited by NBA Tier-I (WA) UG : CSE, ECE, EEE
Mahendhirapuri, Mallasamudram (W), Namakkal (Dt) - 637 503, Tamil Nadu
04288-288 500 / 521 / 522 | www.mahendra.info

Regulations 2024

Semester - II
(Common to all B.E./B.Tech. Programmes)

Course Code	Course Name	Periods/Week			Credit	Maximum Marks
		L	T	P	C	
24HS11003	தமிழரும் தொழில்நுட்பமும்	1	0	0	1	100

அலகு 1	நெசவுமற்றும் பானைத் தொழில்நுட்பம்	3

சங்ககாலத்தில்நெசவுத் தொழில்–பானைத் தொழில்நுட்பம் – கருப்புசிவப்புபாண்டங்கள்–பாண்டங்களில்கீறல்குறியீடுகள்

அலகு 2	வடிவமைப்புமற்றும் கட்டிடத் தொழில்நுட்பம்	3

சங்ககாலத்தில்வடிவமைப்புமற்றும் கட்டுமானங்கள்&சங்ககாலத்தில் வீட்டுப் பொருட்களில்வடிவமைப்பு–சங்ககாலத்தில்கட்டுமானபொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில்மேடைஅமைப்பு பற்றிய விவரங்கள்–மாமல்லபுரச் சிற்பங்களும்,கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள்மற்றும் பிறவழிபாட்டுத் தலங்கள்–நாயக்கர் காலக் கோயில்கள்–மாதிரிகட்டமைப்புகள் பற்றி அறிதல், மதுரைமீனாட்சிஅம்மன் ஆலயம் மற்றும் திருமலைநாயக்கர் மஹால்–செட்டிநாட்டுவீடுகள்–பிரிட்டிஷ்காலத்தில்சென்னையில்இந்தோ–சாரோசெனிக் கட்டிடக் கலை.

அலகு 3	உற்பத்தித் தொழில்நுட்பம்	3

கப்பல்கட்டும் கலை–உலோகவியல்–இரும்புத் தொழிற்சாலை–இரும்பைஉருக்குதல், எஃகு–வரலாற்றுச் சான்றுகளாகசெம்புமற்றும் தங்கநாணயங்கள்–நாணயங்கள்அச்சடித்தல்–மணிஉருவாக்கும் தொழிற்சாலைகள்–கல்மணிகள், கண்ணாடிமணிகள்–சுடுமண் மணிகள்–சங்குமணிகள்–எலும்புத் துண்டுகள்–தொல்லியல்சான்றுகள்–சிலப்பதிகாரத்தில்மணிகளின் வகைகள்.

அலகு 4	வேளாண்மைமற்றும் நீர்ப்பாசனத் தொழில்நுட்பம்	3

அணை, ஏரி, குளங்கள், மதகு–சோழர்காலக் குமிழித் தூம்பின் முக்கியத்துவம் – கல்நடைபராமரிப்பு–கால்நடைகளுக்காகவடிவமைக்கப்பட்ட கினறுகள்–வேளாண்மைமற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள்–கடல்சார் அறிவு–மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல்–பெருங்கடல் குறித்த பண்டையஅறிவு–அறிவுசார் சமூகம்.

அலகு 5	அறிவியல்தமிழ்மற்றும் கணித்தமிழ்	3

அறிவியல்தமிழின் வளர்ச்சி –கணித்தமிழ்வளர்ச்சி –தமிழ்நூல்களைமின்பதிப்புசெய்தல்–தமிழ்மென்பொருட்கள்உருவாக்கம் – தமிழ்இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில்தமிழ்அகராதிகள்–சொற்குவைத் திட்டம்,

TOTAL – 15 PERIODS

MAHENDRA ENGINEERING COLLEGE (Autonomous)- Syllabus			R 2024
DEPARTMENT:	**SCIENCE & HUMANITIES**	**Programme Code & Name**	**CY & CHEMISTRY**

SEMESTER – I (For Non Circuit Branches & ECE) &SEMESTER – II (For Circuit Branches (Except ECE))

COURSE CODE	COURSE NAME	HOURS/WEEK			CREDIT	MAXIMUM MARKS
		L	T	P	C	
24CY22001	**CHEMISTRY LABORATORY (Any eight experiments to be conducted)**	0	0	3	1.5	100

Objectives	▪ To inculcate experimental skills to test basic understanding of water quality parameters, such as, alkalinity, hardness, DO and chloride. ▪ To induce the students to familiarize with electro analytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions. ▪ To design and plan the experimental procedure and to record and process the results.
Outcomes	On completion of this course, students will have the knowledge in ▪ Explain the essential principles and their analysis of water quality parameters, like hardness, alkalinity, DO, and chloride. ▪ Experiment with different types of instruments for analysis of materials using small quantities involved for quick and accurate results. ▪ Analyze the normality of different types of materials such as PVA and Ferrous ion.
1.	Determination of Total, Temporary & Permanent hardness of water using EDTA method.
2.	Determination of the Alkalinity level of a water sample.
3.	Determination of Chloride content of water sample by Argentometry.
4.	Determination of DO content of water sample using Winkler's method.
5.	Determination of molecular weight of polyvinyl alcohol using Viscometry.
6.	Estimation of Iron content of the given solution using Potentiometry.
7.	Determination of strength of given hydrochloric acid using pH meter.
8.	Conductometric titration of strong acid vs strong base.
9.	Determination of strength of acids in a mixture using Conductometry.
10.	Estimation of sulphate in a solution using Conductometry (precipitation).
TEXT BOOK	
1.	Chemistry lab Manual, Department of Chemistry, Mahendra Engineering College, Mallasamudram, 2022.
2.	Chemistry lab Manual, Department of Chemistry, Mahendra Engineering College, Mallasamudram, 2020.
REFERENCES	
1.	Applied chemistry theory and practice by O. P. Vermani and A. K. Narula, second edition.
2.	J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, Vogel's Textbook of Quantitative Chemical Analysis (2009).
3.	Kolthoff I.M. and Sandell E.B. et al. Quantitative chemical analysis, Mcmillan, Madras 1980

S.No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	2	-	-	-	-	-	-	1	2	-	-	-	-	-	-
C02	3	-	-	-	-	-	-	1	2	-	-	-	-	-	-
C03	2	3	-	-	-	-	-	1	2	-	-	-	-	-	-
Avg.	**2.3**	**3**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**

Syllabus - Regulation 2024

Department	**English**

Semester I – Non-Circuit Branches
Semester II – Circuit Branches
(Common to all B.E./B.Tech. Programmes)

Course code	**Course Name**	**Hours/week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
24HS21001	**PERSONALITY DEVELOPMENT PRACTICE**	0	0	2	1	**100**

Objectives	• To develop listening and speaking skills of students for a variety of purposes like making presentations, attending interviews and participating in discussions • To enhance the non-verbal and social interaction skills of students for becoming effective communicators • To enable learners to hone their linguistic (LSRW) skills with the help of Technology
Outcomes	**At the end of the course, the students will be able to** • Understand the language proficiency and its techniques • Prepare the resume with organized details • Develop soft skills to excel in their career

LIST OF EXERCISES

1.	Importance of Communication Skills
2.	Building Vocabulary (Basic level)
3.	Stage Dynamics (Group PPT Presentation)
4.	Predicting the Content of a Given Article (Newspaper, Magazine, etc.,)
5.	Common Errors in English
6.	Interview Skills
7.	Presentation skills
8.	Group Discussion
9.	Soft Skills(Self-Confidence, Team Work, Time Management, Adaptability, Openness to Criticism)
10.	Creative Writing – Any Essay type (Descriptive, Narrative etc.)

Total Hrs : 15

REFERENCE BOOKS:

1. Joshi, Manmohan, ***Soft Skills***, 1st Edition. Bookboon, 2017
2. Raman, Meenakshi&Sangeeta Sharma. ***Technical Communication: Principles and Practice,*** Ed.III, Oxford University Press, New Delhi. 2015

Online Websites:

https:// www.ted.com/talks, https://quizziz.com, www.pdfdrive.com
https://www.calameo.com/read/00072308558ed20d410e7/

Activity: Worksheets for relevant topics

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	1	1	-	1	2	-	1	-	-	-
CO2	2	-	-	-	-	1	1	-	1	2	-	1	-	-	-
CO3	3	-	-	-	-	1	1	-	1	2	-	1	-	-	-
CO	**3**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**2**	**-**	**1**	**-**	**-**	**-**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE(Autonomous)						
Regulations 2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Semester II						
COURSE CODE	**COURSE NAME**	**Hours/Week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE24201	**ELECTRIC CIRCUIT LABORATORY**	**0**	**0**	**3**	**1.5**	**100**
Objective(s)	• To learn the concepts of electric circuits • To studythe transient and frequency response of resonance circuits • To compute three phase balanced and unbalanced star/delta connected networks					
Outcome(s)	On completion of this course, students will be able to 1. Apply theorems for electric circuits 2. Demonstrate the frequency and transient response of RLC circuits 3. Apply the concepts of three phase balanced and unbalanced star/delta connected networks					

LIST OF EXPERIMENTS	
1.	Verification of Ohm's laws and Kirchoff's laws
2.	Simulation of mesh and nodal analysis.
3.	Verification of Thevenin's and Norton's Theorem
4.	Verification of superposition Theorem
5.	Verification of reciprocity theorem and maximum power transfer theorem.
6.	Simulation of series and parallel circuits
7.	Transient response of RL and RC circuits for DC input.
8.	Frequency response of series and parallel resonance circuits.
9.	Frequency response of single tuned coupled circuits.
10.	Simulation of three phase balanced and unbalanced star & delta connected networks.
	Total **45 Hours**

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	1	1	1	1	2	1	-	1	1	1	1
CO2	3	-	-	-	1	1	1	1	2	1	-	1	1	1	1
CO3	3	-	-	-	1	1	1	1	2	1	-	1	1	1	1
CO	**3**	**-**	**-**	**-**	**1**	**1**	**1**	**1**	**2**	**1**	**-**	**1**	**1**	**1**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus					**Regulations2024**	
Department	**MATHEMATICS**	**ProgrammeCode**				
III Semester						
Course code	**Course Name**	**Hours/week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
24MA12301	**TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS (Aero, Aerospace, Agri, Chemical, Civil, EEE, ECE, Food, Mech, MCT &Pharma)**	3	1	0	4	**100**
Objective(s)	To enable students to • Acquire knowledge of Z- transform to solve difference equations. • Learn about Fourier transforms, inverse Fourier transform and its properties and apply convolution theorem and Parseval's identity to various functions. • Construct Fourier series of various functions and to compute harmonics of Fourier series. • Understand the partial differential equation concepts. • Study the method of separation of variables and solving boundary value problems using Fourier series.					
Outcome(s)	At the end of the course, the students will be able to • Apply the knowledge of Z-transform to the analysis of digital filters and discrete signals. • Solve the problems using Fourier integral and convolution theorem technique. • Apply Fourier series techniques in solving heat flow problem used in various situations. • Formulate and solve first and higher order partial differential equations. • Solve real time Engineering problems using Partial differential equations.					
UNIT-I	**Z -TRANSFORMS AND DIFFERENCE EQUATIONS**					**9+3**
Z-transforms - Elementary properties – Inverse Z-transform – Partial fraction and Residue method-Convolution theorem -Formation ofdifference equations – Solution of difference equations using Z-transform.						
UNIT-II	**FOURIER TRANSFORMS**					**9+3**
Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.						
UNIT-III	**FOURIER SERIES**					**9+3**
Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic Analysis.						
UNIT-IV	**PARTIAL DIFFERENTIAL EQUATIONS**					**9+3**

Formation of partial differential equations – Solutions of standardtypes of first order partial differential equations – Lagrange's linear equation – Homogeneous linear partial differential equations of second and higher order with constant coefficients.		
UNIT-V	**APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS**	**9+3**
Solutions of one dimensional wave equation – One dimensional equation of heat conduction –Steady state solution of two-dimensional equation of heat conduction (Insulated edges excluded)– Fourier series solutions in Cartesian coordinates.		
	Total hours to be taught	**(L:45+T:15): 60PERIODS**

TEXT BOOK :	
1	Dr.P.Kandasamy ,Dr.K.Thilagavathy and Dr.K.Gunavathy, " Engineering Mathematics Volume – III",S.Chand& company Ltd. New Delhi, 2012.
2	Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2008.
REFERENCES:	
1	Erwin Kreyszig, Advanced Engineering Mathematics.2011, John Wiley & Sons, 2010.
2	Bali N. Pand Manish Goyal, "A Text book of Engineering Mathematics", Laxmi Publications Pvt Ltd., 2012.
3	Veerarajan.T, "Transforms and Partial Differential Equations" , Tata McGraw Hill, 2011.

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	1	-	-	-	-	-	1	-	-	-
CO2	3	-	-	-	-	1	-	-	-	-	-	1	-	-	-
CO3	3	-	-	-	-	1	-	-	-	-	-	1	-	-	-
CO4	2	3	-	-	-	1	-	-	-	-	-	1	-	-	-
CO5	3	-	-	-	-	1	-	-	-	-	-	1	-	-	-
CO	**2.2**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Regulations 2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
III Semester						
COURSE CODE	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE14301	**ANALOG ELECTRONICS**	**3**	**0**	**0**	**3**	**100**
Objectives	• To learn the concepts of Bipolar Junction Transistor • To impart knowledge on feedback amplifiers and oscillators • To study the characteristics of Operational Amplifier ICs • To acquire knowledge on the applications of Operational Amplifier • To study the internal functional blocks of special ICs					
Outcomes	At the end of the course, learners will be able to 1. Infer the characteristics of BJT 2. Design a feedback amplifiers and oscillators using BJT 3. Explain the characteristics of Operational amplifier 4. Summarize the applications of Operational amplifier 5. Elaborate the applications of special ICs					
UNIT I	**BIPOLAR JUNCTION TRANSISTOR**					**(9)**
BJT– Structure – Operation – Characteristics – Biasing methods – Small signal model – Analysis of CE, CB, CC amplifiers – Gain and frequency response – Differential amplifier – Common mode and difference mode analysis – High frequency analysis						
UNIT II	**FEEDBACK AMPLIFIERS AND OSCILLATORS**					**(9)**
Power amplifiers (Qualitative analysis) – Advantages of negative feedback – Voltage / current series, shunt feedback – positive feedback – Condition for oscillations – Phase–shift, Wien bridge, Hartley, Colpitts and Crystal oscillators						
UNIT III	**OPERATIONAL AMPLIFIERAND ITS CHARACTERISTICS**					**(9)**
Ideal characteristics- Inverting and non-inverting- DC characteristics- AC characteristics-Frequency response of Op-Amp- Differential amplifier-Applications-Adder-Subtracter-Differentiator and Integrator circuits						
UNIT IV	**APPLICATION OF OPERATIONAL AMPLIFIER**					**(9)**
Instrumentation amplifiers -First-order and Second order active filters -V to I and I to V converters, Comparators and multi-vibrators, Waveform generators, Clippers and Clampers, Peak detector, D/A converters(Weighted resistance type and R-2R ladder type)-A/D converters(Flash type, Dual slope type and Successive Approximation types)						
UNIT V	**SPECIAL ICs**					**(9)**
555 Timer circuit-Functional block diagram-Characteristics-Applications-Astable and Mono stable multivibrator -566 Voltage Controlled Oscillator circuits-Phase Locked Loop(PLL) applications-Function generator circuit-Linear Voltage regulators						
					Total	**45 Hours**
TEXT BOOKS						
1.	DavidAbell, “Electroniccircuits”, OxfordUniversityPress, Fifth Edition, 2011.					
2.	Ramakant A Gayakwad," Op-Amp and Linear Integrated Circuits ", FourthEdition, Pearson Education/PHI, Fourth Edition, 2012.					

3.	D.RoyChoudary, S.B.Jain," Linear Integrated Circuits", New Age publishers,Third Edition 2014.
REFERENCES	
1.	Millman and Halkias, " Integrated Electronics'' , McGraw Hill Publications, Second Edition, 2017.
2.	Muhammad H,Rashid, "Linear Integrated Circuits " Cengage Learning, First Edition, 2014
3.	**NPTEL :** **Prof.PradipMandal, Analog Electronic Circuits, IIT Kharagpur** https://nptel.ac.in/courses/108105158

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	1	-	-	-	1	-	1	2	-	1
CO2	2	3	-	-	-	1	-	-	-	1	-	1	2	-	1
CO3	2	-	-	-	-	1	-	-	-	1	-	1	2	-	1
CO4	3	-	-	-	-	1	-	-	-	1	-	1	2	-	1
CO5	3	-	-	-	-	1	-	-	-	1	-	1	2	-	1
CO	**2.4**	**3**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**-**	**1**	**2**	**-**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)							
Regulations 2024							
Department	**Electrical and Electronics Engineering**	**Programme Code**					**1051**
III Semester							
Course Code	**Course Name**	**Hours/Week**				**Credit**	**Maximum Marks**
24EE14302	**ELECTROMAGNETIC FIELDS**	**L**	**T**	**P**		**C**	**100**
		3	**1**	**0**		**4**	
Objectives	This course is designed: • To impart knowledge on the concepts of electromagnetic vector fields, electrostatics and their applications. • To impart knowledge on the Electric field intensity and Electric flux density due to various charge distributions. • To familiarize the concepts of magnetostatics, boundary conditions and inductance. • To impart knowledge on the concepts of faraday's law, induced emf and Maxwell's Equation. • To learn the concepts of electromagnetic wave equation, wave propagation and Poynting theorem.						
Outcomes	Upon completion of this course, the Learners will be able to 1. Describe the Electromagnetic quantities in spatial distribution of different Coordinate systems. 2. Explain the behavior of Electric field intensity and Electric flux density due to various charge distributions. 3. Apply the principles of magnetostatics to magnetic field, boundary conditions and inductance. 4. Analyze the concepts related to faraday's law, induced emf and Maxwell's Equation. 5. Apply the concepts of electromagnetic wave equation, wave propagation and Poynting theorem.						
UNIT-I	**VECTOR CALCULAS**						**(9)**
Scalar and vector fields - Coordinate systems; Cartesian, cylindrical and spherical coordinate systems - relationship between coordinate systems - types of integral related to EMF - Gradient - Curl - Divergence theorem – Stoke's theorem							
UNIT-II	**ELECTROSTATICS**						**(9)**
Coulombs' law - Electric field intensity, electric flux density and electric potential due to various charge distributions - Electric field intensity due to infinite line charge, charged circular ring, infinite sheet of charge - Gauss's law and applications - Electric dipole - Boundary conditions - Poisson's and Laplace's equations - Capacitance; capacitance of parallel conductors, capacitance of an isolated sphere, concentric spheres and coaxial cables							
UNIT-III	**MAGNETOSTATICS**						**(9)**
Lorentz law of force - Biot-savart law - Ampere's circuital law - Magnetic field intensity and magnetic flux density - B and H due to finite length of conductorat any point along the axis of circular coil, solenoid and at the center oftoroidal coil - Magnetic dipole - Magnetization - Boundary conditions at the magnetic surface - Magnetic torque - Inductance; self and mutual inductance, inductance of solenoid and toroid-coaxial cable-two transmission lines							

UNIT-IV	ELECTRODYNAMIC FIELDS	(9)
Faraday's law of electromagnetic induction - Coefficient of coupling - Point form of Gauss's law - Maxwell's equation (differential and integral form) - Conduction current - Displacement current – Current densities - Equation of continuity - Energy stored in electric and magnetic fields; energy density - Relation between field theory and circuit theory		
UNIT-V	**ELECTROMAGNETIC WAVES**	**(9)**
Derivation of Electromagnetic wave equations - Wave equations for free space - Wave parameters; velocity, intrinsic impedance - Wave propagation in a lossless medium, wave propagation in a conducting medium, wave propagation in good dielectrics and good conductors - Skin effect - Poynting theorem		
	Total	**45 Hours**

TEXTBOOKS:	
1	Matthew N.O. Sadiku, "Principles of Electromagnetics", International Version, Oxford University Press, Fifth Edition, 2015
2	W.H.HaytJ.A.Buck and M.Jallel Akhtar, "Engineering Electromagnetics", Eighth Edition, McGraw Hill Education (India) Private Limited, Special Indian Edition 2014.
3	K A Gangadhar, 'Electromagnetic Field Theory', Khanna Publishers; Eighth Reprint :2015
REFERENCES:	
1	S.P.Ghosh, LipikaDatta, 'Electromagnetic Field Theory', First Edition, McGraw HillEducation (India) Private Limited, Second reprint 2015.
2	Kraus/Fleisch, "Electromagnetics with Applications", McGraw Hill Education (India), Fifth Edition, 2010.
3	**NPTEL :** **Prof. Pradeep Kumar K, Electromagnetic Theory, IIT Kanpur** https://archive.nptel.ac.in/courses/108/104/108104087/#

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	1	1	1	-	-	-	1	1	-	1
CO2	2	-	-	-	-	1	1	1	-	-	-	1	1	-	1
CO3	3	-	-	-	-	1	1	1	-	-	-	1	1	-	1
CO4	2	3	-	-	-	1	1	1	-	-	-	1	1	-	1
CO5	3	-	-	-	-	1	1	1	-	-	-	1	1	-	1
CO	**2.4**	**3**	**-**	**-**	**-**	**1**	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Regulations 2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
III Semester						
COURSE CODE	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE14303	**ELECTRICAL MACHINES I**	**3**	**0**	**0**	**3**	**100**
Objectives	1. To learn magnetic-circuit analysis and electromechanical energy conversion techniques 2. To impart knowledge on EMF pattern of armature and field windings of DC generators 3. To explore knowledge on operation and characteristics of DC machines 4. To learn the characteristics of transformers 5. To impart knowledge on testing of DC machines and transformers					
Outcomes	At the end of the course, students shall be able to: 1. Explain the basics of magnetic circuits and rotating electrical machines 2. Illustrate the constructional features and principle of operation of DC Generators 3. Analyze the performance of the DC machines under various operating conditions 4. Evaluate the performance of transformers using phasor diagrams and equivalent circuits 5. Apply the testing procedures of DC machines and Transformers					
UNIT I	**ELECTROMAGNET AND ENERGY CONVERSION**					**9**
Faraday's and Lenz's law - Lorentz's force law - B-H relations - flux linkage, inductance – Magnetization curve- AC Excitation - Principles of Energy conversion - Singly and Doubly excited magnetic field systems - Determination of magnetic force - torque from energy and co-energy						
UNIT II	**DC GENERATORS**					**9**
Construction-Principle of operation –EMF equation – Methods of Excitation – Types- No Load and Load Characteristics - Armature reaction-Commutation-Methods of improving commutation –Parallel operation-Losses and Efficiency						
UNIT III	**DC MOTORS**					**9**
Principle of operation-Back EMF – Starters and its methods- Torque equation – condition for maximum power developed - Types – Electrical and mechanical characteristics of DC Shunt, Series and Compound motor-Speed control methods-Testing– Brake test, Swinburne's test and Hopkinson's test						
UNIT IV	**SINGLE PHASE TRANSFORMER**					**9**
Transformers – Principle of operation – Construction – Types –EMF equation - Phasor diagrams - Equivalent circuit - Losses and Efficiency – Regulation and All-day efficiency - Auto Transformer - Testing-Polarity test, Open Circuit, Short Circuit test, Load test – Sumpner's test						
UNIT V	**THREE PHASE TRANSFORMER**					**9**
Transformers – Principle of operation – Construction – Types -Three phase transformer Connections – Scott connection – off load and on load tap changers- Regulation and All-day efficiency- Parallel operation						
					Total	**45 Hours**
TEXT BOOKS						
1.	Nagrath, I.J. and Kothari, D.P., 'Electrical Machines', Tata McGraw - Hill Education Private					

	Limited Publishing Company Ltd., Fifth Edition, 2017.
2.	Dr. P.S. Bhimbra, 'Electrical Machinery', Khanna Publications ,Revised Edition, 2021.
3.	Murugesh Kumar K, "DC Machines & Transformers", Vikas Publishing House Pvt. Ltd., Second Edition, 2004.
REFERENCES	
1.	A.E. Fitzgerald and Charles Kingsley, 'Electric Machinery', Tata McGraw - Hill Publications, Sixth Edition, 2002.
2.	J.B. Gupta, 'Theory and Performance of Electrical Machines', S.K.Kataria and Sons, Fifteenth Edition, 2022.
3.	S.Sarma&K.Pathak "Electric Machines Principles, Applications and Control Schematics", Cengage Learning India (P) Ltd., Delhi Second Edition, 2015.
4.	**NPTEL :** **Dr. D.Kastha –Electrical Machines –I, IIT Kharagpur** http://nptel.ac.in/courses/108105017/

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	1	1	1	-	-	-	1	1	-	1
CO2	2	-	-	-	-	1	1	1	-	-	-	1	1	-	1
CO3	2	3	-	-	-	1	1	1	-	-	-	1	1	-	1
CO4	2	3	-	-	-	1	1	1	-	-	-	1	1	-	1
CO5	3	-	-	-	-	1	1	1	-	-	-	1	1	-	1
CO	**2.2**	**3**	**-**	**-**	**-**	**1**	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE(Autonomous)						
Department	**Electrical and Electronics Engineering**				**Programme Code**	**1051**
III Semester						
Course code	**Course Name**	**Hours/week**			**Credit**	**Maximum marks**
24EE14304	**FUNDAMENTALS OF PYTHON PROGRAMMING**	**L**	**T**	**P**	**C**	**100**
		1	0	0	1	
Objective(s)	• To understand the needs of Python language for developers • To learn basics of flow control • To know the concept of list, Dictionaries and structured data					
Outcome(s)	1. Explain the basics concepts of Python Programming Language 2. Analyze the flow control statements **3.** Apply the data structures concepts in solving computational problems					
UNIT-I	**INTRODUCTION TO PYTHON**					**6**
The Integer, Floating-Point, and String Data Types -String Concatenation - Storing Values in Variables - Assignment Statements-Variable Names-The print Function - The input Function-Printing the User's Name-The len Function -The str(), int(), and float() Functions.						
UNIT-II	**FLOW CONTROL**					**6**
Boolean Logic and Expressions: Boolean Values, Comparison Operators, Boolean Operators, Binary Boolean Operators, the not Operator, Mixing Boolean and Comparison Operators. **Structure of Flow Control:** Elements of Flow Control, Conditions, Blocks of Code, Flow Control Statements. **Conditional Statements:** if Statements, else and elif Statements. **Looping and Control Transfer**while Loop Statements, break Statements.						
UNIT-III	**LISTS, TUPLE AND DICTIONARIES**					**3**
List Fundamentals: List Data Type, Getting Individual Values in a List using Indexes, Negative Indexing in Lists, Getting Sublists using Slices, Getting a List's Length using len(). **List Operations and Control:** Using for Loops with Lists, Using in and not in Operators. **Understanding Data Types:** Mutable and Immutable Data Types. **Other Data Structures:** Tuple – Definition and Usage, Dictionary – Key-Value Pair Representation.						
					Total Hours	**15**

TEXT BOOK :

1	Bill Lubanovic, "Introducing Python", O'Reilly Media, Inc. 2nd Edition, November 2019

REFERENCES:

1	Wesley J. Chun. "Core Python Programming", Second Edition, Prentice Hall-2006
2	Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, "Data Structures and Algorithms in Python",Wiley-2013
3	Kenneth A. Lambert, Fundamentals of Python: First Programs, CENGAGE Learning, 2012

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2				2							2		2	
CO2	2	3			2							2		2	
CO3	3				2							2		2	
CO	**2.3**	**3**			**2**							**2**		2	
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
24HS11006	UNIVERSAL HUMAN VALUES	2	1	0	3	100

(Mandatory Credit Course to All UG Programmes to be offered in III / IV Semester)

Pre-requisites: Universal Human Values 1 (Induction Programme) (desirable)

The foundation course "H-102 Universal Human Values: "Understanding Harmony" may be covered in III or IV semester. This course discusses the role of human beings in their family. It also touches issues related to their role in the society and the nature. During the Induction Program, students would get an initial exposure to human values through Universal Human Values 1. This exposure is to be augmented by this compulsory full semester foundation course. The Course has 5 Modules (5 Units): 30 Lectures and 15 Practice sessions (Tutorials).

1. COURSE OBJECTIVES:

The objectives of the course are:

(i). Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.

(ii). Understanding (or developing clarity) the harmony in the human being, family, society and nature/existence

(iii). Strengthening of self-reflection for harmonious relationship in family, society

(iv). Development of commitment and courage to act as human being in ensuring harmony in nature for co-existence.

(v). Development of holistic principles of harmony and professional ethics for natural acceptance of human values and observe ethical human conduct.

2. COURSE OUTCOMES:

Upon completion of the Course the Learner will be able to:

- Distinguish between values and skills, and highlight the need for Universal Human Values.
- Describe the need for Harmony and distinguish between happiness and accumulation of physical facilities, etc.
- Relate the value of harmonious relationship in family, society based on trust and respect for happiness and prosperity in their life and profession.
- Outline the role of a human being in ensuring harmony in nature for co-existence.
- Apply the holistic principles of Harmony and Professional Ethics for natural acceptance of human values and observe Ethical Human Conduct.

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

L 1. Purpose and motivation for the course, recapitulation from Universal Human Values-I (Induction Programme).

L 2. Self-Exploration–what is it? Its content and process; 'Natural Acceptance' and Experiential Validation-as the process for self-exploration.

L 3. Continuous Happiness and Prosperity - A look at basic Human Aspirations.

L 4. Right understanding, Relationship and Physical Facility - the basic requirements for fulfillment of aspirations of every human being with their correct priority.

L 5. Understanding Happiness and Prosperity correctly - A critical appraisal of the current scenario.

L 6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

3 Practice sessions *(T1 to T3) - 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.*

Module 2: Understanding Harmony in the Human Being - Harmony in Myself!

L 7. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
L 8. Understanding the needs of Self ('I') and 'Body'- happiness and physical facility
L 9. Understanding the Body as an instrument of 'I'(I being the doer, seer and enjoyer)
L 10. Understanding the characteristics and activities of 'I' and harmony in 'I'
L 11. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.
L 12. Programs to ensure Sanyam and Health.

3 Practice sessions *(T4 to T6) - 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.*

Module 3: Understanding Harmony in the Family and Society - Harmony in Human-Human Relationship

L 13. 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.
L 14. Understanding the meaning of Trust; Difference between intention and competence.
L 15. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship.
L 16. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals.
L 17. Visualizing a universal harmonious order in Society-Undivided Society, Universal Order-from family to world family.

3 Practice sessions *(T7 to T9): 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. Discuss Gratitude as a universal value in relationships, scenarios. Elicit examples from students' lives.*

Module4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

L 18. Understanding the harmony in the Nature.
L 19. Interconnectedness and mutual fulfillment among the four orders of nature - recyclability and self-regulation in nature.
L 20. Understanding Existence as Co-existence of mutually interacting units in all - pervasive space.
L 21. Holistic perception of harmony at all levels of existence.

2 Practice sessions *(T10 to T11): 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.*

Module 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics

L 22. Natural acceptance of human values.
L 23. Definitiveness of Ethical Human Conduct.
L 24. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order.
L 25. 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.
L 26. Case studies of typical holistic technologies, management models and production systems.

L 27. 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.
L 28. Definition of Morals, Values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully.
L 29. Importance of Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality.
L 30. Introduction to Yoga and meditation for professional excellence and stress management. *Sum up.*

4 Practice sessions *(T12 to T15) - Include Practice Exercises and Case Studies which will be taken up in Practice (Tutorial) Sessions.*
eg. To discuss the conduct as an Engineer or Scientist, etc.

TOTAL = 45 Hours

3. READINGS:

3.1 Textbook

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010.

3.2 Reference Books

1. JeevanVidya: EkParichaya, ANagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of My Experiments with Truth -by Mohandas Karamchand Gandhi
4. Small is Beautiful - E. F Schumacher.
5. Slow is Beautiful - Cecile Andrews.
6. Economy of Permanence - J C Kumarappa.
7. Bharat Mein Angreji Raj - PanditSunderlal.
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. Mika Martin and Roland Scinger, 'Ethics in Engineering', Pearson Education/Prentice Hall, New York 1996.

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	2	1	3	-	1	-	1	-	-	-
CO2	-	-	-	-	-	2	1	3	-	1	-	1	-	-	-
CO3	-	-	-	-	-	2	1	3	-	1	-	1	-	-	-
CO4	-	-	-	-	-	2	1	3	-	1	-	1	-	-	-
CO5	-	-	-	-	-	2	1	3	-	1	-	1	-	-	-
CO	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**3**	**-**	**1**	**-**	**1**	**-**	**-**	**-**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE(Autonomous)						
Regulations 2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
III Semester						
COURSE CODE	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE24301	**ANALOG ELECTRONICS LABORATORY**	**0**	**0**	**3**	**1.5**	**100**
Objectives	• To learn the operation and applications of electronic devices • To study the characteristics of Operational Amplifiers • To impart knowledge on the applications of Operational Amplifiers					
Outcomes	At the end of the course, students shall be able to, 1. Demonstrate the characteristics and frequency response of Amplifiers 2. Demonstrate the applications of Operational Amplifiers 3. Design a wave shaping and multi-vibrator circuits using Operational Amplifiers					
1.	Characteristics of BJT					
2.	Frequency response of CE amplifier circuit					
3.	Differential Amplifier using BJT					
4.	Design of RC phase shift oscillators					
5.	Design of LC oscillators					
6.	Design an inverting and Non-inverting op-amp					
7.	Design an Instrumentation amplifier using Op amp					
8.	Design of Adder- Subtractor circuits using Op-amp					
9.	Design an analog to digital converter using Op-amp					
10.	a) Design of Wave shaping circuits b) Design an Astable&Monostablemultivibrator using IC555 timer					
					Total	**45 Hours**

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	1	2	1	-	1	1	-	2
CO2	3	-	-	-	-	-	-	1	2	1	-	1	1	-	2
CO3	2	2	3	-	-	-	-	1	2	1	-	1	1	-	2
CO	**2.6**	**2**	**3**	**-**	**-**	**-**	**-**	**1**	**2**	**1**	**-**	**1**	**1**	**-**	**2**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)			
Regulations 2024			
Department	**Electrical and Electronics Engineering**	**Programme Code**	**1051**

III Semester

COURSE CODE	COURSE NAME	Hours/week			Credit	Maximum Marks
		L	T	P	C	
24EE24302	**ELECTRICAL MACHINES I LABORATORY**	**0**	**0**	**3**	**1.5**	**100**

Objectives	• To impart knowledge on performance characteristics of DC Motors • To study the performance characteristics of DC Generators • To learn the performance parameters ofsingle-phase transformer
Outcomes	At the end of the course, students shall be able to 1. Analyze the performance of DC Motors 2. Apply the testing procedures for DC Generator 3. Determine the parameters and performance of a single-phase transformer

LIST OF EXPERIMENTS

1.	Load test on DC shunt motor
2.	Swinburne's test and Speed control on DC shunt motor
3.	Load test on DC series motor
4.	Load test on DC Compound motor
5.	Open circuit and load characteristics onSeparately excited DC generator
6.	Open circuit and load characteristics on DC shunt generator
7.	Load test ondifferential and cumulative DC compound generator
8	Open circuit and short circuit test on single-phase transformer
9.	Load test on single-phase transformer
10.	Sumpner's test on Transformers
	Total **45 Hours**

REFERENCES

1.	Sakshat Virtual Laboratory- Electrical Machines Laboratory Link: http://iitg.vlab.co.in/?sub=61&brch=168

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	-	1	-	-	-	1	1	-	1	1	1	2
CO2	3	-	-	-	1	-	-	-	1	1	-	1	1	1	2
CO3	2	3	-	-	1	-	-	-	1	1	-	1	1	1	2
CO	**2.3**	**3**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**1**	**1**	**2**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)							
Syllabus						**Regulations2024**	
Department	**MATHEMATICS**	**Programme Code**				**1051**	
IV Semester							
Course code	**Course Name**	**Hours/week**			**Credit**	**Maximum marks**	
24MA12404	**NUMERICAL METHODS (AERO, AEROSPACE, CIVIL, EEE & MCTS)**	**L**	**T**	**P**	**C**	**100**	
		3	1	0	4		
Objective(s)	To enable the students to, • Understand the solution of algebraic and transcendental equations and study the methods to solve linear system of equations by direct and iterative methods. • Interpolate the values of a function using Lagrange's, Newton's and cubic spline polynomial approximations. • Evaluate the derivatives from finite differences and evaluate single and double integrals by numerical integration methods. • Gain the knowledge to solve ordinary differential equations by single step and multi-step methods. • Acquire the knowledge to solve boundary value problems in ordinary and Partial differential equations, using finite difference approximations.						
Outcome(s)	At the end of the course the students will be able to • Determine the solution of algebraic and transcendental equations and system of linear equations numerically. • Demonstrate the concepts of interpolations. • Solve numerical differentiation and integration using finite differences. • Apply numerical methods to solve ordinary differential equations. • Solve ordinary and partial differential equations using finite difference methods.						
UNIT-I	**NUMERICAL SOLUTION OF EQUATIONS**						**9+3**
Solution of Algebraic and transcendental equations – Iteration method and Newton Raphson method – Solution of linear system of equations-Gauss elimination and Gauss Jordon methods- Gauss Jacobi and Gauss Seidel methods-Matrix inversion by Gauss Jordon method.							
UNIT -II	**INTERPOLATION AND APPROXIMATION**						**9+3**
Review of difference operators-Interpolation using Lagrange's and Newton's divided difference interpolation-Newton's forward and backward difference interpolation-Interpolating with cubic spline.							
UNIT -III	**NUMERICAL DIFFERENTIATION AND INTRGRATION**						**9+3**

Differentiation using Newton's forward and backward interpolation formula- Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules-Two and Three point Gaussian quatrature formulae-Double integrals using Trapezoidal rule and Simpson's rule.		
UNIT -IV	**NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS**	**9+3**
Ordinary differential equations: Taylor's series, Euler and modified Euler's methods. Runge- Kutta method of fourth order for solving first and second order equations. Milne's and Adam's predicator-corrector methods.		
UNIT -V	**NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS**	**9+3**
Partial differential equations: Finite difference solution two dimensional Laplace equation and Poisson equation, Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods), Finite difference explicit method for waveequation.		
	Total hours to be taught	**(L:45+T:15): 60PERIODS**

TEXT BOOK :	
1	Veerarajan.T, and Ramachandran, T., " Numerical Methods with programming in C" , Tata McGraw Hill, 2007.
2	Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", Tata McGraw-Hill, New Delhi, 2015.
REFERENCES:	
1	Erwin kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2016.
2	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2017
3	Gerald, C.F.and Wheatley, P.O., " Applied Numerical Analysis", 6th Edition, Pearson Education, Asia, New Delhi, 2006.

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	-	-	-	-	-	1	-	-	1	-	-	-
CO2	3	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO3	3	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO4	3	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO5	3	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**-**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Regulations 2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
IV Semester						
Course Code	**Course name**	**HOURS/WEEK**			**CREDIT**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE14401	**DIGITAL ELECTRONICS**	**2**	**1**	**0**	**3**	**100**
Objective(s)	• To expose knowledge on number systems, codes and digital logic families. • To learn thecombinational logic circuits using logic gates • To impart knowledge on synchronous sequential circuits • To acquire knowledge on asynchronous sequential circuits and PLCs. • To impart knowledge on digital simulation for development of application-oriented logic circuits					
Outcome(s)	At the end of the course, the students will be able to, 1. Discuss the concept of number systems, codes and digital logic families 2. Design combinational logic circuits using logic gates 3. Design various synchronous sequential circuits 4. Design Various Asynchronous sequential circuit 5. Summarize the digital simulation for development of application-oriented logic circuits.					
UNIT I	**NUMBER SYSTEMS AND DIGITAL LOGIC FAMILIES**					**(9)**
Review of number systems, binary codes, error detection and correction codes (Parity and Hamming code0- Digital Logic Families ,comparison of RTL, DTL, TTL, ECL and MOS families -operation, characteristics of digital logic family						
UNIT II	**COMBINATIONAL CIRCUITS**					**(9)**
Combinational logic - representation of logic functions-SOP and POS forms, K-map representations-minimization using K maps –Tabulation Methods - simplification and implementation of combinational logic – adders, subtractors-multiplexers and demultiplexers - code converters, Magnitude comparator; Design of seven segment display						
UNIT III	**SYNCHRONOUS SEQUENTIAL CIRCUITS**					**(9)**
Sequential logic- SR, JK, D and T flip flops - level triggering and edge triggering - counters - asynchronous and synchronous type - Modulo counters - Shift registers - design of synchronous sequential circuits – Moore and Melay models- Counters, state diagram; state reduction; state assignment						
UNIT IV	**ASYNCHRONOUS SEQUENTIAL CIRCUITS AND PROGRAMMABLE LOGIC DEVICES**					**(9)**
Asynchronous sequential logic circuits-Transition table, flow table-race conditions, hazards &errors in digital circuits; analysis of asynchronous sequential logic circuits-introduction to Programmable Logic Devices: PROM – PLA –PAL						
UNIT V	**DESIGN USING SOFTWARE(VERILOG / VHDL)**					**(9)**
RTL Design – combinational logic – Sequential circuit – Operators – Introduction to Packages – Subprograms – Test bench. (Simulation /Tutorial Examples: adders, counters, flip-flops, FSM, Multiplexers /Demultiplexers)-HDL based design						
					Total	**45 Hours**
TEXT BOOKS						
1.	Raj Kamal, ‘Digital systems-Principles and Design’, Pearson Education, Second edition, 2014.					

2.	M. Morris Mano, 'Digital Design with an introduction to the Verilog HDL, VHDL and System Verylog', Pearson Education, Sixth Edition , 2018
3.	Comer, "Digital Logic & State Machine Design, Oxford, Third Edition, 2012.
REFERENCES	
1.	Mandal, "Digital Electronics Principles & Application", McGraw Hill Edu, First Edition, 2017.
2.	William Keitz, "Digital Electronics-A Practical Approach with VHDL", Ninth Edition, Pearson, 2013.
3.	Floyd and Jain, 'Digital Fundamentals', Pearson Education, Eighth edition, 2003.
4.	Anand Kumar, "Fundamentals of Digital Circuits", PHI, Second Edition, 2013.
5.	Charles H.Roth,Jr,LizyKurian John, "Digital System Design using VHDL", Cengage, International Edition, 2013.
6.	Gaganpreet Kaur, "VHDL Basics to Programming", Pearson, First edition, 2011.
7.	**NPTEL :** **Prof. IndranilSengupta , Switching Circuits and Logic Design, IIT Kharagpur** https://onlinecourses.nptel.ac.in/noc20_cs67/preview

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	1	-	1	1	-	1
CO2	2	2	3	-	-	-	-	-	-	1	-	1	1	-	1
CO3	2	2	3	-	-	-	-	-	-	1	-	1	1	-	1
CO4	2	2	3	-	-	-	-	-	-	1	-	1	1	-	1
CO5	3	-	-	-	2	-	-	-	-	1	-	1	1	2	1
CO	**2.2**	**2**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**1**	**2**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Regulations 2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
IV Semester						
Course Code	**Course name**	**HOURS/WEEK**			**CREDIT**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE14402	**ELECTRICAL MACHINES II**	**2**	**1**	**0**	**3**	**100**
Objective(s)	• To learn the construction and performance of synchronous machines • To impart knowledge on the basic principles and performance of induction machines • To understand the construction, principle of operation and performance of single-phase induction motors • To learn the concepts of permanent magnets and characteristics of permanent magnet motors • To study the construction, operation, characteristics ofswitched reluctance motor and stepper motors					
Outcome(s)	At the end of the course, students shall be able to, 1. Discuss the construction, working principle and performance of Synchronous Machines 2. Explain the construction, working principle, developing equivalent circuit and performance of three Phase Induction motor 3. Interpret the typesand performanceof single-phase induction motors 4. Describe the construction, operation performance characteristics of permanent magnet motors and its power controllers 5. Illustrate the construction, operation ofswitched reluctance motorand stepper motors					
UNIT I	**SYNCHRONOUS MACHINES**					**(9)**
Synchronous generators – construction, principle and types –Stator windings- armature reaction - load characteristics – voltage regulation –two-reaction theory – parallel operation-Synchronous motors - Synchronous machines on infinite bus bars - phasor diagram - V and inverted-V curves -Hunting and its suppression - starting methods.						
UNIT II	**THREE PHASE INDUCTION MOTORS**					**(9)**
Constructional details – Types of rotors –Rotating Magnetic field- Principle of operation -Need for starting – Types of starters-Equivalent circuit - Torque-Slip characteristics - Condition for maximum torque – Losses and efficiency – Load test - No load and blocked rotor tests – Separation of losses – Speed control methods- Induction generators –Introduction to magnetic levitation systems						
UNIT III	**SINGLE PHASE INDUCTION MOTORS**					**(9)**
Constructional details of single-phase induction motor – Double field revolving theory and operation – Equivalent circuit – No load and blocked rotor test – Performance analysis – Starting methods of single-phase induction motors-Fractional horse power motors						
UNIT IV	**PERMANENT MAGNET MOTORS**					**(9)**
Brushless DC Motor: Construction-Principle of operation- EMF and Torque equations-Characteristics and control.**Permanent Magnet Synchronous Motor:** Construction-Principle of operation – EMF and torque equations - Power controllers–Power Drivers						
UNIT V	**SWITCHED RELUCTANCE MOTORAND STEPPER MOTOR**					**(9)**
Switched Reluctance Motor: Constructional features –Principle of operation- Torque prediction – performance Characteristics-Power controllers – Control of SRM drive- Sensor less operation of SRM						

–**Stepper Motor:**Constructional features –Principle of operation –Types – Torque equation – Linear and Non- linear analysis – Characteristics – Drive circuits – Closed loop control	
Total	**45 Hours**
TEXT BOOKS	
1.	Nagrath, I.J. and Kothari, D.P., 'Electrical Machines', Tata McGraw - Hill Education Private Limited Publishing Company Ltd., Fifth Edition, 2017.
2.	Dr. P.S. Bhimbra, 'Electrical Machinery', Khanna Publications ,Revised Edition, 2021.
3.	A.E. Fitzgerald, Charles Kingsley, Stephen. D.Umans, 'Electric Machinery', Tata McGraw Hill publishing Company Ltd, 2003
REFERENCES	
1.	Deshpande M. V., Electrical Machines, Prentice Hall India, New Delhi, 2011.
2.	M.N.Bandyopadhyay, Electrical Machines Theory and Practice, PHI Learning PVT LTD., New Delhi, Fourth Reprint, 2014.
3.	Murugesh Kumar K, "DC Machines & Transformers", Vikas Publishing House Pvt. Ltd., Second Edition, 2004.
4.	Alexander S. Langsdorf, Theory of Alternating-Current Machinery, Tata McGraw Hill Second Edition, 2009
5.	**NPTEL :** **Prof. Tapas Kumar Bhattacharya, Electrical Machines - II, IIT Kharagpur** https://nptel.ac.in/courses/108105131

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	1	-	1	1	-	1
CO2	2	-	-	-	-	-	-	-	-	1	-	1	1	-	1
CO3	3	-	-	-	-	-	-	-	-	1	-	1	1	-	1
CO4	2	-	-	-	-	-	-	-	-	1	-	1	1	-	1
CO5	3	-	-	-	-	-	-	-	-	1	-	1	1	-	1
CO	**2.4**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**1**	**-**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Regulations 2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
IV Semester						
Course code	**Course name**	**Hours/Week**			**Credit**	**Maximum marks**
24EE14403	**ELECTRICAL MEASUREMENTS AND INSTRUMENTATION**	**L**	**T**	**P**	**C**	**100**
		3	**0**	**0**	**3**	
Objective(s)	1. To learn the basic functional elements of instrumentation 2. To study the fundamentals of electrical and electronic instruments 3. To impart knowledge on the various measurement techniques using bridges 4. To acquire knowledge on various storage and display devices 5. To learn the concepts of transducers and data acquisition systems					
Outcome(s):	At the end of the course, students shall be able to, 1. Explain the fundamentals of electrical and electronic instruments 2. Illustrate the functions of measuring instruments 3. Compare various measurement techniques using bridges 4. Identify the Various storage and display devices 5. Analyze the concepts Various transducers and the data acquisition systems					
UNIT-I	**INTRODUCTION**					(9)
Functional elements of an instrument – Static and dynamic characteristics – Errors in measurement – Statistical evaluation of measurement data – Standards and calibration- Electrostatic and electromagnetic interference – Grounding techniques						
UNIT-II	**ELECTRICAL AND ELECTRONICS INSTRUMENTS**					(9)
Principle and types of analog and digital voltmeters, ammeters, multimeters – Single and three phase watt meters, energy meters and Smart Energy meters – Magnetic measurements – Determination of B-H curve and measurements of iron loss – Instrument transformers – Maximum Demand Indicator,power factor and frequency meters.						
UNIT-III	**TRANSDUCERS AND DATA ACQUISITION SYSTEMS**					(9)
Classification of transducers – Selection of transducers – Resistive, capacitive & inductive transducers – Piezoelectric, Hall effect, optical and digital transducers – Elements of data acquisition system – A/D, D/A converters – Smart Sensors-Computer controlled instrumentation						
UNIT-IV	**AC AND DC BRIDGES**					
Review of D.C & A.C Potentiometers,D.C & A.C bridges, transformer ratio bridges, self-balancing bridges. Interference & screening – Multiple earth and earth loops						
UNIT-V	**STORAGE AND DISPLAY DEVICES**					(9)
Magnetic disk and tape – Recorders, digital plotters and printers, CRT display, digital CRO, LED, LCD & dot matrix display – Introduction to Data Loggers						
					Total	**45Hours**
Text book :						
1.	A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation', DhanpatRai and Co, 2015					
2.	J. B. Gupta, 'A Course in Electronic and Electrical Measurements', S. K. Kataria& Sons, Delhi, Fourteenth Edition 2014.					

3.	Doebelin E.O. and Manik D.N., Measurement Systems – Applications and Design, Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd., Seventh Edition 2017.
References:	
1.	H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw Hill, Third Edition, 2017.
2.	D.V.S. Moorthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt Ltd, Second Edition, 2008.
3.	A.J. Bouwens, 'Digital Instrumentation', Tata McGraw Hill, 1997.
4.	**NPTEL :** **Prof. Avishek Chatterjee,Electrical Measurement and Electronic Instruments, IIT Kharagpur** https://nptel.ac.in/courses/108/105/108105153/

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	1	1	-	1
CO2	3	-	-	-	-	-	-	-	-	-	-	1	1	-	1
CO3	3	-	-	-	-	-	-	-	-	-	-	1	1	-	1
CO4	2	3	-	-	-	-	-	-	1	1	-	1	1	-	1
CO5	2	3	-	-	-	-	-	-	1	1	-	1	1	-	1
CO	**2.2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**1**	**-**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Department	**Electrical and Electronics Engineering**				**Programme Code**	**1051**
IV SEMESTER						
Course code	**Course Name**	**Hours/week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
24EE14404	**LOW VOLTAGE SWITCHGEAR**	1	0	0	1	**100**
Objective(s)	• Introduce the learners to proper wiring practices and associated harness required. • Facilitate the learners in proper use of Miniature Circuit Breakers for over current Protection. • To imbibe in the learners; the necessity of Residual Current Devices for both human protection and protection of electrical gadgets.					
Outcome(s)	On successful completion of the course, the learners will be able to: 1. Compare and contrast different wiring practices 2. Identify the different tripping characteristics of MCBs in relation to their applications **3.** Relate the importance of RCDs in protecting human lives and electrical gadgets					
UNIT-I	**WIRING HARNESS**					**6**
Introduction to wire harness assembly - Safety - Engineering documentation - Materials and components - Tools and equipment - Wire preparation and processing - IPC/WHMA - A - 620 standard						
UNIT-II	**MINIATURE CIRCUIT BREAKERS (MCBS)**					**6**
Introduction to MCBs - Types of MCBs - MCB structure and working principle – MCB specifications and selection - application of MCBs - IS/IEC 60898-1:2015						
UNIT-III	**RESIDUAL CURRENT DEVICES(RCDS)**					**3**
Introduction to RCDs - Working principle of RCDs - RCD selection and application - Installation and maintenance of RCDs) - Safety aspects and regulations - IS 12640 (Parts 1 and 2)						
					Total Hours	**15**

REFERENCES:

1	A complete guide to Wire Harness Design practices and Tips - https:,//www.moldtekengineering.com
2	Engineering Design Handbook: Electrical Wire and Cable - https://apps.dtic.mil
3	White paper on MCBs - https://new.abb.com/low voltage products -
4	Residual Current Devices

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	1	-	-	-	-	-	1	1	-	1
CO2	3	-	-	-	-	1	-	-	-	-	-	1	1	-	1
CO3	1	2	3	-	-	1	-	-	-	-	-	1	1	-	1
CO	**2.3**	**2**	**3**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**

Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

MAHENDRA ENGINEERING COLLEGE (Autonomous)-Syllabus						R 2024
DEPARTMENT:	**SCIENCE & HUMANITIES**		**Programme Code & Name**			**CY& CHEMISTRY**
SEMESTER-III (For Non Circuit Branches) & SEMESTER- IV (For Circuit Branches)						
COURSE CODE	**COURSE NAME**	**HOURS/WEEK**			**CREDIT**	**MAXIMUM MARKS**
		L	**T**	**P**	**C**	
24CY11001	**ENVIRONMENTAL SCIENCE AND SUSTAINABILITY**	2	0	0	-	**100**
Objectives	To make the students familiar with : 1. The importance of Environment, Ecosystem and Biodiversity. 2. The causes, effects and prevention measures of environmental pollution. 3. The social issues of the environment and National laws for environment protection. 4. The green environment and associated issues. 5. The concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze.					
Outcomes	At the end of the course the student will be able to 1. Explain the importance of Environment, Ecosystem and various types of Biodiversity. 2. Identify the different types of Pollution and be familiar with control measures. 3. List out the environmental issues and essential legislation on environmental laws. 4. Develop the concept of green synthesis method in environment and related problems. 5. Recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.					
UNIT-I	**ENVIRONMENT, ECOSYSTEM &BIODIVERSITY**					12 Hrs
Definition, Scope and Importance of Environment – Need for public awareness – Ecosystem: concept of an ecosystem – structure and function of an ecosystem – energy flow in the ecosystem – Biodiversity: Introduction – definition - genetic, species and ecosystem diversity – value of biodiversity – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity – Field visit to local area.						
UNIT-II	**ENVIRONMENTAL POLLUTION & DISASTER MANAGEMENT**					9 Hrs
Definition – causes, effects and control measures of: (a) Air, (b) Water, (c) Soil, (d) Noise, (e) Thermal pollution– solid waste management: causes, effects and control methods of municipal solid wastes – disaster management: floods, earthquake and landslides– E-waste and plastic waste: recycling and reuse - role of an individual in prevention of pollution – pollution case studies (vizag gas leakage) – Field visit to local polluted area.						
UNIT-III	**SOCIAL ISSUES & ENVIRONMENTAL IMPACT ASSESMENT**					9 Hrs
Social issues – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies (Global warming). – EPA: Environment protection act - EIA: EIA structure-methods of baseline data acquisition. Planning and management of impact studies - operational aspects of EIA - methods for impact identification- Role of NGOs in creating awareness among people regarding environmental issues.						

UNIT-IV	GREEN ENVIRONMENTAL ISSUES	9 Hrs
Introduction – Clean development mechanism – carbon emission-carbon foot printing - carbon credits - carbon sequestration and Polluter pay principle – Sustainable green building practices – Carbon Neutrality in India - Geneva Conventions and their Additional Protocols.		
UNIT-V	**SUSTAINABILITY AND MANAGEMENT**	6 Hrs
Development , GDP ,Sustainability- concept, needs and challenges - economic, social and aspects of sustainability - from unsustainability to sustainability - millennium development goals, and protocols- Sustainable Development Goals - targets, indicators and intervention areas.		
	TOTAL	**45 Hrs**

TEXT BOOKS :	
1.	Rajagopalan, R, "Environmental Studies-From Crisis to Cure", Oxford University Press (2015)
2.	Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2017.
3.	Dr.A.Ravikrishnan, "Environmental Science and Engineering" , Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2014.
4.	Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
REFERENCES	
1.	R.K. Trivedi, "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media.
2.	Gilbert M.Masters, "Introduction to Environmental Engineering and Science", 3nd Edition, Pearson Education, 2023.
3.	Dharmendra S. Sengar, "Environmental law", Prentice hall of India PVT LTD, New Delhi, 2007.

S.No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	2	-	-	-	-	2	3	1	-	-	-	1	-	-	-
C02	2	-	-	-	-	2	3	1	-	-	-	1	-	-	-
C03	2	-	-	-	-	2	3	1	-	-	-	1	-	-	-
C04	2	-	-	-	-	2	3	1	-	-	-	1	-	-	-
C05	2	-	-	-	-	2	3	1	-	-	-	1	-	-	-
Avg.	**2**	**-**	**-**	**-**	**-**	**2**	**3**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**-**

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Regulations 2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
IV Semester						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE24401	**DIGITAL ELECTRONICS LABORATORY**	**0**	**0**	**3**	**1.5**	**100**
Objectives	• To gain knowledge on Boolean functions and code conversions • To learn the concepts of Adder,Subtractor,codeconverters, Multiplexers and De-multiplexers • To acquire the practical knowledge in design of flip-flop, counters and shift registers					
Outcomes	Students shall be able to, 1. Demonstrate the characteristics of Boolean functions 2. Design Adder,Subtractor,codeconverters,Multiplexers&Demultiplexers 3. Design parity checker, decoders, encoders, flip-flops, counters, shift register.					
LIST OF EXPERIMENTS						
1.	Verification of Logic Gates Realization of a Boolean function: To simplify the given expression and to realize it using Basic gates and Universal gate					
2.	Design of Adders and Subtractors					
3.	Design of Code converters: Excess-3 to BCD Binary to Gray code converter Gray code to binary converter					
4.	Parity generator and parity checking.					
5.	Design of Encoders and Decoders					
6.	Multiplexer and De-multiplexer a. To design and set up a 4:1 ; 8:1Multiplexer b. To design and set up a 1:4;1:8 Demultiplexer					
7.	Verification of Flipflops Conversion of one type of Flipflop to another					
8.	Verification of Flipflops Conversion of one type of Flipflop to another					
9.	Design and implementation of synchronous up and down counters using flip flops.					
10.	Shift Registers: Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitable IC's Using Virtual Instrumentation					
					Total	**45 Hours**

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	1	1	-	1	2	1	-	1	1	-	1
CO2	2	2	3	-	1	1	-	1	2	1	-	1	1	-	1
CO3	2	2	3	-	1	1	-	1	2	1	-	1	1	-	1
CO	**2.3**	**2**	**3**	**-**	**1**	**1**	**-**	**1**	**2**	**1**	**-**	**1**	**1**	**-**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Regulations 2024						
Department	**Electrical and Electronics Engineering**				**Programme Code**	**1051**
IV Semester						
Course Code	**Course name**	**HOURS/WEEK**			**CREDIT**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE24402	**ELECTRICAL MACHINES II LABORATORY**	**0**	**0**	**3**	**1.5**	**100**
Objective(s)	• To learn the testing procedures of alternator and synchronous motor • To impart knowledge on performance of Induction Machines • To gain knowledge on performance of special electrical machines					
Outcome(s)	At the end of the course, students shall be able to, 1. Analyze the regulation and performance characteristics of synchronous machines 2. Analyze the performance of induction machines 3. Analyze the performance of special electrical machines.					
1	Regulation of three phase alternator by EMF, MMF methods					
2	Regulation of three phase alternator by Zero Power Factor and American Standard Association methods.					
3	V and Inverted V curves of Three Phase Synchronous Motor.					
4	Load test on single phase induction motor.					
5	Load test on three-phase induction motor.					
6	No load and blocked rotor test on single phase and three-phase induction motor					
7	Separation of No-load losses of three-phase induction motor					
8	Load characteristics of switched reluctance motor.					
9	Speed control of 3 phase AC motor with IPM power module.					
10	Speed control of brushless DC motor with eddy current load set up.					
11	Simulation of load characteristics of PMSM and switched reluctance motor.					
					Total	**45 Hours**

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	-	-	1	-	1	2	1	-	1	1	-	1
CO2	2	3	-	-	-	1	-	1	2	1	-	1	1	-	1
CO3	2	3	-	-	-	1	-	1	2	1	-	1	1	-	1
CO	**2**	**3**	**-**	**-**	**-**	**1**	**-**	**1**	**2**	**1**	**-**	**1**	**1**	**-**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

Syllabus - Regulation 2024

Department	**English**

Semester – IV
(Common to all B.E./B.Tech. Programmes)

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24HS21002	PROFESSIONAL COMMUNICATION SKILLS (Common to all B.E./B.Tech. Degree Programmes)	0	1	2	2	100

Objectives	• To familiarize students with the stage dynamics • To help the learners to improve their creative skills • To make them acquire the ability to speak effectively in real life situations
Outcomes	**At the end of the course, the learners will be able to :** ➢ Apply suitable vocabulary in academic and workplace contexts ➢ Demonstrate communication skills effectively in both oral and written formats ➢ Create documents professionally and make presentations effectively

LIST OF EXERCISES

11.	Introduction to Professional Communication and SWOT Analysis
12.	Soft Skills (Goal Setting, Empathy, Stress Management, Emotional Intelligence, Conflict Resolution)
13.	Building Vocabulary (Intermediate Level)
14.	Welcome Address and Vote of Thanks
15.	Stage Dynamics (Body Language and Paralanguage –Individual Presentation for 3 minutes)
16.	Framing Questions (WH Questions & 'Yes' or 'No' Questions)
17.	Narrative Techniques - Narrating the Experience
18.	Master of Ceremony Skills
19.	Picture Description
20.	Impromptu Speech (Just a Minute)

Total Hrs : 30

Textbook:

1	Joshi, Manmohan, *Soft Skills*, 1st Edition. Bookboon, 2017

Reference Books:

1	Muralikrishna, &Sunita Mishra, *Communication Skills for Engineers*. Pearson, New Delhi, 2011.
2	Barun K. Mitra, Personality Development and Soft Skills, Oxford University Press, New Delhi, 2011
Online Websites:	
1	https:// www.ted.com/talks
2	https://joshtalks.com
3	https://quizziz.com
4	www.pdfdrive.com
5	www.talking books.com

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	1	1	1	1	3	1	2	-	-	-
CO2	-	-	-	-	-	1	1	1	1	3	1	2	-	-	-
CO3	-	-	-	-	-	1	1	1	1	3	1	2	-	-	-
CO	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**1**	**3**	**1**	**2**	**-**	**-**	**-**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
V Semester						
Course Code	**COURSE NAME**	**Hours/Week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE14501	**POWER ELECTRONICS**	**3**	**0**	**0**	**3**	**100**
Objectives	• To learn different types of power semiconductor devices • To acquire knowledge on the operation and characteristics of controlled rectifiers • To study the switching techniques and basics topologies of DC-DC regulators • To discuss different modulation techniques of PWM inverters • To know the operation of AC to AC voltage controller					
Outcomes	At the end of the course, students will be able to: 1. Explain the Characteristics of Power Semiconductor Devices 2. Analyze various types of single phase and three phase power converters. 3. Analyze DC-DC converter circuits for real time application 4. Design the control circuits and modulation techniques for inverter circuits 5. Apply various control techniques on AC to AC converter and cyclo converters					
UNIT I	**POWER SEMICONDUCTOR DEVICES**					**(9)**
Structure and characteristics of switching devices, Diode, SCR, TRIAC, GTO, BJT, MOSFET, IGBT- Static and Dynamic characteristics - Triggering and commutation circuit for SCR and IGBT- Snubber circuit-Intelligent Power Modules- Heat sink calculations.						
UNIT II	**AC-DC CONVERTERS**					**(9)**
Controlled and uncontrolled rectifiers (single phase and three phase) –Effect of source inductance – Dual converters –Application- light dimmers.						
UNIT III	**DC-DC CONVERTERS**					**(9)**
Introduction – Step-down and step-up chopper-control strategy – buck converter, boost converter, buck-boost converter – Device selection for DC - DC converter-Applications-Battery operated vehicles-Solar PV applications.						
UNIT IV	**DC-AC CONVERTERS**					**(9)**
Introduction - Single phase and three phase voltage source inverters (both 120^0 mode and 180^0 mode) – Pulse Width Modulation techniques: Multiple PWM, Sinusoidal PWM– Voltage source inverter - current source inverter- Applications-Uninterrupted Power Supply-Multi-level inverters and applications.						
UNIT V	**AC PHASE CONTROLLERS**					**(9)**
TRIAC Triggering concept with positive and negative gate pulse triggering-TRIAC based phase controllers-various configurations for SCR based single and three phase controllers - Matrix converter and its methods.						
					Total	**45 Hours**
TEXT BOOKS						
1.	Muhammad H.Rashid, 'Power Electronics: Circuits, Devices and Applications', Prentice Hall of India, Pearson Education, 4th Edition, 2013.					
2.	P.S.Bimbra,'Power Electronics', Khanna Publishers, 5th Edition, 2012.					
3.	L. Umanand, 'Power Electronics Essentials and Applications', Wiley, 2013.					
4.	Video Reference / NPTEL (for each Unit) https://nptel.ac.in/courses/108108122					

REFERENCES	
1.	Joseph Vithayathil, 'Power Electronics, Principles and Applications', McGraw Hill Series, 6th Reprint, 2013.
2.	Ashfaq Ahmed, 'Power Electronics for Technology Pearson Education', Indian reprint, 2003.
3.	Philip T. Krein, 'Elements of Power Electronic', Oxford University Press, 2004 Edition.
4.	https://nptel.ac.in/courses/108/102/108102145/
5.	http://site.iugaza.edu.ps/malramlawi/files/RASHID_Power_Electronics_Handbook.pdf

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	1	-	-	-	-	1	-	1	1	-	1
CO2	2	3	-	-	1	-	-	-	-	1	-	1	1	-	1
CO3	2	3	-	-	1	-	-	-	-	1	-	1	1	-	1
CO4	2	2	3	-	1	-	-	-	-	1	-	1	1	-	1
CO5	3	-	-	-	1	-	-	-	-	1	-	1	1	-	1
CO	**2.2**	**2.6**	**3**	**-**	**1**					**1**		**1**	**1**	**1**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**				**Programme Code**	**1051**
V Semester						
Course code	**Course name**	**Hours/Week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
24EE14502	**CONTROL SYSTEMS**	**3**	**1**	**0**	**4**	**100**
Objective(s)	• To acquire knowledge on the transfer function models for physical systems and introduce the control system components. • To provide adequate knowledge in the time response of systems and steady state error analysis. • To learn the basic knowledge on the open loop and closed loop frequency responses of systems. • To introduce the state variable representation of physical systems and study the effect of state feedback. • To acquire knowledge on the design of compensator and controllers.					
Outcome(s)	At the end of the course, students will be able to, 1. Discuss the behavior of linear and nonlinear system and develop the mathematical model of the given physical system. 2. Analyze the response of time domain systems 3. Evaluate the response of frequency domain systems 4. Analyze the state space model for time varying systems. 5. Design Lag, Lead compensators and linear controllers.					
UNIT-I	**SYSTEM MODELING**					(9)
Control system - Open and closed Loop - Effect of feedback - System representations - Transfer functions of single input & single output and multivariable systems – Block diagrams – Signal flow graphs–Gain formula– First Principle Modeling: Mechanical, Electrical systems and Electromechanical systems.						
UNIT-II	**TIME RESPONSE ANALYSIS**					(9)
Standard test inputs- Time response – Time domain specifications-Damping ratio and order of the system - Effects of adding poles and zeros – Dominant poles - Stability – Routh Hurwitz criterion – Root locus construction and interpretation.						
UNIT-III	**FREQUENCY RESPONSE ANALYSIS**					(9)
Frequency response – Bode plot, Polar Plot and Nyquist Plot-Introduction to Closed Loop Frequency Response-Effect of adding lag and lead compensators.						
UNIT-IV	**STATE VARIABLE ANALYSIS**					(9)
Concept of state variables – State models for linear and time invariant Systems – State transition matrix-Solution of state and output equation in controllable canonical form – Concepts of controllability and observability –Effect of state feedback.						
UNIT-V	**DESIGN OF FEEDBACK CONTROL SYSTEM**					(9)
Design specification-Lead, Lag and Lag Lead compensators using Root Locus and Bode Plot techniques-of P, PI, PD and PID Controllers Design-PI and PID Control in state feedback form-Lyapunov stability-Introduction to Digital control.						

	Total	**45 Hours**
Text book :		
1.	M. Gopal, Control Systems, 'Principles and Design', 4th Edition, Tata McGraw Hill, New Delhi, 2012.	
2.	K. Ogata, 'Modern Control Engineering', 5th edition, PHI, 2012.	
3.	S.K.Bhattacharya, 'Control System Engineering', 3rd Edition, Pearson, 2013.	
4.	Dhanesh. N. Manik, Control System, Cengage Learning, 2012.	
5.	S.Palani,'Control Systems Engineering',2nd Edition, Tata McGraw Hill, New Delhi, 2010.	
References:		
1.	Arthur, G.O.Mutambara, 'Design and Analysis of Control Systems, CRC Press, 2009	
2.	Richard C. Dorf and Robert H. Bishop, 'Modern Control Systems', Pearson Prentice Hall, 2012.	
3.	Benjamin C. Kuo, Automatic Control systems, 7th Edition, PHI, 2010.	
4.	https://onlinecourses.nptel.ac.in/noc18_ee41	

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	1	-	-	-	-	-	-	1	2	-	1
CO2	2	3	-	-	1	-	-	-	-	-	-	1	2	-	1
CO3	2	2	3	-	1	-	-	-	-	-	-	1	2	-	1
CO4	2	3	-	-	1	-	-	-	-	-	-	1	2	-	1
CO5	2	2	3	-	1	-	-	-	-	-	-	1	2	-	1
CO	**2**	**2.5**	**3**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**-**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
V Semester						
Course Code	**Course name**	**HOURS/WEEK**			**CREDIT**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE14503	**TRANSMISSION AND DISTRIBUTION SYSTEM**	**3**	**1**	**0**	**4**	**100**
Objective(s)	• To introduce the structure of power system. • To discuss the electrical parameters of the transmission lines. • To learn the structural parameters of transmission line and cables. • To acquire knowledge on modeling of transmission line in power system. • To gain knowledge on distribution system, distribution generation and FACTS in power system.					
Outcome(s)	At the end of the course, students will be able to, 1. Describe about the structure of power system. 2. Evaluate the electrical parameters in transmission system. 3. Analyze the structure of overhead line and underground cables. 4. Develop the model for transmission line in power system. 5. Elaborate the distribution system, distributed generation and FACTS in power system.					
UNIT I	**INTRODUCTION TO POWER SYSTEM**					**(12)**
Structure of Electric Power System - Various Systems of Power Transmission - Typical HVAC, EHVAC and HVDC power Supply Scheme- Economics of Power Transmission - Variable load on power system- Introduction to Power Grid-Smart Grid - Micro Grid - Power scenario in Indian grid – National and Regional load dispatching centers.						
UNIT II	**TRANSMISSION LINE PARAMETERS**					**(12)**
Parameters of single and three phase transmission lines with single and double circuits-Resistance, inductance and capacitance of solid, stranded and bundled conductors -Symmetrical and unsymmetrical spacing and transposition-application of self and mutual GMD; Skin and proximity effects-Interference with neighboring communication circuits- Corona discharge- Factors affecting corona.						
UNIT III	**OVERHEAD LINES, INSULATORS AND CABLES**					**(12)**
Overhead line - Conductor Types – Insulators types - voltage distribution in insulator string - improvement of string efficiency -Sag and tension calculations for transmission line - Types of towers - Underground cables -Types of cables - Grading of cables - Capacitance of 1-core and 3-core belted cable.						
UNIT IV	**TRANSMISSION LINE MODELLING**					**(12)**
Performance of Transmission lines - Short line, medium line and long line -Equivalent circuits, phasor diagram, attenuation constant, phase constant, surge impedance - Transmission efficiency and voltage regulation, real and reactive power flow in lines - Power Circle diagrams - Ferranti effect – Surge impedance loading -Shunt and series compensation.						
UNIT V	**DISTRIBUTION SYSTEM**					**(12)**
Distribution Systems – Kelvin's Law – AC and DC distributions– Distribution Losses - **Reliability** and Quality of Distribution System- Techniques of Voltage Control and Power factor improvement - Types of Substations - Methods of grounding -Introduction to FACTS: TCSC, SVC, STATCOM, UPFC-Introduction to SCADA, Vehicle to Grid and Grid to vehicle technology.						
					Total	**60 Hours**

TEXT BOOKS	
1.	John J. Grainger, William D. Stevenson, Jr, 'Power System Analysis', Mc Graw Hill Education (India) Private Limited, New Delhi, 2015.
2.	HadiSaadat, 'Power System Analysis, 'PSA Publishing; Third Edition, 2010.
3.	J. Duncan Glover, MulukutlaS.Sarma, Thomas J. Overbye, 'Power System Analysis & Design', Cengage Learning, Fifth Edition, 2012.
4.	C.L.Wadhwa, 'Electrical Power Systems', New Academic Science Ltd, 2010.
REFERENCES	
1.	D.P.Kothari, I.J.Nagarath, 'Power System Engineering' Tata-Mc-Graw-Hill Publishing Company limited, New Delhi, 2007.
2.	V.K.Mehta and RohitMetha, ' Principles of Power System' ,S.Chand Publication , New Delhi, Fourth Edition., 2011.
3.	O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 2005.
4.	RavindraP.Singh, 'Switchgear and Power System Protection', PHI Learning Private Ltd., New Delhi, 2009.
5.	NPTEL Link: https://nptel.ac.in/courses/108/102/108102047/

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	1	1	-	-	-	-	1	1	-	1
CO2	2	2	3	-	-	1	1	-	-	-	-	1	1	-	1
CO3	2	3	-	-	-	1	1	-	-	-	-	1	1	-	1
CO4	1	2	3	-	-	1	1	-	-	-	-	1	1	-	1
CO5	3	-	-	-	-	1	1	-	-	-	-	1	1	-	1
CO	**2**	**2.3**	**3**	**-**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
V Semester						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE24501	**POWER ELECTRONICS LABORATORY**	**0**	**0**	**3**	**1.5**	**100**
Objectives	• To learn the characteristics of power devices and single phase rectifier circuits • To acquire knowledge about the operation of single phase and three phase Inverters and choppers • To apply different loading conditions on AC to AC converters and examine the converter circuit and controllers using suitable software					
Outcomes	At the end of the course, students will be able to 1. Analyze the characteristics of power semiconductor devices and single phase rectifier circuits 2. Analyze the operation of and choppers, single phase and three phase Inverters 3. Apply different loading conditions on AC to AC converters and examine the converter circuit and controllers using suitable software					

LIST OF EXPERIMENTS	
1.	Characteristics of SCR and TRIAC
2.	Characteristics of MOSFET and IGBT
3.	Characteristics of AC to DC half controlled converter
4.	Characteristics of AC to DC fully controlled Converter
5.	Characteristics of Step down and step up MOSFET based choppers
6.	Characteristics of IGBT based single phase PWM inverter
7.	Characteristics of IGBT based three phase PWM inverter
8.	Simulation on 1Φ & 3Φ semiconverter,1Φ & 3Φ full converter
9.	Simulation on dc-dc converters, AC voltage controller
10.	Simulation on Matrix converter
Total	**45 Hours**

REFERENCES	
1.	http://vlabs.iitb.ac.in/

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	-	1	-	-	-	1	1	-	1	1	1	2
CO2	2	3	-	-	1	-	-	-	1	1	-	1	1	1	2
CO3	3	-	-	-	1	-	-	-	1	1	-	1	1	1	2
CO	**2.3**	**3**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**1**	**1**	**2**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)			
Syllabus-R2024			
Department	**Electrical and Electronics Engineering**	**Programme Code**	**1051**

V Semester

COURSE CODE	COURSE NAME	Hours/week			Credit	Maximum Marks
		L	T	P	C	
24EE24502	**CONTROL AND INSTRUMENTATION LABORATORY**	**0**	**0**	**3**	**1.5**	**100**

Objectives	• To apply the transfer function representation for armature and field controlled DC motor and analyze the characteristics of synchros. • To assess the system performance using time domain and frequency domain analysis and techniques for improving the performance and develop compensators, controllers, linear and digital systems using simulation software. • To Apply the concepts of measurement techniques using various bridges and Analyze the functionality of various transducers
Outcomes	At the end of the course, students will be able to, 1. Examine the system transfer function representations for armature and field controlled DC motor and analyze the characteristics of synchros. 2. Apply various time domain and frequency domain techniques to assess the system performance and Design the various compensators, controllers to improve system performance using simulation software. 3. Apply the concepts of measurement techniques using various bridges and Analyze the functionality of various transducers

LIST OF EXPERIMENTS

1.	Determination of transfer function of Armature and field controlled DC motor.
2.	Determination of transfer functions of separately exited DC generator.
3.	Synchro-Transmitter- Receiver and Characteristics.
4.	Design and implementation of Lag and Lead Compensators.
5.	AC and DC Position Control Systems.
6.	Simulate and design PI and PID controllers
7.	Bridge Networks –AC and DC Bridges
8.	Transducers: (a) Temperature (b) Pressure (c) Displacement
9.	Instrumentation Amplifier
10.	Analog to Digital Converters and Digital to Analog Converters (ADCs and DACs)
11.	Stability analysis of linear systems using simulation tools.
12.	Digital simulation of first order and second order systems.
	Total **45 Hours**

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	-	1	-	-	1	1	1	-	1	2	1	1
CO2	3	-	-	-	1	-	-	1	1	1	-	1	2	1	1
CO3	2	2	3	-	1	-	-	1	1	1	-	1	2	1	1
CO	**2.3**	**2.5**	**3**	**-**	**1**	**-**	**-**	**1**	**1**	**1**	**-**	**1**	**2**	**1**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

Syllabus - Regulation 2024

Department	**English**

Semester – V
(Common to all B.E./ B.Tech. Programmes)

Course code	**Course Name**	**Hours/week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
24HS21003	**INTERVIEW SKILLS AND SOFT SKILLS** (Common to all B.E./B.Tech. Degree Programmes)	0	1	2	2	**100**

Objectives	• To improve the learners reading fluency skills through extensive reading • To help the learners obtain speaking skills in both formal and informal situation. • To make them acquire presentation skills and interview skills to face challenges in the career aspects
Outcomes	**At the end of the course, the learners will be able to :** ➢ Analyse the content and apply knowledge and skills efficiently wherever necessary. ➢ Create profile and other essential documents. ➢ Demonstrate soft skills effectively at the time of interview and workplace.

LIST OF EXERCISES

1.	Employability Skills (Interpersonal, Intrapersonal, Leadership, Decision Making and Problem Solving)
2.	Building Vocabulary (Advanced level)
3.	Short Conversations (Situation Based Dialogues)
4.	Art of Storytelling
5.	Professional E-mail Writing
6.	Preparing One Page Resume
7.	Interview Skills (Mock Interview & Interview Etiquette)
8.	Professional Etiquette (Polite Expressions, Telephone Etiquette, Online Etiquette)
9.	Group Discussion
10.	Public Speaking

Total Hrs : 30

Textbook:

1	Joshi, Manmohan, *Soft Skills*, 1st Edition. Bookboon, 2017

Reference Books:	
1	Raman, Meenakshi & Sangeeta Sharma, *Technical Communication: Principles and Practice,* Ed.III, Oxford University Press, New Delhi. 2015.
2	Barun K. Mitra, Personality Development and Soft Skills, Oxford University Press, New Delhi, 2011
Online Websites:	
1	https:// www.ted.com/talks
2	https://www.joshtalks.com
3	https://quizziz.com
4	www.pdfdrive.com
5	www.talking books.com

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	1	1	1	1	3	1	2	-	-	-
CO2	-	-	-	-	-	1	1	1	1	3	1	2	-	-	-
CO3	-	-	-	-	-	1	1	1	1	3	1	2	-	-	-
CO	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**1**	**3**	**1**	**2**	**-**	**-**	**-**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**				**Programme Code**	**1051**
V Semester						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE36501	**INTERNSHIP**	**0**	**0**	**2**	**1**	**100**
Objectives	• To give exposure to the practical aspects of the discipline Minimum of six weeks in an Industry in the area of Electrical Engineering • To experience the specific task or project which is assigned by the Industry to the students.					
Outcomes	At the end of the course, students will be able to, 1. Elaborate the Variety of Industries and Career Options 2. Develop the Professional Network 3. Apply the Knowledge in the Professional World					
➢ Minimum of Three weeks in an Industry in the area of Electrical Engineering. ➢ The summer internship should give exposure to the practical aspects of the discipline. ➢ In addition, the student may also work on a specified task or project which may be assigned to him/her. ➢ The outcome of the internship should be presented in the form of a report and evaluated by Internal and external examiners.						
					Total Hours	**L:0 T:0 P:30 (30 Hours)**

CO MAPPING WITH POs AND PSOs

S.NO.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	-	-	-	2	2	3	3	3	2	3	2	-	2
CO2	2	2	2	3	-	2	2	3	3	3	2	3	2	2	2
CO3	3	-	-	-	-	2	2	3	3	3	2	3	2	-	2
CO	**3**	**2**	**2**	**3**	**-**	**2**	**2**	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**2**

"-" - No correlation , "1" - Lower correlation , "2" - Moderate correlation , "3" – Higher

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
VI Semester						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE14601	**SOLID STATE DRIVES**	**3**	**0**	**0**	**3**	**100**
Objectives	• To learn the steady state operation and transient dynamics of a motor load system. • To study the Steady state analysis of converter/chopper fed DC drives. • To discuss the operation and performance of AC motor drives. • To impart knowledge on speed control of 3 phase Synchronous motor. • To acquire knowledge on operation of speed controller for a closed loop system.					
Outcomes	At the end of the course, students will be able to, 1. Explain the steady state operation and transient dynamics of a motor load system. 2. Illustrate the Steady state analysis of converter/chopper fed DC drives. 3. Interpret the operation and performance of AC motor drives. 4. Summarize the speed control of 3 phase Synchronous motor drives. 5. Apply the digital computer based control techniques for various drives.					
UNIT I	**DRIVE CHARACTERISTICS**					**9**
Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, starting & stopping – typical load torque characteristics – Selection of motor.						
UNIT II	**CONVERTER / CHOPPER FED DC MOTOR DRIVE**					**9**
Steady state analysis of the single and three phase converter fed separately excited DC motor drive– continuous and discontinuous conduction– Time ratio and current limit control – 4 quadrant operations of converter / chopper fed drive - Applications.						
UNIT III	**INDUCTION MOTOR DRIVES**					**9**
Stator voltage control–energy efficient drive– V/F control-Rotor Resistance control–constant airgap flux–field weakening mode – voltage / current fed inverter – closed loop control-Slip power recovery schemes-SVPWM control Techniques.						
UNIT IV	**SYNCHRONOUS MOTOR DRIVES**					**9**
V/F control and self-control of synchronous motor: Margin angle control and power factor control – permanent magnet synchronous motor-Applications.						
UNIT V	**DIGITAL CONTROL AND DRIVE APPLICATIONS**					**9**
Digital Control and Drive Applications - Advantages and limitations -Microcontroller and PLC based control of Induction Motor drives - Selection of drives and control schemes for Steel mills, Lifts and Cranes.						
					Total	**45 Hours**

TEXT BOOKS

1.	S.K.Pillai,'A First course on Electrical Drives', New Age International, 3rd Edition 2012.
2.	BimalK.Bose. 'Modern Power Electronics and AC Drives', Pearson Education, 2002.
3.	R.Krishnan, 'Electric Motor & Drives: Modeling, Analysis and Control', Prentice Hall of India, 2001.

4.	Gopal K.Dubey, 'Fundamentals of Electrical Drives', Narosa Publishing House, 2nd Edition, 2001.
REFERENCES	
1.	John Hindmarsh and Alasdain Renfrew, 'Electrical Machines and Drives System', Elsevier 2012.
2.	ShaahinFelizadeh, 'Electric Machines and Drives', CRC Press (Taylor and Francis Group), 2013.
3.	VedamSubramanyam, "Electric drives concepts and applications", Tata McGraw Hill publishing company Ltd., II Edition,New Delhi, 2011.
4.	S. Sivanagaraju, M. Balasubba Reddy, A. Mallikarjuna Prasad 'Power semiconductor drives', PHI, 5th printing, 2013.
4.	https://nptel.ac.in/courses/108/104/108104140/

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	1	2	1	2
CO2	3	-	-	-	1	-	-	-	-	-	-	1	2	1	2
CO3	3	-	-	-	1	-	-	-	-	-	-	1	2	1	2
CO4	2	-	-	-	1	-	-	-	-	-	-	1	2	1	2
CO5	3	-	-	-	1	-	-	-	-	-	-	1	2	1	2
CO	**2.6**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**1**	**2**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus – R2024						
Department	**Electronics and Electronics Engineering**				**Programme Code**	**1051**
VI Semester						
Course code	**Course Name**	**Hours/week**			**Credit**	**Maximum marks**
24EE14602	**MICROCONTROLLER BASED SYSTEM DESIGN**	**L**	**T**	**P**	**C**	**100**
		3	0	0	3	
Objective(s)	• To gain exposure on 8051 architecture, instruction set and addressing modes. • To develop knowledge on assembly language programming on 8051 microcontroller. • To gain the knowledge on PIC Microcontroller. • To acquire knowledge about the features and functionalities of the peripheral devices. • To introduce the concepts of developing microcontroller based systems for various applications.					
Outcome(s)	At the end of the course, students will be able to, 1. Describe the 8051 architecture, instruction set and addressing modes. 2. Develop assembly language programs for 8051 Microcontroller. 3. Describe the architecture and instructions of PIC Microcontroller. 4. Summarize the features and functionalities of peripheral devices. 5. Develop the microcontroller based systems for various applications.					
UNIT-I	**8051 MICROCONTROLLER**					**9**
8051 Microcontroller Architecture - Addressing modes - Instruction set - Interrupts - Timer and counter - Serial Communication.						
UNIT-II	**8051 PROGRAMMING**					**9**
Assembly Language Programming- Arithmetic Instructions – Logical Instructions –Single bit Instructions – Timer Counter Programming – Serial Communication Programming, Interrupt Programming.						
UNIT-III	**PIC MICROCONTROLLER**					**9**
Architecture – memory organization – addressing modes – instruction set – I/O port, Data Conversion, RAM & ROM Allocation, Timer programming.						
UNIT-IV	**PERIPHERAL OF PIC MICROCONTROLLER**					**9**
Timers – Interrupts, I/O ports- I2C bus-A/D converter-UART- CCP modules -ADC, DAC and Sensor Interfacing –Flash and EEPROM memories						
UNIT-V	**SYSTEM DESIGN USING 8051**					**9**
Interfacing LCD Display – Keypad Interfacing - Generation of Gate signals for converters and Inverters - Motor Control – Controlling DC/ AC appliances.						
					Total	**45 Hours**
TEXT BOOK :						
1	Rajkamal, “Microcontrollers Architecture, Programming Interfacing,& System Design”,Pearson,2012.					
2	Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey ‘ PIC Microcontroller and Embedded Systems using Assembly and C for PIC18’, Pearson Education 2008.					
3	John B Peatman, “Designing with PIC Micro Controller”, McGraw-Hill, 2013.					

REFERENCES:	
1	Kenneth J Ayala, “The 8051-microcontroller architecture programming and application”, Penram International publication, New Delhi, 2004.
2	Mohammed Ali Mazidi and Janice GillispieMazidi, "The 8051 Microcontroller and Embedded Systems",Pearson Education Asia, 2nd Edition, New Delhi, 2008.
3	John Iovine, ‘PIC Microcontroller Project Book ’, McGraw Hill 2004
4	Senthil Kumar,Saravanan,Jeevanathan,”Microprocessor & Microcontrollers,Oxford,2013.

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	1	-	-	1	-	-	-	1	2	1	1
CO2	2	2	3	-	1	-	-	1	-	-	-	1	2	1	1
CO3	2	-	-	-	1	-	-	1	-	-	-	1	2	1	1
CO4	2	-	-	-	1	-	-	1	-	-	-	1	2	1	1
CO5	2	2	3	1	1	-	-	1	-	-	-	1	2	1	1
CO	**2**	**2**	**3**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**2**	**1**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
VI Semester						
Course Code	**Course name**	**HOURS/WEEK**			**CREDIT**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE14603	**POWER SYSTEM OPERATION AND ANALYSIS**	**3**	**1**	**0**	**4**	**100**
Objective(s)	• To provide exposure on the economic operation of power generation. • To discuss the power system under steady state operating condition. • To acquire knowledge on iterative techniques for power flow analysis. • To study the short circuit parameters in power system. • To acquire knowledge on the stability of the power system.					
Outcome(s)	At the end of the course, students will be able to, 1. Explain the concepts of economic operation of electric power generation. 2. Develop the model of power system under steady state operating condition. 3. Determine the complex power flow in the power system. 4. Calculate the fault current under different fault condition in power system. 5. Analyze the stability problems in power system.					
UNIT I	**ECONOMIC OPERATION OF POWER SYSTEMS**					**(12)**
Statement of economic dispatch problem - input and output characteristics of thermal plant - incremental cost curve - optimal operation of thermal units without and with transmission losses (no derivation of transmission loss coefficients) - statement of unit commitment (UC) problem - constraints on UC problem – Solution of UC problem using priority list, Dynamic Programming method.						
UNIT II	**PRELIMINARIES FOR POWER SYSTEM ANALYSIS**					**(12)**
Power system components –Single line diagram - per unit quantities - P.U. impedance and reactance diagram– Formation of bus admittance matrix by direct inspection method -Formation of bus impedance matrix using building algorithm- Symmetrical component analysis of unbalanced system.						
UNIT III	**LOAD FLOW ANALYSIS**					**(12)**
Bus classification - Formulation of Power Flow problem in polar coordinates - Power flow solution using Gauss Seidel method - Handling of Voltage controlled buses - Power Flow Solution by Newton Raphson method.						
UNIT IV	**FAULT ANALYSIS**					**(12)**
Types and assumptions in short circuit analysis - Symmetrical short circuit analysis using Thevenin's theorem. Analysis of unsymmetrical faults at generator terminals: LG, LL and LLG - Unsymmetrical fault occurring at any point in a power system- computation of post fault currents in symmetrical component and phasor domains-Fault analysis using Thevenin's method and bus impedance matrix.						
UNIT V	**STABILTY ANALYSIS**					**(12)**
Classification of power system stability – Rotor angle stability - Swing equation – Swing curve Power-Angle equation - Equal area criterion - Critical clearing angle and time - Classical step-by-step solution of the swing equation – modified Euler method.						
					Total	**60 Hours**
TEXT BOOKS						
1.	Allen. J. Wood and Bruce F. Wollen berg, 'Power Generation, Operation and Control', John					

	Wiley & Sons, Inc., 2016.
2.	HadiSaadat, ‘Power System Analysis, ’PSA Publishing; Third Edition, 2010.
3.	Kundur P., ‘Power System Stability and Control’, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.
4.	John J. Grainger, William D. Stevenson, Jr, ‘Power System Analysis’, Mc Graw Hill Education (India) Private Limited, New Delhi, 2015.
REFERENCES	
1.	D.P.Kothari, I.J.Nagarath, ‘Power System Engineering’ Tata Mc Graw -Hill Publishing Company limited, New Delhi, 2007.
2.	B.R.Gupta, ‘Power System Analysis and Design’ S. Chand, New Delhi, Fifth Edition, 2008.
3.	C.L.Wadhwa, ‘Electrical Power Systems’, New Academic Science Ltd, 2009.
4.	O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education, 2005.
5.	NPTEL Link : https://nptel.ac.in/courses/108/102/108102047/

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	1	-	1	-	1	-	1	2	1	1
CO2	1	2	3	-	-	1	-	1	-	1	-	1	2	1	1
CO3	2	3	-	-	-	1	-	1	-	1	-	1	2	1	1
CO4	2	3	-	-	-	1	-	1	-	1	-	1	2	1	1
CO5	2	3	-	-	-	1	-	1	-	1	-	1	2	1	1
CO	**1.8**	**2.75**	**3**	**-**	**-**	**1**	**-**	**1**	**-**	**1**	**-**	**1**	**2**	**1**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**				**Programme Code**	**1051**
VI Semester						
Course code	**Course name**	**Hours/week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
24EE14604	**ELECTRIC VEHICLES**	**3**	**0**	**0**	**3**	**100**
Objective(s)	• To impart knowledge on the concept of electrical vehicles and its operations • To give exposure on architecture and power train components of electrical vehicles • To acquire knowledge on DC and AC drives for electric vehicles • To learn the concepts of energy storage in electric and hybrid vehicles • To study the concepts of fuel cell based electric vehicle design.					
Outcome(s):	At the end of the course, students will be able to, 1. Explain the functionalities of various components in electric/hybrid/plug-in hybrid vehicles. 2. Discuss the components of elective vehicles such as electric motors, batteries. 3. Determine the Power converter drives for electric vehicles 4. Analyze the performance of electric vehicles and energy storage systems. 5. Design fuel cell based electric vehicles.					
UNIT-I	**ELECTRIC VEHICLES AND VEHICLE MECHANICS**					(9)
Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), Engine ratings, Comparisons of EV with internal combustion Engine vehicles, Fundamentals of vehicle mechanics.						
UNIT-II	**ARCHITECTURE OF EV's AND POWER TRAIN COMPONENTS**					(9)
Architecture of EV's and HEV's – Plug-in Hybrid Electric Vehicles (PHEV) - Power train components and sizing, Gears, Clutches, Transmission and Brakes- Safety issues in electric vehicles.						
UNIT-III	**CONTROL OF DC AND AC DRIVES**					(9)
DC/DC chopper based four quadrant operations of DC drives – Inverter based V/F Operation (motoring and braking) of induction motor drive system – Induction motor and permanent motor based vector control operation – Switched reluctance motor (SRM) drives						
UNIT-IV	**PERFORMANCE AND BATTERY ENERGY STORAGE SYSTEMS**					(9)
Electric vehicle verses IC engine vehicle comparison: efficiency comparison legislation and standardizations for electric vehicles –EV performance testing –safety requirements of electric vehicles Battery Basics, Different types, Battery Parameters, Battery modeling, Traction Batteries, Battery monitoring system- Electric Vehicle charging station-charging types.						
UNIT-V	**FUEL CELL BASED EV DESIGN**					(9)
Fuel cell – Characteristics- Types and comparison- electric circuit model of fuel cell – conventional and advanced hydrogen storage system and Fuel cell EV –Selection of FC stack - FC controller – power converters – battery pack and motors – Safety issues for hydrogen based electric vehicles.						
					Total	**45 Hours**
Text book :						
1.	Ali Emadi, MehrdadEhsani, "Vehicular Electric Power Systems" Marcel Dekker, Inc., New York, 2014.					

2.	IqbalHussain, “Electric & Hybrid Vehicles – Design Fundamentals”, Second Edition, CRC Press, 2011.
3.	SandeepDhameja, “Electric Vehicle Battery Systems” Newnes, an imprint of Elsevier, 2013.
References:	
1.	J.M. Miller, “Propulsion Systems for Hybrid Vehicles”, Institution of Electrical Engineers (IEE), London, UK, 2004.
2.	R. Stone and J.K. Bell, “Automotive Engineering Fundamentals”, SAE International, Warrendale,PA, 2004.
3.	James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2003.
4.	Eric ForstaThacher, “ A Solar Car Primer – A guide to the design and construction of solar-powered racing vehicles”, Springer International Publishing Switzerland, 2015.
5.	Hybrid and electric vehicle solutions guide – released by Texas Instruments, 2011 available in www.ti.com/hev.
6	NPTEL Course Electric Vehicles Part 1- Link: https://nptel.ac.in/courses/108/102/108102121/#

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	1	1	-	-	-	-	1	1	-	1
CO2	3	-	-	-	-	1	1	-	-	-	-	1	1	-	1
CO3	2	3	-	-	1	1	1	-	-	-	-	1	1	-	1
CO4	2	3	-	-	-	1	1	-	-	-	-	1	1	-	1
CO5	2	2	3	-	-	1	1	-	-	-	-	1	1	-	1
CO	**2.4**	**2.6**	**3**	**-**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

Regulations 2024

Semester - V/VI
(Common to all B.E./B.Tech. Programmes)

Course code	Course Name	Periods/week			Credit	Maximum marks
		L	T	P	C	
24HS11004	CONSTITUTION OF INDIA	3	0	0	-	100

Objectives	• To know about the salient features of the Constitution of India. • To gain knowledge about structure and functions of Union Government. • To learn about the structure and functions of State Government. • To understand about amendments in Indian Constitution, Judicial review. • To study in detail about the Indian society.
Outcomes	**On completion of the course, the learners should be able to:** • Summarize the features of the Indian Constitution and observe the fundamental duties, rights and responsibilities. • Explain the functioning of Indian parliamentary system at the Center and the responsibilities of important functionaries. • Describe the functioning of State Government and important functionaries. • Recognize Amendments in Indian Constitution and Judicial review. • Illustrate the composition and features of Indian society.

UNIT-I	**INTRODUCTION ABOUTINDIAN CONSTITUTION**	9
Historical Background – Constituent Assembly of India – Role and salient features - Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Citizenship – Constitutional Remedies for citizens.		
UNIT-II	**STRUCTURE AND FUNCTION OF UNION GOVERNMENT**	9
Parliamentary system – Legislature, Executive. Union Government – Structures of the Union Government. Functions and Responsibilities of President – Vice President – Prime Minister – Cabinet – Council of Ministers, Union Territories.		
UNIT-III	**STRUCTURE AND FUNCTION OF STATE GOVERNMENT**	9
State Legislature - State Government – Structure and Functions – Governor – Chief Minister – Cabinet – Special Provisions (Article 370. 371, 371J) for some States. Judicial System in States – High Courts and other Subordinate Courts, Judicial review.		
UNIT-IV	**CONSTITUTION FUNCTIONS, AMENDMENTS AND REVIEW**	9
Indian Federal System – Centre-State Relations – President's Rule – Assessment of working of the Parliamentary System in India - Constitutional Amendments – Methods in Constitutional Amendments (How and Why) and Important Constitutional Amendments. Amendments – 7,9,10,12,42,44, 61, 73, 74, 75, 86, and 91, 94, 95, 100, 101, 118. Savior of the Constitution – The Supreme Court of India – The Hon'ble Chief Justice of India and Hon'ble Judges of the Supreme Court. Judicial Review of Parliamentary and Executive functions.		
UNIT-V	**INDIAN SOCIETY**	9

Society : Nature, Meaning and definition; Indian Social Structure; Caste, Religion, Language in India; Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections - Special Constitutional Provisions for SC & ST, OBC, Special Provision for Women, Children & Backward Classes.	
TOTAL HOURS	**45**

TEXTBOOKS:	
1	Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of India, New Delhi
2	R.C.Agarwal, (1997) "Indian Political System", S.Chand and Company, New Delhi.
REFERENCES:	
1	Sharma, Brij Kishore, "Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.
2	Maciver and Page, " Society: An Introduction Analysis ", Mac Milan India Ltd., New Delhi.
3	K.L.Sharma, (1997) "Social Stratification in India: Issues and Themes", Jawaharlal Nehru University, New Delhi.
4	U.R.Gahai, "Indian Political System ", New Academic Publishing House, Jalaendhar
5	R.N. Sharma, "Indian Social Problems ", Media Promoters and Publishers Pvt. Ltd.

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**				**Programme Code**	**1051**
VI Semester						
Course Code	**Course name**	**Hours/Week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE24601	**ELECTRICAL DRIVES LABORATORY**	**0**	**0**	**3**	**1.5**	**100**
Objective(s)	• To learn the dual core concepts of DSP controller and IPM power module. • To test the characteristics and speed control of special electrical Machines. • To demonstrate the load characteristics of PMSM and SRM.					
Outcomes(s)	At the end of the course, students will be able to, 1. Illustrate dual core DSP controller & IPM power module. 2. Analyze the performance of different types of special electrical machines like SRM, BLDC,5-Phase IM,3 phase LIM and stepper motor. 3. Determine the performance of switched reluctance motor and PMSM motor.					
1.	Study of dual core detail of DSP controller.					
2.	Study of IPM power module.					
3.	Speed control of DC shunt motor using three phase fully controlled converter					
4.	Simulation of closed loop control of converter fed DC motor.					
5.	Simulation of closed loop control of chopper fed DC motor.					
6.	Simulation of VSI fed 3 phase induction motor.					
7.	Simulation of 3 phase synchronous motor drive.					
8.	Load characteristics of 5-Phase Induction motor in open loop mode.					
9.	Speed control of 3 phase Linear Induction motor.					
10.	Simulation of load characteristics of PMSM and switched reluctance motor.					
					Total Hours to be taught	**45 HOURS**
REFERENCES						
	https://www.iitg.ac.in/.../courses/electrical_machines_laboratory.pdf					
	https://ems-iitr.vlabs.ac.in/electrical-machines-(simulation)					

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	1	-	-	1	1	1	1	1	2	1	1
CO2	2	3	-	-	1	-	-	1	1	1	1	1	2	1	1
CO3	2	3	-	-	1	-	-	1	1	1	1	1	2	1	1
CO	**2.3**	**3**	**-**	**-**	**1**	**-**	**-**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
VI Semester						
COURSE CODE	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE24602	**MICROCONTROLLER LABORATORY**	**0**	**0**	**3**	**1.5**	**100**
Objectives	• To impart knowledge on 8051 based programming skills and use them for practical applications. • To learn the concepts of I/O devices. • To develop assembly language for PIC microcontroller					
Outcomes	At the end of the course, students will be able to, 1. Develop the Assembly Language programming for arithmetic operation in 8051 microcontroller. 2. Solve the Assembly Language programming for control operation in 8051 microcontroller 3. Design and develop micro-controller based systems on I/O devices for practical applications.					

LIST OF EXPERIMENTS	
1.	Assembly Language Programming with Arithmetic Operations using 8051
2.	Assembly Language Programming for control instruction(Increment/Decrement, Ascending/ Descending order) using 8051
3.	Assembly Language Programming for control instruction (Maximum/Minimum of numbers, Hex/BCD code conversion) using 8051
4.	Assembly Language Programming for arithmetic, control instructions using PIC microcontroller
Developing Programs using Interface Boards for 8051	
5.	Traffic Light Interface
6.	Keyboard Interface
7.	Display Interface
8.	DAC Interface
9.	ADC Interface
10.	Stepper motor controller interface
	Total **45 Hours**

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	3	-	1	-	-	1	1	1	1	1	2	2	1
CO2	3	-	-	-	1	-	-	1	1	1	1	1	2	2	1
CO3	1	2	3	-	1	-	-	1	1	1	1	1	2	2	1
CO	**1.6**	**2**	**3**	**-**	**1**	**-**	**-**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**				**Programme Code**	**1051**
VI Semester						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE36601	**MINI PROJECT**	**0**	**0**	**3**	**1.5**	**100**
Objectives	• To Identify the area of the project based on core knowledge • To train the students in preparing literature review • To develop simulation model of the Identified problem • To design prototype and validate the result • To cultivate the art of thesis writing					
Outcomes	At the end of the course, students will be able to, 1. Identify the real-time / problems in area of interest 2. Review literature to identified gaps and define objectives & scope of the work. 3. Derive the model for Identified problem using simulation tools 4. Develop prototypes/models, experimental set-up necessary to meet the objectives. 5. Formulate the different modules of the work into thesis/ research paper.					
• The students in a group of 3 to 4 works on a topic approved by the project guide and head of the department. • The progress of the project is evaluated in successive reviews (Min 3). The review committee will be constituted by the Head of the Department. • At end of the semester a project report, experimental setup is required for completion of project work phase I. • The project work is evaluated by external and internal examiners constituted by the Head of the Department based on design, working condition of the project, oral presentation and quality of report.						
					Total	**45 Hours**

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	1	1	1	2	1	3	1	2	2	2
CO2	2	2	3	-	1	1	1	1	2	1	3	1	2	2	2
CO3	2	2	2	3	2	1	1	1	2	1	3	1	2	2	2
CO4	2	2	2	3	2	1	1	1	2	1	3	1	2	2	2
CO5	2	2	3	-	2	1	1	1	2	1	3	1	2	2	2
CO	**2**	**2**	**2.5**	**3**	**1.75**	**1**	**1**	**1**	**2**	**1**	**3**	**1**	**2**	**2**	**2**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
VII Semester						
Course Code	**Course name**	**HOURS/ WEEK**			**CREDIT**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE14701	**POWER SYSTEM CONTROL AND PROTECTION**	**2**	**1**	**0**	**3**	**100**
Objective(s)	• To discuss the frequency controller in power system. • To study about the reactive power flow and voltage control in power system. • To discuss the characteristics and functions of relays protection schemes. • To explore the concepts of circuit breakers. • To impart knowledge on various protective scheme for electrical apparatus.					
Outcome(s)	At the end of the course, students will be able to, 1. Develop the frequency controller in power system. 2. Explain the voltage control methods in power system. 3. Illustrate the working of Relays used in power system protection. 4. Elaborate the construction and operation of circuit breakers in protection. 5. Describe the protective methods for various power system apparatus.					
UNIT I	**REAL POWER-FREQUENCY CONTROL**					**(9)**
Basics of speed governing mechanisms and modeling - speed regulation of two generators in parallel - Load Frequency Control (LFC) of single area system - static and dynamic analysis- state variable model - LFC of two area system - tie line modeling - block diagram representation of two area system - static and dynamic analysis - tie line with frequency bias control .						
UNIT II	**REACTIVE POWER -VOLTAGE CONTROL**					**(9)**
Generation and absorption of reactive power - basics of reactive power control – Automatic Voltage Regulator (AVR) – brushless AC excitation system – block diagram representation of AVR loop - static and dynamic analysis– voltage drop in transmission line - methods of reactive power injection - tap changing transformer, FACTS devices for voltage control.						
UNIT III	**PROTECTIVE RELAYS**					**(9)**
Relays- Essential qualities, Zone of protection, Instrument Transformer, Electromagnetic relays- Over current relay-Directional relay- Distance relays-Negative sequence relay-Under frequency relays- Pilot relay -Buchholz relay. Static and Numeric relay-. Microprocessor based relays.-Relay setting- Relay coordination.						
UNIT IV	**CIRCUIIT BREAKERS**					**(9)**
Physics of arcing phenomenon and arc interruption - DC and AC circuit breaking – re-striking voltage and recovery voltage - rate of rise of recovery voltage - current chopping - interruption of capacitive current - resistance switching- Types of circuit breakers – air, oil, SF6 and vacuum circuit breakers – Rating and selection of Circuit breakers. Fuse-Moulded case circuit breaker (MCCBs)- construction – type- ratting. House Applications, Shutdown and maintenance service.						
UNIT V	**ELECTRICAL APPARATUS PROTECTION**					**(9)**
Differential protection for alternator, transformer, transmission line and busbar –Distance protection for transmission line- Carrier aided protection in lines- Motor protection-Single phasing-Ground fault-Phase Fault- Phase reversal. Overvoltage protection-Causes for Overvoltage- Earth screening- Overhead ground wire- Surge arrester-protection mechanism for photovoltaic system.						
					Total	**45 Hours**

TEXT BOOKS
1. J. Duncan Glover, MulukutlaS.Sarma, Thomas J. Overbye, 'Power System Analysis & Design', Cengage Learning, Fifth Edition, 2012.
2. HadiSaadat, 'Power System Analysis, 'PSA Publishing; Third Edition, 2010.
3. Y.G.Paithankar and S.R.Bhide, 'Fundamentals of power system protection', Second Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
4. D.P.Kothari, I.J.Nagarath, 'Power System Engineering' Tata Mc Graw -Hill Publishing Company limited, New Delhi, 2007
REFERENCES
1. John J. Grainger, William D. Stevenson, Jr, 'Power System Analysis', Mc Graw Hill Education (India) Private Limited, New Delhi, 2015.
2. B.R.Gupta, 'Power System Analysis and Design' S. Chand, New Delhi, Fifth Edition, 2008.
3. Olle.I.Elgerd, 'Electric Energy Systems theory - An introduction', McGraw Hill Education Pvt. Ltd., New Delhi, 34th reprint, 2010.
4. RavindraP.Singh, 'Switchgear and Power System Protection', PHI Learning Private Ltd., New Delhi, 2009.
5. Power system Control NPTEL Link: http://nptel.ac.in/courses/108101040/
6. Power system Protection NPTEL Link: https://nptel.ac.in/courses/108/105/108105167/
7. http://www.electrical-engineering-portal.com/

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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CO2	2	-	-	-	-	-	-	-	-	-	-	1	2	1	2
CO3	3	-	-	-	-	-	-	-	-	-	-	1	2	1	2
CO4	3	-	-	-	-	-	-	-	-	-	-	1	2	1	2
CO5	2	-	-	-	-	-	-	-	-	-	-	1	2	1	2
CO	**2.2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**1**	**2**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**				**Programme Code**	**1051**
VII Semester						
COURSE CODE	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE14702	**EMBEDDED SYSTEMS**	**3**	**0**	**0**	**3**	**100**
Objectives	• To introduce the concepts of Embedded System. • To impart knowledge on input/output interfacing and serial communication protocols. • To give exposure on embedded firmware development environment. • To introduce the concepts and features of Real-time operating systems. • To learn the concepts of embedded systems for various applications.					
Outcomes	At the end of the course, learners will be able to 1. Describe the basics concepts of Embedded Systems. 2. Summarize the process of interfacing basic peripherals. 3. Elaborate various Embedded Development Strategies. 4. Implement Real time operating system for embedded systems. 5. Apply the concepts of Embedded Systems for various applications.					
UNIT I	**INTRODUCTION TO EMBEDDED SYSTEMS**					**(9)**
Introduction to Embedded Systems – The build process for embedded systems- Structural units in Embedded processor, selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging-Overview of functional safety standards for embedded systems.						
UNIT II	**EMBEDDED NETWORKING**					**(9)**
Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols – RS232 standard – RS422 – RS485 – CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I^2C) –Wireless protocol based on Wifi, Bluetooth, Zigbee-need for device drivers.						
UNIT III	**EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT**					**(9)**
Embedded Product Development Life Cycle- objectives, different phases of EDLC, Modelling of EDLC; Issues in Hardware-software Co-design, Data Flow Graph, state machine model, Sequential Program Model, concurrent Model, object oriented Model.						
UNIT IV	**RTOS BASED EMBEDDED SYSTEM DESIGN**					**(9)**
Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing` and Multitasking, Preemptive and non-preemptive scheduling, Task communication shared memory, message passing-, Inter process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance, comparison of Real time Operating systems: Vx Works, µC/OS-II, RT Linux.						
UNIT V	**EMBEDDED SYSTEM APPLICATION DEVELOPMENT**					**(9)**
Case Study of Washing Machine- Automotive Application- Smart card System Application-ATM machine –Digital camera-smart phone -Adaptive Cruise control in a Car, Mobile Phone software for key inputs.						
					Total	**45 Hours**
TEXT BOOKS						

1.	Shibu. K.V, “Introduction to Embedded Systems”, 2e, Mc graw Hill, 2017.
2.	Peckol, “Embedded system Design”, John Wiley & Sons,2010
3.	Lyla B Das,” Embedded Systems-An Integrated Approach”, Pearson, 2013
REFERENCES	
1.	Raj Kamal, ‘Embedded System-Architecture, Programming, Design’, Mc Graw Hill, 2013.
2.	C.R.Sarma, “Embedded Systems Engineering”, University Press (India) Pvt. Ltd, 2013.
3.	Tammy Noergaard, “Embedded Systems Architecture”, Elsevier, 2006.
4.	Han-Way Huang, “Embedded system Design Using C8051”, Cengage Learning, 2009.
5.	Rajib Mall “Real-Time systems Theory and Practice” Pearson Education, 2007.
6.	NPTEL Link: Embedded System https://nptel.ac.in/courses/108/102/108102045/ https://nptel.ac.in/courses/108/105/108105057/

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	1	-	-	-	-	1	-	1	2	2	1
CO2	2	-	-	-	1	1	1	-	-	1	-	1	2	2	1
CO3	3	-	-	-	1	1	1	-	-	1	-	1	2	2	1
CO4	3	-	-	-	1	1	1	-	-	1	-	1	2	2	1
CO5	3	-	-	-	1	1	1	-	-	1	-	1	2	2	1
CO	**2.6**	**-**	**-**	**-**	**1**	**1**	**1**	**-**	**-**	**1**	**-**	**1**	**2**	**2**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)					
Syllabus-R2024					
Department	**Electrical and Electronics Engineering**		**Programme Code**		**1051**
VII Semester					
Course code	Course name	Hours / week			Credit
		L	T	P	C
	PRINCIPLES OF MANAGEMENT	3	0	0	3
Objective(s)	• To expose the students to understand the basic concepts of management process. • To inculcate how an organization functions. • To inculcate the complexity and wide variety of issues faced by the managers in today's business firms. • To explain and direct how to motivate the organization culture with effective communication. • To apply the control study with different process of controlling				
Outcomes(s)	1. Explain the concept of Management in Organization 2. Plan the concepts and Decision making process 3. Discuss the Organizational structures and staffing process 4. Apply Motivational theories and understand communication process 5. Apply the process and techniques of controlling				
UNIT-I INTRODUCTION TO MANAGEMENT					**9**
Organization- Management- Roles & Skills of managers- Evolution of management thought-Taylor, Fayol, Mary Follet, Elton Mayo and Peter Ducker- Organization and the environmental factors- International business Strategies.					
UNIT-II PLANNING					**9**
Importance of planning- Planning process- Types of plans- Objectives- Managing by Objective (MBO) - strategies- Types of strategies – Policies – Decision Making- Types of decision- Decision making process- Rational decision making process- Decision making under different conditions.					
UNIT-III ORGANISING					**9**
Purpose of organizing- Formal and informal organization- Organization structure and its types Departmentation - Span of control- Centralization and decentralization- Authority and Responsibility -Line and staff authority - Staffing- Recruitment- Selection – Orientation- Training- Performance appraisal - Career development- Career stages.					
UNIT-IV DIRECTING					**9**
Directing and coordination - Characteristics - Motivation Theories-Leadership Theories- Communication- Hurdles to effective communication- Organization culture- Elements and types of culture- Managing cultural diversity.					
UNIT-V CONTROLLING					**9**

Process of controlling- Types of control- Budgetary and non-budgetary control techniques- Managing productivity- Cost control- Purchase control- Maintenance control- Quality control- Best Management Practices across the world.	
Total Hours to be taught	**(L:45 T:00): 45 HOURS**
Text Books:	
1	Andrew J. Dubrin, Essentials of Management, Thomson Southwestern, 9th edition, 2012.
2	Harold Koontz, and Heinz Weihrich, Essentials of Management, An International and Leadership Perspective, 9th edition, McGraw Hill, 2013.
References:	
1	Samuel C. Certo and Tervis Certo, Modern management: concepts and skills, Pearson education, 12th edition, 2012.
2	Charles W.L Hill and Steven L McShane, 'Principles of Management, McGraw Hill Education, Special Indian Edition, 2007.
3	Richard L. Daft, The New Era of Management, Thomson Southwestern, 10th edition, 2007.
4	R.Saravanan & R.Karuppasamy Management Principles Sci Tech Publications (India) Pvt.Ltd., 2009
5	Stoner, Freeman and Gilbert Jr.Management, Pearson Education, Sixth Edition,Second Impression 2007.
Extensive Reading:	
	P C Tripathi P N Reddy Principles of Management Tata McGraw Hill 2006
	V.S.P Rao V.Hari Krishna Management : Text and Cases Excel Books 2002
Websites:	
	http://en.wikiversity.org/wiki/ http://www.managementparadise.com http://education-portal.com/academy/topic/theories-ofmanagement.html http://www.druckerinstitute.com/link/about-peterdrucker/ http://www.forbes.com/2009/10/13/influentialbusiness-thinkers-leadership-thought-leaderschart.html http://www.globalgurus.org/management/index.php 11. https://www.mdi-training.com

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
VII Semester						
COURSE CODE	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE24701	**POWER SYSTEM SIMULATION LABORATORY**	**0**	**0**	**3**	**1.5**	**100**
Objectives	• To discuss the transmission line and formulate the bus admittance and impedance matrix for a given power system network. • To acquire knowledge on the power flow, short circuit, stability for a given power system and solve the economic dispatch problem and load frequency control in power generation. • To learn about the solar, wind and hybrid power generation system.					
Outcomes	At the end of the course, students will be able to, 1. Determine the bus admittance and impedance of a power system network. 2. Analyze the power flow, short circuit, stability for a power system networkand solve the economic dispatch problem and load frequency control in power generation. 3. Design the solar, wind and hybrid power generation system.					

LIST OF EXPERIMENTS	
1.	Computation of transmission line Parameters
2.	Modeling of Transmission line for short ,medium and long transmission line
3.	Formation of Bus Admittance and Impedance Matrices.
4.	Load Flow Analysis - I : Solution of load flow and related problems using Gauss-Seidel Method
5.	Load Flow Analysis - II: Solution of load flow and related problems using Newton Raphson.
6.	Symmetrical and unsymmetrical fault analysis in the power system.
7.	Stability Analysis for Single-Machine Infinite Bus System.
8.	Load – Frequency Dynamics of Single- Area and Two area system
9.	Economic Dispatch in Power Systems.
10.	Simulation on PV Energy System
11.	Simulation on Wind Energy Generator.
12.	Simulation on Hybrid (Solar-Wind) Power System.
	Total **45 Hours**

Reference	
1.	https://www.vlab.co.in/

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	-	2	1	1	-	1	1	-	1	1	2	1
CO2	2	3	2	-	2	1	1	-	1	1	-	1	1	2	1
CO3	2	2	3	-	2	1	1	-	1	1	-	1	1	2	1
CO	**2**	**2.6**	**2.6**	**-**	**2**	**1**	**1**	**-**	**1**	**1**	**-**	**1**	**1**	**2**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)			
Syllabus-R2024			
Department	**Electrical and Electronics Engineering**	**Programme Code**	**1051**

VII Semester

COURSE CODE	COURSE NAME	Hours/week			Credit	Maximum Marks
		L	T	P	C	
24EE24702	**EMBEDDED SYSTEMS LABORATORY**	**0**	**0**	**3**	**1.5**	**100**

Objectives	• To impart knowledge on the functions of Light emitting diode • To familiarize the concept of Arduino • To impart knowledge on interfacing DC motor and 7 segment Display using Arduino
Outcomes	At the end of the course, students will be able to, 1. Apply the logical functions and interfacing the Light emitting diode using Arduino 2. Demonstrate the interfacing DC motor and 7 segment Display using Arduino 3. Evaluate the distance using Ultrasonic sensor and activate the DC Relay module

LIST OF EXPERIMENTS

1.	LED blinking and LED fading using Arduino.
2.	Interfacing LED and PWM using Arduino.
3.	Implementation of Traffic light controller using Arduino Uno.
4.	Making switching operation from analog input using Arduino.
5.	RGB LED blinking of Arduino.
6.	Making sounds using Arduino.
7.	Interfacing DC motor and temperature sensor using Raspberrypi.
8	Writing and execution the 1 digit and 4 digit 7 Segment Displays using Arduino.
9.	Finding the various distance using Ultrasonic sensor by Arduino.
10.	Activate the DC Relay module by using Arduino.
	Total **45 Hours**

REFERENCES

1.	http://vlabs.iitkgp.ac.in/rtes/

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	2	1	1	1	1	1	-	1	1	2	-
CO2	3	-	-	-	2	1	1	1	1	1	-	1	1	2	-
CO3	3	-	-	-	2	1	1	1	1	1	-	1	1	2	-
CO	**3**	**-**	**-**	**-**	**2**	**1**	**1**	**1**	**1**	**1**	**-**	**1**	**1**	**2**	**-**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**				**Programme Code**	**1051**
VII Semester						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE36701	**PROJECT WORK(PHASE I)**	**0**	**0**	**6**	**3**	**100**
Objectives	• To Identify the area of the project based on core knowledge • To train the students in preparing literature review • To develop simulation model of the Identified problem • To design prototype and validate the result • To cultivate the art of thesis writing					
Outcomes	At the end of the course, students will be able to, 1. Identify the real-time / problems in area of interest 2. Review literature to identify gaps and define objectives & scope of the work. 3. Model the Identified problem using simulation tools 4. Develop a prototypes/models, experimental set-up necessary to meet the objectives. 5. Formulate the different modules of the work into thesis/ research paper.					
• The students in a group of 3 to 4 works on a topic approved by the project guide and head of the department. • The progress of the project is evaluated in successive reviews (Min 3). The review committee will be constituted by the Head of the Department. • At end of the semester a project report, experimental setup are required for completion of project work phase I. • The project work is evaluated by external and internal examiners constituted by the Head of the Department based on design, working condition of the project, oral presentation and quality of report.						
					Total Hours	**L:0 T:0 P:90 (90 HOURS)**

CO MAPPING WITH POs AND PSOs

S.NO.	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	2	2	2	-	-	2	2	2	2	2	2	2	3	3	3
CO2	2	2	3	-	-	2	2	2	2	2	2	2	3	3	3
CO3	2	2	3	-	2	2	2	2	2	2	2	2	3	3	3
CO4	2	2	3	3	2	2	2	2	2	2	2	2	3	3	3
CO5	2	2	3	3	2	2	2	2	2	2	2	2	3	3	3
CO	**2.0**	**2.0**	**2.8**	**3.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.2**	**3.0**	**3.0**	**3.0**

"-" - No correlation , "1" - Lower correlation , "2" - Moderate correlation , "3" – Higher correlation

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**				**Programme Code**	**1051**
VIII Semester						
Course code	**Course name**	**Hours/Week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
24EE36801	**PROJECT WORK(PHASE II)**	**0**	**0**	**12**	**6**	**100**
Objective(s)	• To Identify the area of the project based on core knowledge • To train the students in preparing literature review • To develop simulation model of the Identified problem • To design prototype and validate the result • To cultivate the art of thesis writing					
Outcome(s)	At the end of the course, students will be able to, 1. Identify the real-time / problems in area of interest 2. Review literature for the project work 3. Analyze the results to draw valid conclusions 4. Develop prototypes/models, experimental set-up and prepare a report 5. Explore the possibility of publishing papers in peer reviewed journals/conference proceedings					

- A project must be selected through literature survey or continuation of Phase I in consultation with their Guide.
- Design and development of a model is carried out progressively
- The progress of the project work is evaluated through periodical reviews. The review committee will be constituted by the Head of the Department.
- Detailed Project report with hardware setup and minimum one publication in either Journal/ Conference is mandatory for the successful completion of the work.
- The project work is evaluated by external and internal examiners constituted by the Head of the Department based on design, working condition of the project, oral presentation and quality of report.

Total Hours	**L:0 T:0 P:180 (180 HOURS)**

CO MAPPING WITH POs AND PSOs

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	2	2	2	2	2	2	2	3	2	3
CO2	2	2	2	2	2	2	2	2	2	2	2	2	3	2	3
CO3	2	3	3	3	2	2	2	2	2	2	2	2	3	2	3
CO4	2	2	3	-	2	2	2	2	2	2	2	2	3	2	3
CO5	2	2	2	3	2	2	2	2	2	2	2	2	3	2	3
CO	**2**	**2**	**2**	**3**	**2**	**2**	**2.0**	**2**	**2**	**2**	**2**	**2**	**3**	**2.0**	**3.0**

"-" - No correlation , "1" - Lower correlation , "2" - Moderate correlation , "3" – Higher correlation.

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
COURSE CODE	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE15001	**ELECTRICAL SAFETY**	**3**	**0**	**0**	**3**	**100**
Objectives	• To acquire knowledge on basics of electrical fire safety and statutory requirements • To discuss the causes of accidents due to electrical hazards • To study the various protection systems in industries • To learn the process of selection, installation, operation and maintenance in industries • To impart knowledge on hazardous zones					
Outcomes	At the end of the course, students will be able to, 1. Discuss the basic concepts in electrical circuit and hazards 2. Summarize the electrical hazards in Industries 3. Explain the various protection systems of electrical hazard 4. Describe the process of selection, installation, operation and maintenance in industries 5. Summarize the various hazardous zones					
UNIT I	**CONCEPTS AND STATUTORY REQUIREMENTS**					**(9)**
Introduction – electrostatics, electro magnetism, stored energy, energy radiation and electromagnetic interference – Working principles of electrical equipment-Indian electricity act and rules-statutory requirements from electrical inspectorate-international standards on electrical safety – first aid-cardio pulmonary resuscitation(CPR).						
UNIT II	**ELECTRICAL HAZARDS**					**(9)**
Primary and secondary hazards-Human safety in the use of electricity, Energy leakage-clearances and insulation-classes of insulation-voltage classifications-excess energy-current surges-Safety in handling of war equipments-over current and short circuit current-heating effects of current-electromagnetic forces-corona effect-static electricity –Sources, hazardous conditions, control, electrical causes of fire and explosion-ionization, spark and arc-ignition energy-national electrical safety code ANSI. Lightning, hazards, lightning arrestor, installation – earthing, specifications, earth resistance, earth pit maintenance.						
UNIT III	**PROTECTION SYSTEMS**					**(9)**
Fuse, circuit breakers and overload relays – protection against over voltage and under voltage – safe limits of amperage – voltage –safe distance from lines-capacity and protection of conductor-joints-and connections, overload and short circuit protection-no load protection-earth fault protection. FRLS insulation-insulation and continuity test-system grounding-equipment grounding-earth leakage circuit breaker (ELCB)-cable wires-maintenance of ground-ground fault circuit interrupter-use of low voltage-electrical guards-Personal protective equipment – safety in handling hand held electrical appliances tools and medical equipments.						
UNIT IV	**SELECTION, INSTALLATION, OPERATION AND MAINTENANCE**					**(9)**

Role of environment in selection-safety aspects in application - protection and interlock-self diagnostic features and fail safe concepts-lock out and work permit system-discharge rod and earthing devices-safety in the use of portable tools-cabling and cable joints-preventive maintenance.		
UNIT V	**HAZARDOUS ZONES**	**(9)**
Classification of hazardous zones-intrinsically safe and explosion proof electrical apparatus-increase safe equipment-their selection for different zones-temperature classification-grouping of gases-use of barriers and isolators-equipment certifying agencies-Case Studies.		
	Total	**45 Hours**

TEXT BOOKS

1.	Accident prevention manual for industrial operations", N.S.C., Chicago, 2010.
2.	Indian Electricity Act and Rules, Government of India. Link : https://www.indiacode.nic.in
3.	Power Engineers – Handbook of TNEB, Chennai, 2009

REFERENCES

1.	Fordham Cooper, W., "Electrical Safety Engineering" Butterworth and Company, London, 2006
2.	Martin Glov Electrostatic Hazards in powder handling, Research Studies Pvt. Ltd., England, 2008.
3.	NPTEL Electricity & Safety Measures Link: https://onlinecourses.swayam2.ac.in/nou20_cs08/preview

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	1	1	1	-	-	-	1	1	-	1
CO2	2	-	-	-	-	1	1	1	-	-	-	1	1	-	1
CO3	2	-	-	-	-	1	1	1	-	-	-	1	1	-	1
CO4	2	-	-	-	-	1	1	1	-	-	-	1	1	-	1
CO5	2	-	-	-	-	1	1	1	-	-	-	1	1	-	1
CO	**2**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE15002	**POWER QUALITY**	**3**	**0**	**0**	**3**	**100**
Objectives	• To introduce the various power quality issues • To learn the concept of power and power factor in single phase and three phase systems supplying nonlinear loads • To acquire knowledge on production of voltages sags and swell and the methods of control • To study the sources and effect of harmonics in power system • To impart knowledge on various methods of power quality monitoring					
Outcomes	After completion the above subject, students will be able to 1. Explain the concept of power quality disturbances, their causes, detrimental effects and knowledge about national and international Power quality standards 2. Elaborate the concepts of impact of harmonics in single phase and three phase distribution systems 3. Analyze the voltage sags interruptions under various faulted conditions. 4. Explain harmonics, transients, voltage & current distortion in power systems. 5. Discuss the concepts of commonly used power quality monitoring tools.					
UNIT I	**INTRODUCTION**					**9**
Introduction – Characterization of Electric Power Quality: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation,Harmonics- Power acceptability curves – power quality problems: poor load power factor, Non linear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage – Power quality standards.						
UNIT II	**ANALYSIS OF SINGLE PHASE AND THREE PHASE SYSTEM**					**9**
Single phase linear and non linear loads –single phase sinusoidal, non sinusoidal source – supplying linear and nonlinear load – three phase Balance system – three phase unbalanced system – three phase unbalanced and distorted source supplying non linear loads – concept of power factor – three phase three wire – three phase four wire system.						
UNIT III	**VOLTAGE SAGS AND SWELL**					**9**
Estimating voltage sag performance. Thevenin's equivalent source - analysis and calculation of various faulted condition. Estimation of the sag severity - mitigation of voltage sags, active series compensators. Static transfer switches and fast transfer switches. Sources of over voltages - Capacitor switching – lightning - ferro resonance. Mitigation of voltage swells - surge arresters - low pass filters - power conditioners.						
UNIT IV	**HARMONICS**					**9**
Harmonic sources from commercial and industrial loads, locating harmonic sources. Power system response characteristics - Harmonics Vs transients. Effect of harmonics - harmonic distortion – voltage and current distortion - harmonic indices - inter harmonics – resonance. Harmonic distortion evaluation - devices for controlling harmonic distortion - passive and active filters. IEEE and IEC standards.						

UNIT V	POWER QUALITY MONITORING	9
Monitoring diagnosis, Deregulation effect on power quality monitoring- monitoring and diagnostic techniques for various power quality problems - modeling of power quality (harmonics and voltage sag) problems by mathematical simulation tools - power line disturbance analyzer – quality measurement equipment - harmonic / spectrum analyzer - flicker meters - disturbance analyzer.		
	Total	**45 Hours**

TEXT BOOKS	
1.	ArindamGhosh “Power Quality Enhancement Using Custom Power Devices”, Kluwer Academic Publishers, 2002
2.	G.T.Heydt, “Electric Power Quality”, Stars in a Circle Publications, 2nd edition, 1994.
3.	Roger C. Dugan, “Electrical Power Systems Quality”, McGraw Hill Education; 3rd edition, 2017
4.	https://onlinecourses.nptel.ac.in/noc21_ee103/preview
REFERENCES	
1.	E.Aeha and M.Madrigal, “Power System Harmonics, Computer Modelling and Analysis“ Wiley India, 2012.
2.	R.S.Vedam, M.S.Sarma, “Power Quality – VAR Compensation in Power Systems,” CRC Press 2013.
3.	http://www.electrotek.com/basic-power-quality-training/

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	1	1	-	-	-	1	1	-	1
CO2	3	-	-	-	-	-	1	1	-	-	-	1	1	-	1
CO3	2	3	-	-	-	-	1	1	-	-	-	1	1	-	1
CO4	2	-	-	-	-	-	1	1	-	-	-	1	1	-	1
CO5	2	-	-	-	-	-	1	1	-	-	-	1	1	-	1
CO	**2.2**	**3**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
COURSE CODE	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE15003	**ELECTRIC POWER UTILIZATION AND CONSERVATION**	**3**	**0**	**0**	**3**	**100**
Objectives	• To learn the concepts of Electric drives and Traction systems. • To acquire the basic Principles of illumination and various lighting systems. • To discuss the working of various devices used by industry for effective utilization of electrical power. • To study the concepts of electrolytic process and electricity storage. • To explore the conservation of Low Tension and High Tension Tariff Structure.					
Outcomes	At the end of the course, students will be able to, 1. Explain the operation of electric traction systems and their performance. 2. Summarize different light sources for various illumination systems 3. Illustrate different applications of electric heating and electric welding 4. Apply the concepts of electro chemical process in various electricity storages. 5. Calculate the Tariff Structure of electrical energy utilization.					
UNIT I	**ELECTRIC DRIVES AND TRACTION**					**(9)**
Fundamentals of electric drive - Choice of an traction motor - Characteristic features of traction motor - Systems of electric traction - Power supply systems for track-electrification - - Various methods of starting and speed control of DC and AC drives used in traction - Comparison and application of different traction systems - Electric braking - Recent trends in electric traction.						
UNIT II	**ILLUMINATION**					**(9)**
Terminologies used in illumination engineering - Laws of illumination- Requirement of good lighting - Classification of light sources - Incandescent lamps, sodium vapor lamps, mercury vapor lamps, neon lamps– Design of illumination systems - Indoor lighting schemes - Outdoor lighting schemes - LED.						
UNIT III	**INDUSTRIAL HEATING AND WELDING**					**(9)**
Role of electric heating for industrial applications – Resistance heating – Induction heating – Dielectric heating – Microwave heating- Electric arc furnaces – Induction furnace- Brief introduction to electric welding –AC and DC arc welding - Welding generator - Welding transformer and its characteristics.						
UNIT IV	**ELECTROLYTIC PROCESS**					**(9)**
Electrolysis -Faradays laws of electrolysis- Electroplating - Factors affecting electro-deposition -Types & construction, Charging & discharging - Recent trends in manufacturing of batteries - lead acid - Nickel iron - Nickel cadmium batteries.						
UNIT V	**CONSERVATION**					**(9)**
Importance of electricity conservation- Economic Low Tension and High Tension Tariff Structure – Impact of Tariff – Power factor Improvement Methods- Impact of Power factor on HT Billing- Introduction to Electrical energy Conservation and methods - Energy Auditing – Electrical energy conservation in India.						
					Total	**45 Hours**

TEXT BOOKS	
1.	C. L. Wadhwa's Generation Distribution and Utilization of Electrical Energy – Third Edition, published by New Age International, is a comprehensive book for undergraduate students of various Indian universities.2014.
2.	J.B.Gupta, "Utilisation Electric power and Electric Traction", S.K.Kataria and Sons, 2000.
3.	C.L. Wadhwa, „Generat ion, Distribution and Utilization of Electrical Energy", New Age International Pvt. ltd, 2010.
REFERENCES	
1.	R.K.Rajput, Utilization of Electric Power, Laxmi publications Private Limited.,2007.
2.	H.Partab, Art and Science of Utilization of Electrical Energy", DhanpatRai and Co., New Delhi, 2004.
3.	S. Sivanagaraju, M. Balasubba Reddy, D. Srilatha,' Generation and Utilization of Electrical Energy', Pearson Education, 2010.
4.	https://nptel.ac.in/courses/121/106/121106014/

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	1	1	-	1
CO2	2	-	-	-	-	-	-	-	-	-	-	1	1	-	1
CO3	3	-	-	-	-	-	-	-	-	-	-	1	1	-	1
CO4	3	-	-	-	-	-	-	-	-	-	-	1	1	-	1
CO5	3	-	-	-	-	-	1	1	-	-	-	1	1	-	1
CO	**2.6**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electronics Communication Engineering**			**Programme Code**		**1041**
Program Elective						
Course code	**Course name**	**Hours/Week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE15004	**CONTROL SYSTEMS ENGINEERING**	**3**	**0**	**0**	**3**	**100**
Objective(s)	• Understand the usage of block diagrams and signal flow graph in the mathematical modelling of physical systems • Provide adequate knowledge in the time response of systems and steady state error analysis • Impart knowledge of the open loop and closed loop frequency responses of systems • Provide summary of stability analysis and the design of compensators • Acquire knowledge of state space model of physical system, controllability and observability using a state variables					
UNIT-I	**INTRODUCTION**					(9)
Control system - Basic components - Open and closed Loop - Effect of feedback – System representations - Transfer functions of single input & single output and multivariable systems – Block diagrams – Signal flow graphs – Gain formula – Modeling of control components – Mechanical and electrical systems						
UNIT-II	**TIME RESPONSE ANALYSIS**					(9)
Transient response- standard test signals -steady state response-Measures of performance of the standard first order and second order system-steady state error- static and dynamic steady state error constant- type of a system.						
UNIT-III	**FREQUENCY RESPONSE ANALYSIS**					(9)
Closed loop frequency response-Performance specification in frequency domain-Frequency response of standard second order system- Bode Plot – Polar Plot- constant M and N circles.						
UNIT-IV	**STABILITY ANALYSIS**					(9)
Concept of stability-Bounded – Input Bounded – Output stability-Routh stability criterion-Relative stability-Root locus concept-Guidelines for sketching root locus- Types of compensators.						
UNIT-V	**STATE VARIABLE ANALYSIS**					(9)
Concept of state variables – State models for linear and time invariant Systems – Solution of state and output equation in controllable canonical form – Concepts of controllability and observability – Effect of state feedback.						
				Total Hours to be taught		**L:45 T:00(45 Hours)**
Outcome(s)	1. Apply the mathematical modelling and simplification techniques in control systems 2. Analyze the system responses and stability in time domain					

	3. Analyze the system responses and stability in frequency domain 4. Apply the Root locus and the Routh Hurwitz criterion for a system transfer function to assess the system's stability 5. Examine the state space model of systems stability, controllability and observability using state variables
Text book(s) :	
1.	M. Gopal, Control Systems, 'Principles and Design', 4th Edition, Tata McGraw Hill, New Delhi, 2017.
2.	S.K.Bhattacharya, 'Control System Engineering', 3rd Edition, Pearson, 2013.
3.	K. Ogata, 'Modern Control Engineering', 5th edition, PHI, 2012.
4.	Dhanesh. N. Manik, Control System, Cengage Learning, 2012.
References:	
1.	Richard C. Dorf and Robert H. Bishop, 'Modern Control Systems', Pearson Prentice Hall, 2016.
2.	Arthur, G.O.Mutambara, 'Design and Analysis of Control Systems, CRC Press, 2009
3.	Benjamin C. Kuo, Automatic Control systems, 7th Edition, PHI, 2010.

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	1	-	-	1	-	-	-	1	1	2	1
CO2	2	-	-	-	1	-	-	1	-	-	-	1	1	2	1
CO3	2	-	-	-	1	-	-	1	-	-	-	1	1	2	1
CO4	3	-	-	-	1	-	-	1	-	-	-	1	1	2	1
CO5	2	-	-	-	1	-	-	1	-	-	-	1	1	2	1
CO	**2.2**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**1**	**2**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE15005	**DESIGN OF ELECTRICAL MACHINES**	**3**	**0**	**0**	**3**	**100**
Objectives	• To study electrical engineering materials and thermal rating of various types of electrical machines. • To acquire knowledge for deriving the armature and field systems for DC machines. • To learn the core, yoke, windings and cooling systems of transformers. • To discuss the design procedure of stator and rotor of induction machines. • To gain the design knowledge of stator and rotor of synchronous machines and study their thermal behavior.					
Outcomes	At the end of the course, students will be able to, 1. Explain the design considerations ,choice of materials for loadings ,Insulation selection 2. Calculate the main dimensions of armature and field systems for D.C. machines. 3. Design the single phase and three phase transformers for the given specification 4. Estimate the design parameters for three phase induction machine. 5. Design the synchronous machine for the given ratings.					
UNIT I	**INTRODUCTION**					**(9)**
Major considerations in Electrical Machine Design - Electrical Engineering Materials – Space factor – Choice of Specific Electrical and Magnetic loadings - Thermal considerations - Heat flow – Temperature rise and Insulating Materials – Standard specifications.						
UNIT II	**DC MACHINES**					**(9)**
Output Equations – Main Dimensions – Choice of Specific Electric and Magnetic Loading - Magnetic Circuits Calculations - Net length of Iron –Real & Apparent flux densities – Selection of number of poles – Design of Armature – Design of commutator and brushes.						
UNIT III	**TRANSFORMERS**					**(9)**
Output Equations – Main Dimensions - kVA output for single and three phase transformers – Window space factor – Design of core and winding – Overall dimensions – Operating characteristics – No load current – Temperature rise in Transformers – Design of Tank - Methods of cooling of Transformers.						
UNIT IV	**INDUCTION MOTORS**					**(9)**
Output equation of Induction motor – Main dimensions – Choice of Average flux density – Length of air gap- Rules for selecting rotor slots of squirrel cage machines – Design of rotor bars & slots – Design of end rings – Design of wound rotor – Magnetic leakage calculations – Leakage reactance of polyphase machines- Magnetizing current - Short circuit current – Operating characteristics- Losses and Efficiency-Introduction to Energy Efficient Motors.						
UNIT V	**SYNCHRONOUS MACHINES**					**(9)**
Output equations – choice of Electrical and Magnetic Loading – Design of salient pole machines – Short circuit ratio – shape of pole face – Armature design – Armature parameters – Estimation of air						

gap length – Design of rotor –Design of damper winding – Determination of full load field mmf – Design of field winding – Design of turbo alternators – Rotor design	
Total	**45 Hours**

TEXT BOOKS

1.	Sawhney, A.K., 'A Course in Electrical Machine Design', DhanpatRai& Sons, New Delhi, 2013.
2.	M.V.Deshpande 'Design and Testing of Electrical Machine Design', Wheeler Publications, 2010.

REFERENCES

1.	A.ShanmugaSundaram, G.Gangadharan, R.Palani 'Electrical Machine Design Data Book', New Age International Pvt. Ltd., Reprint, 2007.
2.	R.K.Agarwal ,'Principles of Electrical Machine Design', Esskay Publications, Delhi, 2012.
3.	Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programmes ', Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2nd Edition, 2006.
4.	NPTEL: https://nptel.ac.in/courses/108/102/108102146/ https://nptel.ac.in/courses/108/105/108105131/
5.	https://www.researchgate.net/publication/322947351_Modern_Electrical_Machine_Design_Optimization_Techniques_Trends_and_Best_Practices

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	1	-	-	-	1	1	-	1
CO2	2	3	-	-	-	-	-	1	-	-	-	1	1	-	1
CO3	2	2	3	-	-	-	-	1	-	-	-	1	1	-	1
CO4	2	3	-	-	-	-	-	1	-	-	-	1	1	-	1
CO5	2	2	3	-	-	-	-	1	-	-	-	1	1	-	1
CO	**2**	**2.5**	**3**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE15006	**HIGH VOLTAGE ENGINEERING**	**3**	**0**	**0**	**3**	**100**
Objectives	• To study the various types of over voltages in power system and protection methods. • To learn the concepts of breakdown mechanism in solid, liquid and gaseous dielectrics. • To explore knowledge on the generation of high voltages and currents. • To acquire the knowledge on different methods of measurement of over voltages and currents. • To gain the knowledge for testing of power apparatus and insulation coordination.					
Outcomes	After the completion of the course, the students will be able to: 1. Explain various over voltages and protection methods. 2. Analyze the breakdown mechanism of solids, liquids and gases. 3. Analyze the circuit parameters involved in generation of high voltages. 4. Apply the methods of measuring direct, alternating and impulse high voltage signals. 5. Estimate the dielectric loss and partial discharge involved in non-destructive high voltage tests.					
UNIT I	**OVER VOLTAGES AND INSULATION COORDINATION**					**9**
Causes of over voltages and its effects on power system – Lightning, switching surges and temporary over voltages – Estimation of over voltages- Reflection and Refraction of Travelling waves- Protection against over voltages, surge diverters, surge modifiers.						
UNIT II	**DIELECTRIC BREAKDOWN**					**9**
Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacuum breakdown – Characteristics, Conduction and breakdown in pure and commercial liquids, Maintenance of oil Quality – Breakdown mechanisms in solidand composite dielectrics.						
UNIT III	**GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS**					**9**
Generation of High DC, AC, impulse voltages and currents - Triggering and control of impulse generators.						
UNIT IV	**MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS**					**9**
High Resistance with series ammeter – Dividers, Resistance, Capacitance and Mixed dividers -Peak Voltmeter, Generating Voltmeters - Capacitance Voltage Transformers, Electrostatic Voltmeters – Sphere Gaps - High current shunts- Digital techniques in high voltage measurement.						
UNIT V	**HIGH VOLTAGE TESTING OF EQUIPMENT AND HIGH VOLTAGE LABORATORIES**					**9**
Indian Standards/IEC specification for testing – high voltage testing of insulators, bushing, circuit breakers, isolators, cables, transformers and surge diverters.						
					Total	**45 Hours**
TEXT BOOKS						

1.	S.Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2013.
2.	E. Kuffel and W.S. Zaengl, J.Kuffel, 'High voltage Engineering fundamentals', Newnes Second Edition Elsevier , New Delhi, 2005.
3.	SubirRay,'An Introduction to High Voltage Engineering', PHI Learning Private Limited, New Delhi, Second Edition, 2013.
REFERENCES	
1.	L.L. Alston, 'High Voltage Technology', Oxford University Press, First Indian Edition, 2011.
2.	C.L. Wadhwa, 'High voltage Engineering', New Age International Publishers, Third Edition, 2010.

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	1	1	-	-	-	-	1	1	-	1
CO2	2	3	-	-	-	1	1	-	-	-	-	1	1	-	1
CO3	2	3	-	-	-	1	1	-	-	-	-	1	1	-	1
CO4	3	-	-	-	-	1	1	-	-	-	-	1	1	-	1
CO5	2	2	3	-	-	1	1	-	-	-	-	1	1	-	1
CO	**2.2**	**2.6**	**3**	**-**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**	**1051**	
Program Elective						
Course code	**Course name**	**Hours/Week**			**Credit**	**Maximum marks**
24EE15007	**EV BATTERIES AND CHARGING SYSTEMS**	**L**	**T**	**P**	**C**	**100**
		3	**0**	**0**	**3**	
Objective(s)	• To acquire the knowledge on energy system in electric vehicles • To gain the knowledge on battery technologies • To discuss the operation of charging infrastructure • To learn various power converters for charging • To apply the concepts in effective energy management					
Outcome(s):	After the completion of the course, the students will be able to: 1. Explain the working of various battery technologies 2. Explain the characteristics of batteries through modeling 3. Describe the charging system for grid and renewable energy 4. Describe the role of power converters in electric vehicle charging 5. Illustrate the components and working of EVSE technologies					
UNIT-I	**ELECTROCHEMICAL BATTERIES**					**9**
Electrochemical reactions – Thermodynamic voltage – Specific energy – Specific power – Energy efficiency – Battery Technologies–Lead acid batteries, Nickel-based batteries and Lithium based batteries.						
UNIT-II	**EV BATTERY TECHNOLOGIES**					**9**
Energy storage issues- Battery Chemistries, battery modeling and simulation – Lithium-ion batteries- Characteristics – Cycle life versus State of Charge.						
UNIT-III	**CHARGING SYSTEM**					**9**
Charging regimes for batteries- Battery parameters, charging methods, termination methods and charging algorithm – Charging from grid – Charging from renewable energy sources.						
UNIT-IV	**POWER CONVERTERS FOR CHARGING**					**9**
Grid and photovoltaic system for charging – DC/DC converters and DC/AC inverters for Grid/PV interconnections – Integrated DC/AC/DC Converter – High frequency transformer based isolated charger topology – Component design.						
UNIT-V	**ELECTRIC VEHICLE SUPPLY EQUIPMENT TECHNOLOGY**					**9**
Basic components – Charger classification – Battery charging duration – Charging network – Charging expenses – Wireless charging – Infrastructure safety codes and standards.						
					Total	**45 Hours**
TEXT BOOKS:						
1.	MehrdadEhsani, YiminGao, Sebastein E. Gay and Ali Emadi, “Modern Electric, Hybrid					

	Electric and Fuel Cell Vehicles – Fundamental, Theory and Design", 1st edition, CRC Publication, 2005
2.	Shedon S. Williamson, "Energy Management Strategies for Electric and Plugin Hybrid Electric Vehicles", 1st edition, Springer, 2013
REFERENCES:	
1.	Doug Kettles, "Electric Vehicle Charging Technology Analysis and Standards", FSEC Report number FSEC-CR-1996-15, 2015
2.	Vermont Energy Investment Corporation." Electric Vehicle Charging Station Guidebook Planning for Installation and Operation", June 2014
3	Narayanaswamy P. and Iyer R., "Power Electronic Converters Interactive Modelling using Simulink", CRC Press, 2018

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	1	1	-	-	-	-	1	1	-	1
CO2	2	-	-	-	1	1	1	-	-	-	-	1	1	1	1
CO3	2	-	-	-	-	1	1	-	-	-	-	1	1	1	1
CO4	2	-	-	-	1	1	1	-	-	-	-	1	1	1	1
CO5	3	-	-	-	-	1	1	-	-	-	-	1	1	-	1
CO	**2.2**	**-**	**-**	**-**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE15008	**BIOMEDICAL INSTRUMENTATION**	**3**	**0**	**0**	**3**	**100**
Objectives	• To introduce the fundamentals of Biomedical Engineering • To study the communication mechanics in a biomedical system with few examples • To study measurement of certain important electrical and non-electrical parameters • To discuss the basic principles in imaging techniques • To learn basic knowledge in life assisting and therapeutic devices					
Outcomes	At the end of the course, students will be able to, 1.Explain the basics of Biomedical Engineering 2.Describe the communication mechanics in a biomedical system with few examples 3.Explain the measurement of certain important electrical and non-electrical parameters 4.Apply the basic principles in imaging techniques 5.Discuss the life assisting and therapeutic devices					
UNIT I	**PHYSIOLOGY AND TRANSDUCERS**					**9**
Cell and its structure – Resting and Action Potential –Circulatory system – cardio vascular system-central nervous system – respiratory system – muscular skeletal system – digestive system – excretory system – sensory organs – voluntary and involuntary action – Basic components of a biomedical system - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements - Fiber optic temperature sensors.						
UNIT II	**BIOPOTENTIALS AND THEIR MEASUREMENTS**					**9**
Electrode theory – bipolar and Unipolar electrode-surface electrode – electrode impedance –equivalent circuit for extra cellular electrodes- micro electrodes. – Amplifiers: Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier- basic recording system of ECG, EEG, EMG with typical waveforms.						
UNIT III	**NON-ELECTRICAL PARAMETER MEASUREMENTS**					**9**
Measurement of blood pressure – Cardiac output – Heart rate – Heart sound –Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers : pH of blood –measurement of blood pCO2, pO2, finger-tip oxymeter - ESR, GSR measurements .						
UNIT IV	**MEDICAL IMAGING**					**9**
Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography – Different types of biotelemetry systems and patient monitoring – Introduction to Biometric systems.						
UNIT V	**ASSISTING AND THERAPEUTIC EQUIPMENTS**					**9**
Pacemakers– Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialyzers – Lithotripsy.						
					Total	**45 Hours**

TEXT BOOKS	
1.	R.S.Khandpur, " Bio-Medical instrumentation- Technology and Applications', Tata McGraw Hill Publishing Co Ltd., 2011.
2.	Leslie Cromwell, Fred J.Weibell, Erich A. Pfeiffer, 'Bio-Medical Instrumentation and Measurements', II edition, Pearson Education, 2015 / PHI.
REFERENCES	
1.	M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2017.
2.	J.Webster, 'Medical Instrumentation', John Wiley & Sons, 2014.
3.	C.Rajarao and S.K. Guha, 'Principles of Medical Electronics and Bio-medical Instrumentation', Universities press (India) Ltd, Orient Longman ltd, 2012.
4.	https://nptel.ac.in/courses/108105101

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	1	1	-	-	-	-	1	-	-	-
CO2	2	-	-	-	-	1	1	-	-	-	-	1	-	-	-
CO3	2	-	-	-	-	1	1	-	-	-	-	1	-	-	-
CO4	3	-	-	-	-	1	1	-	-	-	-	1	-	-	-
CO5	2	-	-	-	-	1	1	-	-	-	-	1	-	-	-
CO	**2.2**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
COURSE CODE	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE15009	**CONTROL ENGINEERING**	**3**	**0**	**0**	**3**	**100**
Objectives	• To introduce the mathematical modeling of systems, open loop and closed loop systems and analyses in time domain and frequency domain. • To impart the knowledge on the concept of stability and various methods to analyze stability in both time and frequency domain. • To introduce sampled data control system.					
Outcomes	At the end of the course, students will be able to, 1. Apply mathematical knowledge to model the systems and understand the behavior of linear and nonlinear system. 2. Solve the block diagram representation of control systems, Reduction of block diagrams, Signal flow graph and problems based on it. 3. Analyze the response of first and second order systems for various inputs and steady state error 4. Analyze the stability of the system by using frequency domain Methods 5. Discuss the concept of digital control system, digital controllers and digital PID controllers.					
UNIT I	**INTRODUCTION**					**(9)**
Historical review, Simple pneumatic, hydraulic and thermal systems, Basic elements in control systems – Open and closed loop systems-Analogies, mechanical and electrical components, Development of flight control systems.						
UNIT II	**OPEN AND CLOSED LOOP SYSTEMS**					**(9)**
Feedback control systems – Control system components - Block diagram representation of control systems, Reduction of block diagrams, Signal flow graphs, Output to input ratios.						
UNIT III	**CHARACTERISTIC EQUATION AND FUNCTIONS**					**(9)**
Laplace transformation, Response of systems to different inputs viz., Step impulse, pulse, parabolic and sinusoidal inputs, Time response of first and second order systems, steady state errors and error constants of unity feedback circuit.						
UNIT IV	**CONCEPT OF STABILITY**					**(9)**
Necessary and sufficient conditions, Routh-Hurwitz criteria of stability, Root locus and Bode techniques, Concept and construction, frequency response.						
UNIT V	**SAMPLED DATA SYSTEMS**					**(9)**
Z-Transforms- Introduction to digital control system, Digital Controllers and Digital PID controllers						
Total Hours to be taught						**L:45 T:00(45 Hours)**
TEXT BOOKS						
1.	I.J.Nagrath and M.Gopal, " Control systems Engineering", 5th edition, New Age International (P) Limited, New Delhi, 2007.					

2.	K. Ogata, 'Modern Control Engineering', 5th edition, PHI, 2012.
3.	Dhanesh. N. Manik, Control System, Cengage Learning, 2012.
REFERENCES	
1.	Norman S. Nise,"Control System Engineering", 4th edition, Wiley Student Edition, 2008.
2.	B.C.Kuo "Automatic control systems", 8th edition, Wiley Student Edition, 2008.
3.	D.K.Cheng, Analysis of linear systems" Narosa Publishing House, New Delhi,2002.

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	-	1	-	1
CO2	2	-	-	-	-	-	-	-	-	-	-	-	1	-	1
CO3	3	-	-	-	-	-	-	-	-	-	-	1	1	-	1
CO4	2	3	-	-	-	-	-	-	-	-	-	1	1	-	1
CO5	2	3	-	-	-	-	-	-	-	-	-	-	1	-	1
CO	**2.2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE15010	**INDUSTRIAL AUTOMATION AND CONTROL**	**3**	**0**	**0**	**3**	**100**
Objectives	• To study the basic concepts of industrial instruments • To learn the function of PLC and SCADA systems. • To study the operation CNC devices and its programming • To classify the automated systems used in digital industries. • To acquire knowledge on the automation of industrial applications.					
Outcomes	At the end of the course, students will be able to, 1. Identify the instruments and their control elements used in industries. 2. Explain about the skills used in ladder logic for development of industrial automation using PLC. 3. Explain the fundamentals of computer numeric control. 4. Describe the function of automated systems. 5. Summarize the operation of automation control applied in various industries.					
UNIT I	**INTRODUCTION TO INDUSTRIAL INSTRUMENTS**					**9**
Automation overview, Requirement of automation system - Architecture of Industrial Automation system - Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and PH measurement - Smart Sensors – Actuators - Process control valves and Motion Actuators - PID Controller- Digital Controller						
UNIT II	**PROGRAMMABLE LOGIC CONTROLLERS**					**9**
Process Controller- Relay Logic – Programmable Logic Controller- Basic Structure –Ladder Logic- Programming- PLC Internal Operation and Signal Processing- I/O Processing- Communication System for Industrial Automation –Advantages and Disadvantages –Applications–Fundamentals of SCADA Systems.						
UNIT III	**COMPUTER NUMERIC CONTROL**					**9**
Introduction to CNC Systems- Types –Analogue, Digital, Absolute and Incremental- Open Loop and Closed Loop - CNC Drives and Feedback Devices- Adaptive Control – CNC Part Programming.						
UNIT IV	**AUTOMATED SYSTEMS**					**9**
Fixed Automation – Programmable Automation – Flexible Automation - Material Transport Systems – Process Monitoring – Conveyor Systems – Cranes and Hoists – Automated Storage and Retrieval Systems – Automated Data Capture – Digital Factories.						
UNIT V	**INDUSTRIAL APPLICATIONS**					**9**
Industrial Control Applications- Cement Industry–Paper Mill –Sugar Mill– Thermal Plant- Water Treatment Plant- Steel Plant- Textile Industry.						
					Total	**45 Hours**
TEXT BOOKS						
1.	Industrial Instrumentation and Control By. S.K. Singh Tata McGraw Hill Companies,2010					
2.	Michael Jacob, ―Industrial Control Electronics – Applications and Design‖, Prentice Hall, 2010					

3.	Richard L.Shell, Ernest L.Hall, ―Hand Book of Industrial Automation, Published by Marcel Dekker Inc., Society of Manufacturing Engineers.
4.	Mikell P. Groover, ―Automation, Production Systems and Computer Integrated Manufacturing‖, 3rd Edition, Pearson Education, 2008.
REFERENCES	
1.	Krishna Kant, ―Computer-Based Industrial Control‖, 2nd Edition, Prentice Hall of India, 2010
2.	Frank D. Petruzella, ―Programmable Logic Controllers‖, 3rd Edition, McGraw Hill, 2010.
3.	Gray Dunning, ―Introduction to Programmable Logic Controllers‖, Delmar Publishers, 2007.

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	1	2	1	1
CO2	2	-	-	-	1	-	-	-	-	-	-	1	2	1	1
CO3	2	-	-	-	1	-	-	-	-	-	-	1	2	1	1
CO4	2	-	-	-	1	-	-	-	-	-	-	1	2	1	1
CO5	2	-	-	-	-	-	-	-	-	-	-	1	2	1	1
CO	**2**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**1**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE
(Autonomous)

Syllabus-R2024

Department	Electrical and Electronics Engineering	Programme Code	1051

Program Elective

Course Code	COURSE NAME	Hours/week			Credit	Maximum Marks
		L	T	P	C	
24EE15011	POWER SYSTEM SECURITY	3	0	0	3	100

Objectives	• . To acquire the knowledge on factors affecting the power system security • To study the concepts of state estimation • To understand the concepts of state assessment • To learn the concepts of state enhancement • To apply the security assessment techniques for improving power system reliability
Outcomes	At the end of the course, students will be able to 1. Outline the factors affecting power system, security assessment and security enhancement 2. Organize the state estimation of power system 3. Choose the network sensitivity factors using various algorithms 4. Interpret the various methods for enhancing the security in power systems 5. Compare the various security assessment techniques

UNIT I	**BASICS OF POWER SYSTEM SECURITY**	**9**
Factors affecting power system security – Decomposition and multilevel approach – State estimation – System monitoring – Security assessment and security enhancement		
UNIT II	**POWER SYSTEM STATE ESTIMATION**	**9**
Maximum likelihood weighted least-square estimation – State estimation – Detection and identification of bad measurements – Estimation of quantities not being measure – Network observability and pseudo measurements		
UNIT III	**SECURITY ASSESSMENT**	**9**
Detection of network problems – Network equivalent for external system – Network sensitivity methods – Calculation of network sensitivity factors – Fast contingency algorithms – Contingency ranking – Dynamic security indices		
UNIT IV	**SECURITY ENHANCEMENT**	**9**
Correcting the generator dispatch by sensitivity methods – Compensated factors – Security constrained optimization – Preventive – Emergency and restorative control through NLP and LP methods		
UNIT V	**SECURITY TECHNIQUES**	**9**
Voltage security assessment – Transient security assessment methods – Comparison – Case study		
	Total	**45 Hours**

TEXT BOOKS

1. Kothari D.P. and Nagrath I.J., “Power System Engineering”, 3rd edition, Tata McGraw-Hill Education, 2019
2. Wood, A.J. and Woolenberg, “Power Generation Operation for Security”, John Wiley and Sons, 2010

REFERENCES

1. Allen J. Wood, Bruce F. Wollenberg and Gerald B. Sheble, “Power Generation, Operation and

	Control", 3rd edition, John Wiley and Sons, 2013
2.	Venkatesh P, Manikandan B.V. and Charles Raja S., "Electrical Power Systems: Analysis, Security and Deregulation", PHI learning Pvt. Ltd., 2012
3.	Leonard L. Grigsby, "Power System Stability and Control", 3rd edition, CRC Press, 2012

COURSE ARTICULATION MATRIX:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	1	-	-	-	-	-	-	1	2	-	2
CO2	2	3	-	-	1	1	-	1	-	-	-	1	2	-	2
CO3	3	-	-	-	1	1	-	-	-	-	-	1	2	-	2
CO4	3	-	-	-	1	-	-	-	-	-	-	1	2	-	2
CO5	2	3	-	-	1	-	-	-	-	-	-	1	2	-	2
CO	**2.4**	**3**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**-**	**1**	**2**	**-**	**2**

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course code	**Course name**	**Hours/Week**			**Credit**	**Maximum marks**
24EE15012	**ENERGY MANAGEMENT AND AUDITING**	**L**	**T**	**P**	**C**	**100**
		3	**0**	**0**	**3**	
Objective(s)	• To impart knowledge on common energy using systems or equipments in commercial and industrial premises • To study the essential and basic knowledge of various energy forms and the challenges faced by current way of energy exploitation. • To learn with professional energy audit procedure. • To acquire knowledge on various energy forms, energy consuming systems, different units of expressing energy • To introduce concepts of the energy conversion in various systems to evaluate its operating efficiency and arrive at energy saving opportunities					
Outcome(s):	Upon completion of the course, students will be able to: 1. Explain the common energy using systems or equipments in commercial and industrial premises 2. Elaborate the various energy forms, its availability and the challenges faced by current way of energy exploitation. 3. Apply energy audit procedure for energy conservation. 4. Discuss the various energy forms, energy consuming systems, different units of expressing energy 5. Analyze the energy conversion in various systems to evaluate its operating efficiency and arrive at energy saving opportunities					
UNIT-I	**ENERGY SCENARIO**					(9)
Indian Energy Scenario – Types & Forms of Energy – An overview of energy consumption and its effects – Reasons to save energy (financial and environmental) - Energy Conservation Acts and related policies – Schemes of Bureau of Energy Efficiency (BEE), Recent policies of Government of India in energy sector						
UNIT-II	**ENERGY COSTS AND FINANCIAL ANALYSIS**					(9)
Understanding Energy Costs– Benchmarking and Energy Performance – Fuel and Energy Substitution – Material Balances – Energy Balances – Financial techniques for assessing energy conservation measures – Fixed and variable cost – Interest charges – Simple payback period – Net Present Value - Discounted cash flow method						
UNIT-III	**ENERGY AUDITING**					(9)
Definition & objective of Energy management – Energy Audit – Types & Methodology– Energy audit report format – Instruments used and purpose – Organizational background desired for energy management –Home Energy Audit- Case studies of energy audit in different industries.						
UNIT-IV	**ELECTRICAL ENERGY USAGE**					(9)
Basics of electrical energy, Electricity Billing – Components & Costs – Determination of kVA demand & Consumption – Time of Day Tariff – Power Factor – Electrical systems – Electric motors.						

UNIT-V	ENERGY EFFICIENCY IN ELECTRICAL UTILITIES	(9)
Fans & blowers – Compressed air systems – Refrigeration and air conditioning systems - Pumps & pumping systems – Lighting systems – Energy efficient technologies in electrical systems, General energy saving measures.		
	Total	**45 Hours**

Text Books	
1.	K.V Sharma, P Venkatasheshaiah (2011) Energy management and Conservation, I.K International publishing house New Delhi.
2.	Albert Thumann, William J. Younger, Handbook of Energy Audits, CRC Press, 2003
3.	Craig B. Smith, Energy management principles, Pergamon Press, 2015.
References:	
1.	Y.P abhi, Shashank Jain (2012), Hand book of energy audit and environment management, TERI Presss
2.	William J Kennedy (2013), Guide to energy management, Lulu.com
3.	IEEE recommended practice for energy management in industrial and commercial facilities,
4.	M Jayaraju and Premlet, Introduction to Energy Conservation And Management, Phasor Books, 2008

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	1	-	-	-	-	-	1	1	-	1
CO2	3	-	-	-	-	-	-	1	-	-	-	1	1	-	1
CO3	3	-	-	-	-	-	-	1	-	-	-	1	1	-	1
CO4	2	-	-	-	-	1	-	-	-	-	-	1	1	-	1
CO5	2	3	-	-	-	-	-	-	-	-	-	1	1	-	1
CO	**2.4**	**3**	**-**	**-**	**-**	**1**	**-**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**	**1051**	
Program Elective						
Course code	**Course name**	**Hours/Week**			**Credit**	**Maximum marks**
24EE15013	**EV STANDARDS AND TESTING**	**L**	**T**	**P**	**C**	**100**
		3	**0**	**0**	**3**	
Objective(s)	• To acquire the knowledge in standards of Electric vehicles • To impart knowledge on battery and charger systems • To discuss the concepts of wind tunnel, body and wheel of EV • To acquire knowledge on crash and wheel testing. • To apply the testing methods of energy and fuel consumption of EV					
Outcome(s):	1. Explain the standards of electric vehicle 2. Interpret the standards of traction battery and charger 3. Apply the testing methods to wind tunnel and body of an EV 4. Illustrate the crash and wheel testing 5. Design methodologies for energy and fuel consumption testing					
UNIT-I	**EV STANDARDS**					(9)
Electric power train vehicles – Construction and functional safety requirements – Measurement of electrical energy consumption – Measurement of range – Measurement of net power and the maximum 30-minute power – Central Motor Vehicle Rules (CMVR) type approval for electric power train vehicles.						
UNIT-II	**TRACTION BATTERY AND CHARGER STANDARDS**					(9)
Battery operated vehicles – Safety requirements of traction batteries – Charger standards – Electric vehicle conductive AC and DC charging system – Public EV charging standards – Charging for high voltage EVs – Home charging standards.						
UNIT-III	**WIND TUNNEL AND BODY TESTING**					(9)
Wind tunnel test requirements – Ground boundary simulation – Wind tunnel selection and Reynolds number capability – Model details, mounting of model – Test procedure – Body test – Dynamic simulation sled testing – Dolly roll over test – Dolly roll over fixture – Vehicle roof strength test – Door system crash test						
UNIT-IV	**CRASH AND WHEEL TESTING**					(9)
Crash testing: Human testing – Dummies – Crash worthiness – Pole crash and near crash testing – Vehicle to vehicle impact and side impact testing – Crash test sensor – Sensor mounting – Braking distance test. Wheel testing: Dynamic cornering and dynamic radial fatigue tests – Procedures, bending moment and radial load calculations – Impact test: Road hazard impact test for wheel and tyre assemblies – Test procedures – Failure criteria and performance criteria						
UNIT-V	**ENERGY AND FUEL CONSUMPTION TESTING**					(9)
Energy consumption by engine cooling fan, air conditioning and brake compressors – Hydraulic pumps power consumption, ABS energy consumption – Test route selection – Vehicle speed test – Cargo, weight and driver selection – Tested data, findings and calculations – Test on rough terrain –						

Pot hole with laden and unladden conditions.	
Total	**45 Hours**

TEXT BOOKS:

1.	John G. Hayes and G. AbasGoodarzi, "Electric Power Train: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles", Wiley, 2018
2.	Course W.H. and Anglin D.L., "Automotive Mechanics", TMG publishing company, 2017

REFERENCES:

1.	Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals", 2nd edition, CRC press, 2010
2.	Automotive Handbook, Bosch - Website: www.mainindia.com/Draft, AIS standards.asp
3.	DHI Centre of Excellence for E-Mobility, Standards - Website: https://emobility.araiindia.com/standards/

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	1	1	-	-	-	-	1	1	-	2
CO2	3	-	-	-	-	-	1	-	-	-	-	1	1	-	2
CO3	3	-	-	-	-	-	1	-	-	-	-	1	1	-	2
CO4	3	-	-	-	-	1	1	-	-	-	-	1	1	-	2
CO5	2	2	3	-	-	-	1	-	-	-	-	1	1	-	2
CO	**2.6**	**2**	**3**	**-**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**2**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Electives						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE15014	**POWER SYSTEMS STABILITY**	**3**	**0**	**0**	**3**	**100**
Objectives	• To acquire the fundamental concepts of stability of power systems and its classification. • To discuss the students to small signal stabilityof power system. • To explain the transient stability of the power system for small and large disturbances. • To discuss the voltage stability behavior of the power system. • To learn and enhance the stability of power systems.					
Outcomes	On completion of the course, student will be able to 1. Explain the stability of power system. 2. Describe the concepts of small-signal stability 3. Discuss the concepts of transient stability. 4. Elaborate the transient stability of power systems. 5. Explain the various methods to enhance the stability of a power system.					
UNIT I	**INTRODUCTION TO STABILITY**					**9**
Fundamental concepts - Stability and energy of a system - Power System Stability: Definition, Causes, Nature and Effects of disturbances, Classification of stability, Modeling of electrical components - Basic assumptions made in stability studies- Modeling of Synchronous machine for stability studies(classical model) - Rotor dynamics and the swing equation.						
UNIT II	**SMALL-SIGNAL STABILITY**					**9**
Basic concepts and definitions – State space representation, Physical Interpretation of small–signal stability, Eigen properties of the state matrix: Eigen values and eigenvectors, modal matrices, Eigen values and stability, mode shape and participation factor. Small– signal stability analysis of a Single-Machine Infinite Bus (SMIB) Configuration with numerical example.						
UNIT III	**TRANSIENT STABILITY**					**9**
Review of numerical integration methods: modified Euler and Fourth Order Runge-Kutta methods, Numerical stability and Interfacing of Synchronous machine (classical machine) model to the transient stability algorithm (TSA) with partitioned – explicit approaches- Application of TSA to SMIB system.						
UNIT IV	**VOLTAGE STABILITY**					**9**
Factors affecting voltage stability- Classification of Voltage stability-Transmission system characteristics-Generator characteristics- Load characteristics- Characteristics of reactive power compensating Devices-Voltage collapse.						
UNIT V	**ENHANCEMENT OF SMALL-SIGNAL STABILITY AND TRANSIENT STABILITY**					**9**
Power System Stabilizer – Principle behind transient stability enhancement methods: high-speed fault clearing regulated shunt compensation, dynamic braking, reactor switching, independent pole-operation of circuit-breakers, single-pole switching, fast- valving, high-speed excitation systems.						
					Total	**45 Hours**
TEXT BOOKS						

1.	Power system stability and control ,P. Kundur ; edited by Neal J. Balu, Mark G. Lauby, McGraw-Hill, 2007.
2.	R.Ramnujam," Power System Dynamics Analysis and Simulation, PHI Learning Private Limited, New Delhi, 2009
3.	T.V. Cutsem and C.Vournas, "Voltage Stability of Electric Power Systems", Kluwer publishers, 2007.
REFERENCES	
1.	Peter W., Saucer, Pai M.A., "Power System Dynamics and Stability, Pearson Education (Singapore), 9th Edition, 2007.
2.	EW. Kimbark., "Power System Stability", John Wiley & Sons Limited, New Jersey, 2013.
3.	SB. Crary., "Power System Stability", John Wiley & Sons Limited, New Jersey, 1955.
4.	K.N. Shubhanga,"Power System Analysis" Pearson, 2017.
5.	https://nptel.ac.in/courses/108106026

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	1	-	-	-	-	1	1	-	1
CO2	2	-	-	-	-	-	1	-	-	-	-	1	1	-	1
CO3	2	-	-	-	-	-	1	-	-	-	-	1	1	-	1
CO4	3	-	-	-	-	-	1	-	-	-	-	1	1	-	1
CO5	2	-	-	-	-	-	1	-	-	-	-	1	1	-	1
CO	**2.2**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**				**Programme Code**	**1051**
Program Elective						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE15015	**DIGITAL SIGNAL PROCESSING**	**3**	**0**	**0**	**3**	**100**
Objectives	• To learn the various types of different signals and systems • To acquire knowledge on the discrete time System using z transform and inverse Z methods • To learn various transformation techniques & their computation methods • To study the concepts of various digital filters and warping techniques • To apply the concepts of DSP Processor for various applications					
Outcomes	On completion of the course, student will be able to • Determine response of LTI systems using time domain and DFT techniques. • Analyze the digital Systems using DFT and FFT. • Identify the basics of finite word length effects in signal processing. • Design of various Transformation techniques for the Digital Filters • Elaborate the architectural features of DSP Processor and its applications					
UNIT I	**INTRODUCTION**					**9**
Classification of systems-Continuous, discrete, linear, causal, stable, dynamic, recursive. Time variance-classification of signals-continuous and discrete, energy and power. Mathematical representation of signals- sampling techniques- quantization-quantization error- Nyquist rate-aliasing effect						
UNIT II	**DISCRETE TIME SYSTEM ANALYSIS**					**9**
z-transform and its properties, inverse z-transforms; difference equation – Solution by z transform, application to discrete systems - Stability analysis, frequency response – Convolution – Linear convolution- circular convolution Discrete Time Fourier transform , magnitude and phase representation.						
UNIT III	**DISCRETE FOURIER TRANSFORM & COMPUTATION**					**9**
Discrete Fourier Transform- properties- circular convolution - Computation of Discrete Fourier transform-using Fast fourier transform algorithm – Decimation in Time & Decimation in Frequency using radix 2 Fourier transform –Butterfly structure.						
UNIT IV	**DESIGN OF DIGITAL FILTERS**					**9**
Finite impulse response & Infinite impulse response filter realization –direct, canonical, Parallel & cascade forms. Finite impulse response design-Windowing Techniques. Infinite impulse response design: Analog filter design: Butterworth and Chebyshev approximations-digital design: impulse invariant and bilinear transformation – Warping &pre Warping- Frequency transformation						
UNIT V	**DIGITAL SIGNAL PROCESSOR APPLICATIONS**					**9**
Introduction – Architecture of TMS320C5X Family of DSP processor – Features – Addressing Formats –Instruction set- Functional modes –Applications: Speech processing and Biomedical signal processing.						
					Total	**45 Hours**
TEXT BOOKS						

1.	J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education/PHI, New Delhi, Revised Edition, 2014 .
2.	A. Oppenheim and R. Schafer , "Discrete-Time Signal Processing, , Prentice Hall", Second edition, 1999
3.	S. K. Mitra, " Digital Signal Processing: A computer based approach" , McGraw Hill, 2011.
4.	Robert Schilling & Sandra L.Harris, Introduction to Digital Signal Processing using Matlab, Cengage Learning, Second Edition, 2011.
5.	https://nptel.ac.in/courses/117102060Link
REFERENCES	
1.	B.P.Lathi, 'Principles of Signal Processing and Linear Systems', Oxford University Press, 6th Edition, 2015.
2.	Taan S. ElAli, 'Discrete Systems and Digital Signal Processing with MATLAB", CRC Press, 4th Revised Edition, 2014
3.	B. Venkatramani&MBhaskar, "Digital Signal Processors, Architecture, programming and applications ", Mc-Graw Hill,2007
4.	https://nptel.ac.in/courses/117105134
5.	https://ocw.mit.edu/courses/res-6-008-digital-signal-processing-spring-2011/pages/study-materials/

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	-	-	-	-	-	-	-	-	1	1	-	1
CO2	2	3	-	-	-	-	-	-	-	-	-	1	1	-	1
CO3	2	-	-	-	-	-	-	-	-	-	-	1	1	-	1
CO4	2	2	3	-	-	-	-	-	-	-	-	1	1	-	1
CO5	3	-	-	-	-	-	-	-	-	-	-	1	1	-	1
CO	**2.2**	**2.6**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)			
Syllabus-R2024			
Department	**Electrical and Electronics Engineering**	**Programme Code**	**1051**

Program Elective

Course Code	Course name	HOURS/WEEK			CREDIT	Maximum Marks
		L	T	P	C	
24EE15016	**EHV AC AND DC TRANSMISSION**	**3**	**0**	**0**	**3**	**100**

Objective(s)	• To acquire the knowledge on transmission systems • To discuss about the concept of EHV AC transmission systems • To learn about the concept of EHV DC transmission systems • To apply the power flow analysis techniques for EHV DC transmission systems • To apply the power flow analysis techniques for EHV AC transmission systems
Outcome(s)	On completion of the course, student will be able to 1. Explain the need of EHV transmission and its modernization 2. Describe the EHV AC system and the problems associated 3. Identify the EHV DC system requirements and its controls 4. Solve the power flow problem in EHV DC transmission system 5. Calculate the effect of EHV systems on environment

UNIT I	**TRANSMISSION SYSTEM**	**(9)**
EHV transmission – Comparison of EHV AC and DC transmission systems – Applications and limitations – Surface voltage gradients – Distribution of voltage gradients – Modern trends in EHV AC and DC transmission		
UNIT II	**EHV AC TRANSMISSION**	**(9)**
Generation and characteristics of corona – Radio interference effects – Over voltage due to switching – Ferro resonance – Reduction of switching surges on EHV system		
UNIT III	**EHV DC TRANSMISSION**	**(9)**
Converter configurations – Types of DC links – DC link control – Converter control characteristics – Firing angle control – Current and excitation angle control – Starting and stopping of DC link		
UNIT IV	**POWER FLOW ANALYSIS IN DC SYSTEMS**	**(9)**
Modeling of DC links – DC network – DC converter – Controller equations – Solution of DC load flow – DC quantities – Solution of AC-DC power flow – Simultaneous method – Sequential method		
UNIT V	**POWER FLOW ANALYSIS IN AC SYSTEMS**	**(9)**
Electric shock – Threshold currents – Calculation of electrostatic fields and magnetic fields of AC and DC lines – Effect of fields on living organism – Electrical field measurement.		
	Total	**45 Hours**

TEXT BOOKS

1.	Begamudre R.D., "Extra High Voltage AC Transmission Engineering", Wiley Eastern, 2017
2.	Padiyar K.R., "HVDC Power Transmission Systems: Technology and System Reactions", New Age International, 2011

REFERENCES

1.	Naidu M. S., and Kamaraju V., "High Voltage Engineering", Tata McGraw Hill, 2013
2.	Rao S., "EHV AC and HVDC Transmission Engineering and Practice", Khanna Publisher, 2009.

COURSE ARTICULATION MATRIX:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO4	3	-	-	-	1	-	-	-	-	-	-	-	1	1	1
CO5	2	3	-	-	1	-	-	1	-	-	-	1	1	1	1
CO	**2.2**	**3**	**-**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**1**	**1**	**1**
Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE15017	**INTELLIGENT CONTROLLERS**	**3**	**0**	**0**	**3**	**100**
Objectives	1. To learn the concepts of ANN and fuzzy set theory. 2. To acquire knowledge on ANN for modeling and control of Non-linear system 3. To study Fuzzy logic for modeling and control of Non-linear system 4. To impart the knowledge of various optimization techniques 5. To learn the basic concepts of hybrid schemes with the ANFIS tool box.					
Outcomes	At the end of the course, learners will be able to: 1. Develop the basic architectures of ANN and Fuzzy sets 2. Design and implement ANN architectures, algorithms and know their limitations. 3. Apply various Fuzzy logic models for controlling the Fuzzy Systems 4. Develop ANN and fuzzy logic based models and control schemes for non-linear systems 5. Explain the operation of hybrid control schemes					
UNIT I	**INTRODUCTION TO ANN AND FUZZY LOGIC**					**9**
Review of fundamentals - Biological neuron, Artificial neuron, Activation function,Single Layer Perceptron – Limitations – Multi Layer Perceptron – Back propagation algorithm (BPA); Fuzzy set theory – Fuzzy sets – Operation on Fuzzy sets - Scalar cardinality, fuzzy cardinality, union and intersection, complement (yager and sugeno), equilibrium points, aggregation, projection, composition, fuzzy relation – Fuzzy membership functions						
UNIT II	**NEURAL NETWORKS FOR MODELLING AND CONTROL**					**9**
Generation of training data - optimal architecture – Model validation- Control of non linear system using ANN- Direct and Indirect neuro control schemes- Adaptive neuro controller –Case study - Familiarization of Neural Network Control Tool Box.						
UNIT III	**FUZZY LOGIC FOR MODELLING AND CONTROL**					**9**
Modeling of nonlinear systems using fuzzy models (Mamdani and Sugeno) –TSK model - Fuzzy Logic controller – Fuzzification – Knowledge base – Decision making logic – Defuzzification- Adaptive fuzz y systems-Case study-Familiarization of Fuzzy Logic Tool Box.						
UNIT IV	**GENETIC ALGORITHM**					**9**
Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like Tabu search, Ant-colony search and Particle Swarm Optimization.						
UNIT V	**HYBRID CONTROL SCHEMES**					**9**
Fuzzification and rule base using ANN–Neuro fuzzy systems-ANFIS –Optimization of membership function and rule base using Genetic Algorithm and Particle Swarm Optimization - Case study– Familiarization of ANFIS Tool Box.GA application to power system optimisation problem, Case studies:Identification and control of linear and nonlinear dynamic systems using Matlab-Neural Network toolbox. Stability analysis of Neural-Network interconnection systems. Implementation of fuzzy logic controller using Matlab fuzzy-logic toolbox.						
					Total	**45 Hours**

TEXT BOOKS	
1.	LaureneV.Fausett, "Fundamentals of Neural Networks, Architecture, Algorithms, and Applications", Pearson Education, 2008.
2.	Timothy J.Ross, "Fuzzy Logic with Engineering Applications", Wiley, Third Edition, 2010.
3.	David E.Goldberg, "Genetic Algorithms in Search, Optimization, and Machine Learning", Pearson Education, 2009
4.	https://nptel.ac.in/courses/108104049
5.	http://www2.ece.ohio-state.edu/~passino/ic-chapter.pdf
REFERENCES	
1.	W.T.Miller, R.S.Sutton and P.J.Webrose, "Neural Networks for Control", MIT Press, 1996
2.	George J.Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic: Theory and Applications", Prentice HalI, First Edition, 1995.

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	-	1	-	-	-	-	-	-	1	1	1	1
CO2	2	2	3	-	1	-	-	-	-	-	-	1	1	1	1
CO3	3	-	-	-	1	-	-	-	-	-	-	1	1	1	1
CO4	2	2	3	-	1	-	-	-	-	-	-	1	1	1	1
CO5	2	-	-	-	1	-	-	-	-	-	-	1	1	1	1
CO	**2.2**	**2**	**3**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
PROFESSIONAL ELECTIVE						
Course Code	**Course name**	**HOURS/WEEK**			**CREDIT**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE15018	**GREEN ENERGY TECHNOLOGIES**	**3**	**0**	**0**	**3**	**100**
Objective(s)	1.To study the nexus between energy, environment and sustainable development 2.To acquire knowledge on solar UPS for domestic applications 3.To apply the concepts of solar PV system for industries. 4.To learn the concepts of waste, energy and water management for creating smart cities 5.To introduce energy demand and generation planning					
Outcome(s)	**At the end of the course, learners will be able to** 1. Explain energy, environment and energy sources for sustainable development 2. Design of solar UPS for domestic applications 3. Design solar PV system for industrial applications 4. Describe the E-Governance and Citizen services 5. Summarize the energy demand and generation planning					
UNIT I	**ENERGY**					**(9)**
Introduction to the nexus between energy, environment and sustainable development, Energy sources over view and classification, sun as the source of energy, fossil fuel reserves and resources - overview of global/ India's energy scenario. Energy consumption models – Specific Energy Consumption.						
UNIT II	**DESIGN OF SOLAR UPS FOR HOME**					**(9)**
Introduction to Inverter, Block diagram of Inverter Rectifier, its type and working principle, PIV of Diode, Filter employed in rectifier, Battery charger circuit, working of Inverter Oscillator, type of Oscillator, Square wave Generator PWM, DC to AC Converter/inverter, Designing an inverter, Working principle, specifications, explanation with the help of block diagram UPS Installation –Find the total Load and Select suitable Inverter/UPS- Finding fault in Inverter and UPS-Replace faulty components in Inverter and UPS						
UNIT III	**DESIGN OF SOLAR PV SYSTEM FOR INDUSTRIES**					**(9)**
Typical System Designs and Options: Grid-Interactive Only (No Battery Backup)- Grid Interactive With Battery Backup – Mounting : Roof mount- Shade Structure- Building-Integrated PV Array (BIPV) – Estimating System Output: Factors Affecting Output–Estimating System Energy Output-System installation.						
UNIT IV	**INTRODUCTION TO SMART CITIES**					**(9)**
E-Governance and Citizen services – Waste management – Water management –Energy management: Smart meters and management, Renewable sources of energy, Energy efficient and Green buildings– Intelligent Traffic management, Integrated Multi-Modal transport – Telemedicine, Tele education.						
UNIT V	**ENERGY DEMAND AND GENERATION PLANNING**					**(9)**
Demand Forecasting and Generation Planning: Sector-wise peak demand and energy forecasting by trend and econometric projection methods. Solar Thermal Systems: Flat Plate Collectors, Energy balance principle, Overall Heat Loss Coefficient; Types of Flat Plate Collectors: Liquid Flat Plate Collectors, Air flat-plate Collectors-Thermal analysis, Evacuated tubular collectors, Solar Energy Storage, Collector tracking systems, Solar tree.						
					Total	**45 Hours**
TEXT BOOKS						
1.	HatimMachrafi, 'Green Energy and Technology,Bentham Science Publishers , Pearson					

	Education 2nd edition, 2012.
2.	D.P.Kothari, 'Renewable Energy Sources and Emerging Technologies, PHI Learning Pvt..Ltd., 2013
REFERENCES	
1.	D. Y. Goswami, F. Kreith and J. F. Kreider, Principles of Solar Engineering, Taylor and Francis, Philadelphia, 2012
2.	C. S. Solanki, "Solar Photovoltaics: Fundamental Applications and Technologies, Prentice Hall of India, 2009.
3.	D. A. Spera, Wind Turbine Technology: Fundamental concepts of Wind Turbine Engineering, ASME Press.
4.	NPTEL : https://nptel.ac.in/courses/121/106/121106014/

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	1	-	-	-	-	1	1	-	2
CO2	2	2	3	-	-	-	1	-	-	-	-	1	1	-	2
CO3	2	2	3	-	-	-	1	-	-	-	-	1	1	-	2
CO4	2	-	-	-	-	-	1	-	-	-	-	1	1	-	2
CO5	2	-	-	-	-	-	1	-	-	-	-	1	1	-	2
CO	**2**	**2**	**3**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**2**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
COURSE CODE	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE15019	**DISASTER MANAGEMENT**	**3**	**0**	**0**	**3**	**100**
Objectives	• To understand the concepts of natural disasters, types and their significance. • To impart knowledge on manmade disasters • To impart knowledge on geospatial technology • To discuss the risk assessment and mitigation • To give exposure on disaster management					
Outcomes	At the end of the course, students will be able to, 1. Acquire knowledge about natural disasters 2. Describe the manmade disasters 3. Explain the concepts of Remote sensing and disaster monitoring technology 4. Discuss various risk assessment and mitigation 5. Elaborate the various disaster management plans.					
UNIT I	**NATURAL DISASTERS**					**(9)**
Hazards and Disasters, Risk and Vulnerability in Disasters, Natural and Man-made disasters, earthquakes, floods drought, landside, land subsidence, cyclones, volcanoes, tsunami, avalanches, global climate extremes						
UNIT II	**MAN MADE DISASTERS**					**(9)**
Chemical industrial hazards, major power breakdowns, traffic accidents, Fire, War, Atom bombs, Nuclear disaster, Forest Fire-Oil fire –accident in Mines.						
UNIT III	**GEOSPATIAL TECHNOLOGY**					**(9)**
Remote sensing, GIS and GPS applications in real time disaster monitoring, prevention and rehabilitation- disaster mapping.						
UNIT IV	**RISK ASSESSMENT AND MITIGATION**					**(9)**
Hazards, Risks and Vulnerabilities. -Disasters in and India ,Assessment of Disaster Vulnerability of a location and vulnerable groups- Preparedness and Mitigation measures for various Disasters- Mitigation through capacity building -Preparation of Disaster Management Plans.						
UNIT V	**DISASTER MANAGEMENT**					**(9)**
Legislative responsibilities of disaster management- Disaster management act 2005- post disaster recovery & rehabilitation, Relief & Logistics Management; disaster related infrastructure development- Post Disaster, Emergency Support Functions and their coordination mechanism.						
Total Hours to be taught						**L:45 T:00(45 Hours)**
TEXT BOOKS						
1.	Disaster Management Guidelines, GOI-UND Disaster Risk Program (2009-2012					
2	Gupta A.K., Niar S.S and Chatterjee S. (2013) Disaster management and Risk Reduction, Role ofEnvironmental Knowledge, Narosa Publishing House, Delhi.					
3	Damon, P. Copola, (2006) Introduction to International Disaster Management, ButterworthHeineman					

REFERENCES	
1.	Disaster Management in India- A Status Report- Published by the National Disaster Management Institute, Ministry of Home Affairs, Govt. of India.2004.
2.	Murthy D B N, “Disaster Management: Text and Case Studies”, Deep and Deep Publications (P) Ltd., New Delhi, 2007.
3.	Sundar I and Sezhiyan T, “Disaster Management”, Sarup and Sons, New Delhi, 2007.
4	NPTEL link: https://onlinecourses.swayam2.ac.in/cec19_hs20/preview

CO MAPPING WITH POs AND PSOs

S.NO.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-
2	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-
3	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-
4	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-
5	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-
	-	**-**	**-**	**-**	**2.0**	**2.0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

"-" - No correlation , "1" - Lower correlation , "2" - Moderate correlation , "3" – Higher correlation

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE15020	**RENEWABLE AND NON-RENEWABLE ENERGY SOURCES**	**3**	**0**	**0**	**3**	**100**
Objectives	• To learn the concepts of recent energy scenario and renewable sources • To impart knowledge on hydroelectric and nuclear energy conversion systems • To study the basic concepts of Solar photovoltaic energy • To explore the basic concepts of wind energy and different types • To learn the basic concepts of Biomass					
Outcomes	At the end of the course, students will be able to, 1. Describe on conventional energy systems 2. Discuss the performance of hydro and nuclear power plants 3. Summarize the principles of Solar energy conversion techniques 4. Illustrate the fundamentals of Wind energy system 5. Interpret the basics of Biomass energy					
UNIT I	**ENERGY SYSTEMS**					**(9)**
Coal fired steam thermal power plant – layout, working, T-S diagram of water and steam, rankine cycle for steam turbine, efficiency. Gas turbine power plant – layout, working and T-S diagram for simple and combined cycle power plant, comparison, efficiency.						
UNIT II	**HYDRO AND NUCLEAR ENERGY SYSTEM**					**(9)**
Hydro Electric plants : Types, energy conversion schemes, environmental aspects – Hydro-Thermal coordination. Ocean Energy Technology, Tidal energy – Wave energy – Open and closed Ocean thermal energy conversion Cycles-Nuclear power plants: fuels, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium-Uranium reactor (CANDU), nuclear waste management.						
UNIT III	**SOLAR ENERGY**					**(9)**
Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability. Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control-On grid, off grid-Solar energy simulation.						
UNIT IV	**WIND ENERGY**					**(9)**
Wind energy estimation in World and in India – Types of wind energy systems – Performance of Wind energy System– Details of wind turbine generator – Safety and Environmental Aspects.						
UNIT V	**BIOMASS ENERGY**					**(9)**
Biomass, sources of biomass, thermo-chemical and bio-chemical conversion of biomass - Pyrolysis, gasification, combustion and fermentation. Gasifiers – Up draft, downdraft and fluidized bed gasifier. Digesters - Fixed and floating digester biogas plants, economics of biomass power generation.						
					Total	**45 Hours**

TEXT BOOKS	
1.	G.D.Rai, “Non-conventional energy sources”, Khanna publishers, Fourth Edition, 2004.
2.	S.P. Sukhatme, Solar Energy, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2006
REFERENCES	
1.	G.N. Tiwari, Solar Energy – Fundamentals Design, Modelling and applications, Narosa Publishing House, New Delhi, 2002.
2.	Twidell, J.W. & Weir, A., "Renewable Energy Sources", EFN Spon Ltd., UK, 2006.

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	1	-	-	-	-	1	1	-	3
CO2	2	-	-	-	-	-	1	-	-	-	-	1	1	-	3
CO3	2	-	-	-	-	-	1	-	-	-	-	1	1	-	3
CO4	3	-	-	-	-	-	1	-	-	-	-	1	1	-	3
CO5	3	-	-	-	-	-	1	-	-	-	-	1	1	-	3
CO	**2.4**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**3**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
COURSE CODE	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE15021	**POWER SYSTEM RESTRUCTURING**	**3**	**0**	**0**	**3**	**100**
Objectives	• To acquire the knowledge on restructuring of power industries and market models • To study about the transmission congestion management • To discuss the fundamental concepts of marginal pricing and financial transmission rights • To apply pricing and ancillary service management in transmission network • To apply financial rights in power system					
Outcomes	At the end of the course, students will be able to, 1. Describe the restructuring of power industry 2. Summarize the congestion management methods 3. Infer the locational margin prices and financial transmission rights 4. Illustrate the significance of ancillary services and pricing of transmission network 5. Explain the knowledge on various power sectors in India					
UNIT I	**RESTRUCTURING OF POWER INDUSTRY**					**(9)**
Deregulation of power industry – Restructuring process – Issues involved in deregulation – Deregulation fundamentals of economics – Various costs of production – Market models based on contractual arrangements – Electricity commodities – Market architecture – Case study						
UNIT II	**TRANSMISSION CONGESTION MANAGEMENT**					**(9)**
Reasons for transfer capability limitation – Importance – Features – Classification – Calculation of ATC – Non-market methods – Market methods – Nodal pricing – Inter and Intra zonal congestion management – Price area congestion management – Capacity alleviation method						
UNIT III	**LOCATIONAL MARGINAL PRICES AND FINANCIAL TRANSMISSION RIGHTS**					**(9)**
Lossless and loss compensated DCOPF model for LMP calculation – ACOPF model for LMP calculation – Financial Transmission rights – Auction – Allocation – Treatment of revenue shortfall – Secondary trading of FTRs – Flow gate rights – FTR and market power – FTR and merchant transmission investment						
UNIT IV	**ANCILLARY SERVICE MANAGEMENT AND PRICING OF TRANSMISSION NETWORK**					**(9)**
Classification – Load generation balancing related services – Voltage control and reactive power support devices – Black start capability service – Co-optimization of energy and reserve services – Transmission pricing – Rolled in transmission pricing methods – Marginal pricing paradigm						
UNIT V	**REFORMS IN INDIAN POWER SECTOR**					**(9)**
Framework of Indian power sector – Reform initiatives – Availability based tariff – Electricity act 2003 – Open access issues – Power exchange – Reforms in the near future						
					Total	**45 Hours**
TEXT BOOKS						

1.	Mohammad Shahidehpour, MuwaffaqAlomoush, Marcel Dekker, "Restructured Electrical Power Systems: Operation, Trading and Volatility", 1st edition, CRC Press, 2017
2	Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, "Operation of Restructured Power Systems", Kluwer Academic Publication, 2012
REFERENCES	
1.	Sally Hunt, "Making Competition Work in Electricity", John Willey and Sons Inc. 2002
2.	Steven Stoft, "Power System Economics: Designing Markets for Electricity", John Wiley & Sons, 2002
3.	Venktesh P., Manikandan B.V., Charles Raja S. and Srinivasan A., "Electrical Power Systems Analysis, Security and Deregulation", PHI Learning Private limited, 2012

COURSE ARTICULATION MATRIX:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	1	-	-	-	1	3	1	1
CO2	2	-	-	-	-	-	-	-	-	-	-	1	2	1	1
CO3	2	-	-	-	-	-	-	1	-	-	1	1	3	1	1
CO4	3	-	-	-	-	-	-	-	-	-	-	1	3	1	1
CO5	2	-	-	-	-	-	-	1	-	-	-	1	2	1	1
CO	**2.2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**1**	**2.6**	**1**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE15022	**AUTOMOTIVE ELECTRONICS AND ITS APPLICATIONS**	**3**	**0**	**0**	**3**	**100**
Objectives	• To learn about the vehicle's electrical systems and wiring circuits • To discuss the basic concepts necessary to diagnose automotive charging and lighting problems • To know starting, and Ignition systems in advanced automotive electrical systems • To discuss electronic fuel control and diagnosing fuel control faults • To explore the sensors and actuators used in automotive electronics system					
Outcomes	1. Explain the construction, characteristics and maintenance of multiplexed wiring systems 2. Describe the characteristics of charging and lightning systems 3. Summarize the types of starting and ignition systems 4. Illustrate the working of Electronic fuel control system 5. Select the sensors and actuators used in automobile system					
UNIT I	**Electrical Systems and Circuits**					**9**
The systems approach-Electrical wiring, terminals and switching -Multiplexed wiring systems-Circuit diagrams and symbols-Electromagnetic compatibility (EMC).						
UNIT II	**Charging and Lighting Systems**					**9**
Requirements of Charging systems -Charging system Principles-DC Generators and Alternators their characteristics. Electronic regulators. Charging systems-Diagnosing charging system faults-Advanced charging system technology- Lighting fundamentals-Lighting circuits-Gas discharge and LED lighting-Diagnosing lighting system faults.						
UNIT III	**Starting Systems and Ignition Systems**					**9**
Requirements of the starting system-Starter motors and circuits-Types of starter motor-Diagnosing starting system faults- Advanced starting system technology. Ignition fundamentals- Electronic ignition-Programmed ignition- Distributor less ignition-Direct ignition-Spark-plugs-Diagnosing ignition system faults.						
UNIT IV	**Electronic Fuel Control**					**9**
Combustion- Engine fuelling and exhaust emissions-Electronic control of carburetion-Fuel injection-Diesel fuel injection- Diagnosing fuel control system faults- Case studies.						
UNIT V	**Sensors and Actuators**					**9**
Automotive Control System Applications of Sensors and Actuators - Throttle Angle Sensor Temperature Sensors-Coolant Sensor-Sensors for Feedback Control-Exhaust Gas Oxygen Sensor- Oxygen Sensor Improvements - Knock Sensors-Automotive Engine Control Actuators-Variable Valve Timing-Electric Motor Actuators-Stepper Motors-Ignition System.						
					Total	**45 Hours**
TEXT BOOKS						
1.	Tom Denton ,"Automobile Electrical and Electronic Systems", Elsevier Butterworth-Heinemann Fifth edition, 2018					

2.	William Ribbens, "Understanding Automotive Electronics - An Engineering Perspective" 7th edition, Elsevier Butterworth-Heinemann, 2012
REFERENCES	
1.	Judge, Arthur William, "Modern Electrical Equipment of Automobiles", Motor Manuals Volume Six , Springer, Dordrecht, 2002
2.	Young A.P. & Griffiths. L. "Automotive Electrical Equipment", ELBS & New Press- 2008
3.	Robert Bosch "Automotive Hand Book", SAE (5th Edition), 2000
5.	https://www.youtube.com/watch?v=kFsl5r34lCI&t=1s https://www.youtube.com/watch?v=W94iksaQwUo https://www.youtube.com/watch?v=xG1w3l41lmQ https://www.youtube.com/watch?v=R5YfLySWQAc

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	1	1	-	1
CO2	2	-	-	-	-	-	-	-	-	-	-	1	1	-	1
CO3	2	-	-	-	-	-	-	-	-	-	-	1	1	-	1
CO4	3	-	-	-	-	-	-	-	-	-	-	1	1	-	1
CO5	2	-	-	-	-	-	-	-	-	-	-	1	1	-	1
CO	**2.2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**		**Programme Code**		**1051**	
Program Elective						
Course Code	**Course name**	**HOURS/WEEK**		**CREDIT**	**Maximum Marks**	
		L	**T**	**P**	**C**	
24EE15023	**POWER SYSTEM DYNAMICS AND CONTROL**	**3**	**0**	**0**	**3**	**100**
Objective(s)	• To study about the basics of dynamics and stability problems • To learn the concepts of synchronous machines • To acquire knowledge on excitation system and speed-governing controllers. • To study the behavior of single machine system connected to infinite busbar. • To acquire knowledge on the applications of power system stabilizers.					
Outcome(s)	At the end of the course, students will be able to, 1. Discuss the basics of power system operation, stability, control and protection. 2. Develop the model of synchronous machines 3. Explain the excitation system and speed-governing controllers. 4. Develop the model for single-machine connected to infinite bus system. 5. Describe the application of power system stabilizer in power system..					
UNIT I	**BASIC CONCEPTS AND REVIEW OF CLASSICAL METHODS**				**(9)**	
General - Power System Stability - States of Operation and System Security - A Review .System Dynamic Problems - Current Status and Recent Trends. System Model - Some Mathematical Preliminaries .Analysis of Steady State Stability- Analysis of Transient Stability - Simplified Representation of Excitation Control.						
UNIT II	**SYNCHRONOUS MACHINE MODELLING**				**(9)**	
Synchronous machine - flux linkage equations - Park's transformation - per unit conversion - normalizing the equations - equivalent circuit - current space model - flux linkage state space model. Sub-transient and transient inductances - time constants. Simplified models (one axis and constant flux linkage) - steady state equations and phasor diagrams.						
UNIT III	**EXCITATION SYSTEM**				**(9)**	
Rotating Self-excited Exciter with direct acting Rheostatic type voltage regulator – Rotating main and Pilot Exciters with Indirect Acting Rheostatic Type Voltage Regulator – Rotating Main Exciter, Rotating Amplifier and Static Voltage Regulator – Static excitation scheme – Brushless excitation system.						
UNIT IV	**ANALYSIS OF SINGLE MACHINE SYSTEM**				**(9)**	
Small signal analysis with block diagram – Representation Characteristic equation and application of Routh Hurwitz criterion- synchronizing and damping torque analysis-small signal model – State equations.						
UNIT V	**APPLICATION OF POWER SYSTEM STABILIZERS**				**(9)**	
Basic concepts in applying PSS – Control signals – Structure and tuning of PSS – Washout circuit – Dynamic compensator analysis of single machine infinite bus system with and without PSS.						
				Total	**45 Hours**	
TEXT BOOKS						
1.	P.M. Anderson and A.A.Fouad, 'Power System Control and Stability', Galgotia Publications, New Delhi, 2022.					
2.	R.Ramanujam, "Power System Dynamics – Analysis and Simulation", PHI, 2009.					
3.	Kundur P., 'Power System Stability and Control', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.					

4.	NPTEL Online Courses : Power System Dynamics, Control and Monitoring
REFERENCES	
1.	John J. Grainger, William D. Stevenson, Jr, 'Power System Analysis', Mc Graw Hill Education (India) Private Limited, New Delhi, 2015.
2.	M.A.Pai and W.Sauer, 'Power System Dynamics and Stability', Pearson Education Asia, India, 2002.
3.	B.R.Gupta, 'Power System Analysis and Design' S. Chand, New Delhi, Fifth Edition, 2008.
4.	B.M.Weedy, B.J.Lory, N.Jenkins, J.B.Ekanayake and G.Strbac," Electric Power Systems", Wiley India, 2018.
5.	O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.
6.	**Video Lecture 1 :** https://www.youtube.com/watch?v=70gLa0-1Rho&list=PL2FE1841A440DE2F8
7.	**Video Lecture 2 :** https://www.youtube.com/watch?v=DzyX_GnSnL0&list=PLuv3GM6-gsE2WXbxLSnqKHf5gcnedXCZH
8.	**Video Lecture 3 :** https://www.youtube.com/watch?v=dHZMAX3R8Qg&list=PLv3GsHFX3KpR6k7995oybfjPeYVhacL6p
9.	**Video Lecture 4:** https://www.youtube.com/watch?v=bH-llxkVLAE
10.	**Video Lecture 5 :** https://www.youtube.com/watch?v=eIHfSBkdejw
11.	**Video Lecture 6 :** https://www.youtube.com/watch?v=Kf2QP5ZUVKM
12.	**Video Lecture 7 :** https://www.youtube.com/watch?v=VH0gQsFyY1k

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	1	-	-	-	-	-	-	1	1	-	1
CO2	2	2	3	-	1	-	-	-	-	-	-	1	1	-	1
CO3	3	-	-	-	1	-	-	-	-	-	-	1	1	-	1
CO4	2	2	3	-	1	-	-	-	-	-	-	1	1	-	1
CO5	3	-	-	-	1	-	-	-	-	-	-	1	1	-	1
CO	**2.6**	**2**	**3**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**	**1051**	
Program Elective						
Course code	**Course name**	**Hours/Week**			**Credit**	**Maximum marks**
24EE15024	**SMART GRID TECHNOLOGIES**	**L**	**T**	**P**	**C**	**100**
		3	**0**	**0**	**3**	
Objective(s)	• To acquire the knowledge on smart grid infrastructure and its composition • To learn about the communication and measurement systems • To discuss the operation of converters and energy storage systems for smart grid • To apply the computational techniques for optimizing the smart grid • To learn about the case studies and testbeds for specified problems.					
Outcome(s):	1. Interpret the knowledge on smart power grids and its issues 2. Explain the communication standard and measurement technologies 3. Apply the optimization and computational intelligence techniques for smart grid design 4. Summarize the power electronic converters and energy storage systems 5. Develop case studies for specified problem, test bench and its benchmark system					
UNIT I	**SMART POWER GRID**					(9)
. Grid challenges – Evolution – Characteristics and benefits of smart grid – Vision and roadmap for India – Examples of SG projects in India, US effort, Europe effort and China effort – Cyber controlled smart power grids – Comparison of microgrid and smart grid						
UNIT II	**COMMUNICATION AND MEASUREMENT**					(9)
Functions of smart grid components – Communication and measurement – Monitoring, PMU and smart meters – Demand side integration –Synchrophasor measurement – IEEE Standards, Multi agent systems technology						
UNIT III	**COMPUTATIONAL TOOLS**					(9)
Decision support tools – Optimization techniques – Classical optimization method – Heuristic optimization – Evolutionary computational techniques – Adaptive Dynamic Programming (ADP) techniques – Pareto methods – Hybridizing optimization techniques						
UNIT IV	**POWER ELECTRONICS AND ENERGY STORAGE SYSTEMS**					(9)
Current source and voltage source converters – Fault current limiting – Shunt and series compensators with energy storage – Energy storage technologies – Batteries, flow battery, fuel cell, flywheels, superconducting magnetic energy storage systems and super capacitors – Energy storage for wind power						
UNIT V	**CASE STUDIES AND TESTBEDS**					(9)
Demonstration projects – Advanced metering – Power system unit commitment problem – ADP for optimal network reconfiguration in distribution automation – Case study of RER integration – Test beds and benchmark systems – Challenges of smart transmission – Benefits of smart transmission						
					Total	**45 Hours**
Text book :						
1.	JanakaEkanayake and Nick Jenkins, "Smart Grid - Technology and Applications", 1st edition,					

	John Wiley and Sons, Canada, 2012
2.	James Momoh, “Smart Grid - Fundamentals of Design and Analysis”, IEEE Press, John Wiley and Sons, Canada, 2012

References:

1.	Ali Keyhani and Muhammad Marwali, “Smart Power Grids 2011”, Springer, 2011
2.	Takuro Sato, Daniel M. Kammen, Bin Duan, Muhammad Tariq, Zhenyu Zhou, Jun Wu and Solomon AbebeAsfaw, “Smart Grid Standards Specifications, Requirements, and Technologies”, John Willey and Sons, 2015
3.	Phadke A.G. and Thorp J.S., “Synchronized Phasor Measurements and their Applications”, Springer, 2010

COURSE ARTICULATION MATRIX:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	1	-	-	-	-	-	-	1	2	1	1
CO2	2	-	-	-	1	-	-	-	-	-	-	1	2	1	1
CO3	3	-	-	-	2	1	-	1	-	-	-	1	2	1	1
CO4	2	-	-	-	1	-	-	-	-	-	-	1	2	1	1
CO5	2	2	3	-	2	1	-	1	-	-	-	1	2	1	1
CO	**2.4**	**2**	**3**	**-**	**1.4**	**1**	**-**	**1**	**-**	**-**	**-**	**1**	**2**	**1**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE15025	**INDUSTRY 4.0**	**3**	**0**	**0**	**3**	**100**
Objectives	1. To impart the basic concepts of Industry 4.0. 2. To study the concepts of cyber physical system. 3. To acquire knowledge on energy resources and storage systems 4. To learn the concepts of smart grid 5. To learn the concepts of Industry 4.0 systems for Energy and smart vehicular applications.					
Outcomes	On completion of the course, student will be able to 1. Explain the basic concepts of Industry 4.0 and the other related fields. 2. Describe cyber physical system and the emerging applications. 3. Analyze the different energy storage systems. 4. Analyze a smart grid system. 5. Apply the smart technologies for smart vehicles					
UNIT I	**INTRODUCTION TO INDUSTRY 4.0**					**9**
Introduction, Historical Context, General framework, Application areas, Dissemination of Industry 4.0 and the disciplines that contribute to its development, Artificial intelligence, The Internet of Things and Industrial Internet of Things, Additive manufacturing, Robotization and automation, Current situation of Industry 4.0. Introduction to Industry 4.0 to Industry 5.0 Advances						
UNIT II	**INDUSTRY 4.0 AND CYBER PHYSICAL SYSTEM**					**9**
Introduction to Cyber Physical Systems (CPS), Architecture of CPS- Components, Data science and technology for CPS, Emerging applications in CPS in different fields. Case study: Application of CPS in health care domain.						
UNIT III	**SMART ENERGY SOURCES**					**9**
Energy Storage for Mitigating the Variability of Renewable Electricity Sources-Types of electric energy storage, Potential of Sodium-Sulfur Battery Energy Storage to Enable Integration of Wind-Case study. Electric Vehicles as Energy Storage: V2G Capacity Estimation.						
UNIT IV	**SMART GRID**					**9**
Smart grid definition and development Smart Grid, Understanding the Smart Grid, Smart grid solutions, Design challenges of smart grid and Industry 4.0.						
UNIT V	**SMART APPLICATIONS**					**9**
Understanding Smart Appliances -Smart Operation-Smart Monitoring-Smart Energy Savings-Smart Maintenance, Case study-Smart Cars, Self-Driving Cars, Introducing Google's Self-Driving Car, Intellectual Property Rights.						
					Total	**45 Hours**

TEXT BOOKS

1. Jean-Claude André, ―Industry 4.0‖, Wiley- ISTE, July 2019, ISBN: 781786304827,2019.
2. Diego GalarPascual, Pasquale Daponte, Uday Kumar, ―Handbook of Industry 4.0 and SMART Systems‖ Taylor and Francis,2020
3. Miller M, ―The internet of things: How smart TVs, smart cars, smart homes, and smart cities are

	changing the world‖, Pearson Education, 2015, ISBN: 9780134021300.
REFERENCES	
1.	Pengwei Du and Ning Lu, ―Energy storage for smart grids: planning and operation for renewable and variable energy resources VERs ‖, Academic Press, 2018, Reprint edition , ISBN-13:978-0128100714
2.	Hossam A. Gabbar, ―Smart Energy Grid Engineering‖, Academic Press, 2017, ISBN 978- 0-12-805343-0.
3.	Mini S. Thomas, John Douglas McDonald, ―Power System SCADA and Smart Grids‖, CRC Press, 2017.

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	1	1	-	-	-	-	1	1	-	1
CO2	2	-	-	-	-	1	1	-	-	-	-	1	1	-	1
CO3	2	3	-	-	-	1	1	-	-	-	-	1	1	-	1
CO4	2	3	-	-	-	1	1	-	-	-	-	1	1	-	1
CO5	3	-	-	-	-	1	1	-	-	-	-	1	1	-	1
CO	**2.2**	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**				**Programme Code**	**1051**
Program Elective						
Course code	**Course name**	**Hours/Week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
24EE15026	**POWER PLANT ENGINEERING**	**3**	**0**	**0**	**3**	**100**
Objective(s)	• To study the coal based thermal power plants. • To study the diesel, gas turbine and combined cycle power plants. • To learn the basic of nuclear engineering and power plants. • To learn the power from renewable energy • To study energy, economic and environmental issues of power plants					
Outcome(s):	1. Outline the construction and working of the components inside a thermal power plant. 2. Explain the concepts of diesel, gas turbine, and combined cycle power plant 3. Infer the operations of nuclear power plant and the safety measures adopted in nuclear power plant 4. Summarize the various types of renewable energy systems and the working of hydro electric power plant 5. Compare the site selection criteria for different powerplants, distinguish the various pollutions control technologies					
UNIT I	**COAL BASED THERMAL POWER PLANTS**					(9)
Rankine cycle improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.						
UNIT II	**DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS**					(9)
Otto, Diesel, Dual & Brayton Cycle Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.						
UNIT III	**NUCLEAR POWER PLANTS**					(9)
Basics of Nuclear Engineering, Layout and subsystems-of Nuclear Power Plants, Working of Nuclear Reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium-Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.						
UNIT IV	**POWER FROM RENEWABLE ENERGY**					(9)
Hydro Electric Power Plants Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.						
UNIT V	**ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS**					(9)
Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.						

	Total	**45 Hours**
Text book :		
1.	Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw-Hill Publishing Company Ltd., 2008.	
2.	A Textbook of Power Plant Engineeringby R.K. Rajput | 1 January 2016	
References:		
1.	El-Wakil. M.M., "Power Plant Technology", Tata McGraw Hill Publishing Company Ltd., 2010.	
2.	Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004	
3.	Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw-Hill, 1998.	
4.	Power Plant Engineeringby B. Vijaya Ramnath C. Elanchezhian, L. Saravanakumar, November 2019	
5.	Power Plant Engineering, As per AICTE: Theory and Practice by Dipak Kumar Mandal, Somnath Chakrabarti, et al. 1 January 2019	

COURSE ARTICULATION MATRIX:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	1	-	-	-	-	-	-	1	2	1	1
CO2	2	-	-	-	1	-	-	-	-	-	-	1	2	1	1
CO3	3	-	-	-	2	1	-	1	-	-	-	1	2	1	1
CO4	2	-	-	-	1	-	-	-	-	-	-	1	2	1	1
CO5	3			-	2	1	-	1	-	-	-	1	2	1	1
CO	**2.6**	**-**	**-**	**-**	**1.4**	**1**	**-**	**1**	**-**	**-**	**-**	**1**	**2**	**1**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**	**1051**	
Program Elective						
Course code	**Course name**	**Hours/Week**			**Credit**	**Maximum marks**
24EE15027	**FLEXIBLE AC TRANSMISSION SYSTEMS**	**L**	**T**	**P**	**C**	**100**
		3	0	0	3	
Objective(s)	• To study the concepts of FACTS Controllers • To impart knowledge on SVC for load flow and dynamic analysis • To acquire knowledge on TCSC for power flow and Stability studies • To learn the concepts of VSC based FACTS controllers for load flow and transient stability studies • To explore the concepts of FACTS controller					
Outcome(s):	At the end of the course, students will be able to, 1. Explain the fundamentals of FACTS Controllers 2. Explain the modeling concepts of Static VAR Compensator with applications 3. Design thyristor controlled series capacitor for power flow and stability studies 4. Analyze the load flow and transient stability studies of VSC based FACTS Controllers 5. Elaborate the Control coordination					
UNIT-I	**INTRODUCTION**					(9)
FACTS concepts- Power flow diagram in AC transmission line. Analysis of uncompensated AC Transmission line- Passive reactive power compensation: Effect of series and shunt compensation at the mid-point of the line on power transfer- Need for FACTS controllers- types of FACTS controllers- benefits from FACTS controllers.						
UNIT-II	**STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS**					(9)
Voltage control by SVC – Advantages of slope in dynamic characteristics – Influence of SVC on system voltage – Design of SVC voltage regulator –Modeling of SVC for power flow and transient stability – Applications: Enhancement of transient stability – Steady state power transfer – Enhancement of power system damping - Prevention of voltage instability.						
UNIT-III	**THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATIONS**					(9)
Operation of the TCSC – Different modes of operation – Modeling of TCSC – Variable reactance model – Modeling for Power Flow and stability studies. Applications: Improvement of the system stability limit – Enhancement of system damping - voltage collapse prevention.						
UNIT-IV	**VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS**					(9)
Static Synchronous Compensator (STATCOM) – Principle of operation – V-I Characteristics. Applications: Steady state power transfer-Enhancement of transient stability - Prevention of voltage instability. SSSC-operation of SSSC and the control of power flow – Modelling of UPFC and IPFC for load flow and transient stability studies- Applications.						
UNIT-V	**POWER FLOW CONTROLLER**					(9)

Basic operating principle, conventional transmission control capabilities, independent real and reactive power flow control, comparison of the UPFC to series compensators and phase angle regulators. Introduction to Inter line Power Flow Controller (IPFC).	
Total	**45 Hours**
Text book :	
1.	"Understanding FACTS Devices" N.G.Hingorani and L.Guygi, IEEE Press. Indian Edition is available:--Standard Publications-2021
2.	Narain G. Hingorani, "Understanding FACTS -Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors, Delhi- 110 006, 2011.
References:	
1.	K.R.Padiyar," FACTS Controllers in Power Transmission and Distribution", New Age International(P) Limited, Publishers, New Delhi, 2008
2.	V.K.Sood,HVDC and FACTS controllers – Applications of Static Converters in Power System, APRIL 2008 , Kluwer Academic Publishers, 2008.
3.	NPTEL: https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-ee44/
4.	https://www.gegridsolutions.com/services/catalog/hv-mv-courses/flexible-ac-transmission-system-facts-e-learning.htm

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	1	-	-	-	-	-	-	1	1	1	1
CO2	3	-	-	-	1	-	-	-	-	-	-	1	1	1	1
CO3	1	2	3	-	1	-	-	-	-	-	-	1	1	1	1
CO4	2	3	-	-	1	-	-	-	-	-	-	1	1	1	1
CO5	3	-	-	-	1	-	-	-	-	-	-	1	1	1	1
CO	**2.4**	**2.5**	**3**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE15028	**DISTRIBUTED GENERATION AND MICRO GRID**	**3**	**0**	**0**	**3**	**100**
Objectives	• To study the conventional and Non-conventional power generation. • To learn the concept of distributed generation and Energy storage elements. • To acquire knowledge on grid integration system. • To impart knowledge on the power electronics interfaces in dc and ac micro grids. • To discuss the concepts of control operation of micro grid.					
Outcomes	At the end of the course, students will be able to, 1. Summarize the conventional power generation. 2. Explain the concept of distributed generation and installation. 3. Illustrate the grid integration system with conventional and non-conventional energy sources. 4. Describe the operation of power electronics interfaces in DC and AC micro grid. 5. Interpret the power quality issues in micro grid.					
UNIT I	**INTRODUCTION**					**9**
Conventional power generation: advantages and disadvantages, Energy crises, Non-conventional energy (NCE) resources: review of Solar PV, Wind Energy systems, Fuel Cells, micro-turbines, biomass, and tidal sources.						
UNIT II	**DISTRIBUTED GENERATIONS (DG)**					**9**
Concept of distributed generations, topologies, selection of sources, regulatory standards/ framework, IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces: IEEE 1547, DG installation classes, security issues in DG implementations. Energy storage elements: Batteries, ultra-capacitors, flywheels.						
UNIT III	**IMPACT OF GRID INTEGRATION**					**9**
Requirements for grid interconnection, limits on operational parameters,: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues.						
UNIT IV	**BASICS OF A MICROGRID**					**9**
Concept and definition of microgrid, microgrid drivers and benefits, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids-Case studies.						
UNIT V	**CONTROL AND OPERATION OF MICROGRID**					**9**
Modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques, microgrid communication infrastructure, Power quality issues in microgrids, regulatory standards, Microgrid economics, Introduction to smart microgrids.						
					Total	**45 Hours**
TEXT BOOKS						

1.	N. Jenkins, J.B. Ekanayake and G. Strbac, 'Distributed Generation', The Institution of Engineering and Technology, London, United Kingdom 2010 The Institution of Engineering and Technology
2.	Hassan Bevrani, Kurdistan, Bruno Francois, ToshifumiIse , 'Microgrid Dynamics and Control, 'Wiely Publishing; 2017 JohnWiley& Sons.
3.	John Twidell and Tony Weir, "Renewable Energy Resources", Taylor and Francis Publications, Second Edition, 2015.
4.	AmirnaserYezdani, and Reza Iravani, "Voltage Source Converters in Power Systems: Modeling, Control and Applications", IEEE John Wiley Publications, 2009.
5.	DorinNeacsu, "Power Switching Converters: Medium and High Power", CRC Press, Taylor & Francis, 2009.
6.	F. Katiraei, M.R. Iravani, 'Transients of a Micro-Grid System with Multiple Distributed Energy Resources', International Conference on Power Systems Transients (IPST'05) in Montreal, Canada on June 19-23, 2010.
7.	H. Lee Willis, Walter G. Scott , 'Distributed Power Generation – Planning and Evaluation', Marcel Decker Press, 2010.
REFERENCES	
1.	Chetan Singh Solanki, "Solar Photo Voltaics", PHI learning Pvt. Ltd., New Delhi, 2009.
2.	J.F. Manwell, J.G "Wind Energy Explained, Theory Design and Applications," McGowan Wiley publication, 2nd Edition, 2009.
3.	Voltage Source Converters in Power Systems: Modeling, Control and Applications,AmirnaserYezdani, and Reza Iravani, IEEE John Wiley Publications,2009.
4.	Power Switching Converters: Medium and High Power, DorinNeacsu, CRC Press, Taylor & Francis, 2006
5.	https://archive.nptel.ac.in/courses/108/107/108107143/

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	1	1	-	1
CO2	2	-	-	-	-	-	-	-	-	-	-	1	1	-	1
CO3	3	-	-	-	-	-	-	-	-	-	-	1	1	-	1
CO4	2	-	-	-	-	-	-	-	-	-	-	1	1	-	1
CO5	3	-	-	-	-	-	-	-	-	-	-	1	1	-	1
CO	**2.4**	-	-	-	-	-	-	-	-	-	-	1	1	-	1
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**				**Programme Code**	**1051**
Program Elective						
COURSE CODE	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE15029	**IOT IN EV APPLICATIONS**	**3**	**0**	**0**	**3**	**100**
Objectives	• To impart knowledge on physical, logical design and business models. • To introduce various technologies behind Internet of things • To design internet of Things Systems using Arduino and Raspberry Pi. • To give exposure on Resource Management in Internet Of Things and Internet of things Applications • To elaborate Web Of Things infrastructure for popular applications					
Outcome	At the end of the course, students will be able to, 1. Describe various layers of Internet of Things protocol stack and protocol functionalities. 2. Demonstrate Internet of Things applications in various domains using prototype models. 3. Discuss working principles of various sensor for different Internet Of Things platforms 4. Explain code for an Internet of Things application and deploy for real-time scenario. 5. Design of web of things applications on different web of things platforms.					
UNIT I	**INTRODUCTION TO INTERNET OF THINGS**					**(9)**
Definition & Characteristics of Internet Of Things -Challenges and Issues -Physical Design of Internet Of Things , Logical Design of Internet Of Things -Internet Of Things Functional Blocks, Security. Control Units Communication modules Bluetooth ZigbeeWifi GPS-Internet Of Things Protocols (IPv6, 6LoWPAN, RPL, CoAPetc), MQTT, Wired Communication, Power Sources						
UNIT II	**INTERNET OF THINGS TECHNOLOGIES**					**(9)**
Four pillars of INTERNET OF THINGS paradigm, -RFID, Wireless Sensor Networks, SCADA (Supervisory Control and Data Acquisition), M2M -Internet Of Things Enabling Technologies - BigData Analytics, Cloud Computing, Embedded Systems						
UNIT III	**DESIGN AND DEVELOPMENT**					**(9)**
Working principles of sensors INTERNET OF THINGS deployment for Raspberry Pi/Arduino /Equivalent plat-form Reading from Sensors, Communication: Connecting microcontroller with mobile devices, communication through Bluetooth, wifi and USB -Contiki OS-Cooja Simulator.						
UNIT IV	**RESOURCE MANAGEMENT AND APPLICATIONS**					**(9)**
Clustering, Clustering for Scalability, Clustering Protocols for Internet of Things , Business models for the internet of things, Smart city, smart mobility and transport, smart buildings and infrastructure, smart health, environment monitoring and surveillance.						
UNIT V	**WEB OF THINGS**					**(9)**
The Future Web of Things Set up cloud environment Cloud access from sensors Data Analytics for Internet Of Things -Case studies-Open Source e-Health sensor platform Be Close Elderly monitoring Other recent project						

	Total Hours to be taught	**L:45 T:00(45 Hours)**
TEXT BOOKS		
1.	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, ―Web Of Things Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017	
REFERENCES		
1.	ArshdeepBahga, Vijay Madisetti, ―Internet of Things – A hands-on approach, Universities Press, 2015	
2.	Olivier Hersent, David Boswarthick, Omar Elloumi , ―The Internet of Things – Key applications and Protocols, Wiley, 2012 (for Unit 2).	
3.	Jan Ho¨ ller, VlasiosTsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Elsevier, 2014.	
4.	Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, O'Reilly Media, 2011.	
5.	Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―Architecting the Internet of Things, Springer, 2011.	
6.	NPTEL Link: Introduction to Internet of things https://nptel.ac.in/courses/106/105/106105166/	

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	2	2	-	-	-	-	2	2	-	2
CO2	2	3	-	-	-	2	2	-	-	-	-	2	2	-	2
CO3	2	3	-	-	-	2	2	-	-	-	-	2	2	-	2
CO4	2	3	-	-	-	2	2	-	-	-	-	2	2	-	2
CO5	2	2	3	3	-	2	2	-	-	-	-	2	2	-	2
CO	**2.0**	**3**	**3**	**3**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**				**Programme Code**	**1051**
Program Elective						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE15030	**ARTIFICIAL INTELLIGENCE**	**3**	**0**	**0**	**3**	**100**
Objectives	• To discuss the underlying structure behind intelligence mathematically. • To apply the logical implications in computational intelligence. • To learn the techniques of knowledge representation • To acquire knowledge on automated learning techniques. • To explore the concepts of artificial intelligence techniques in real-time scenarios.					
Outcomes	After completion the course, students will be able to 1. Discuss the search techniques. 2. Apply the search techniques to real-time problems. 3. Interpret the reasoning techniques to real world problems. 4. Illustrate the representation of knowledge and learning techniques. 5. Apply AI techniques in developing real world applications.					
UNIT I	**INTELLIGENT AGENTS AND SEARCH TECHNIQUES**					**9**
Agents and Environments – Good Behavior: The Concepts of Rationality – The Nature of Environments – The Structure of Agents – Problem Solving by Search – Uninformed Search – Searching with Costs – Informed State Space Search – Heuristic Search: Greedy – A* Search – Problem Reduction Search – Game Search – Constraint Satisfaction Problems.						
UNIT II	**REASONING WITH LOWER ORDER LOGICS**					**9**
Logical Agent – Proposition Logic – Syntax and Semantics – Theorem Proving – Model Checking – Inference in First Order Logic: Forward Chaining – Backward Chaining – Resolution.						
UNIT III	**KNOWLEDGE REPRESENTATION**					**9**
Knowledge Representation Issues – Approaches for Knowledge Representation: Simple Relational Knowledge – Inherited Knowledge – Semantic Nets – Frames – Semantic Web – Ontology.						
UNIT IV	**AI PLANNING AND NATURAL LANGUAGE PROCESSING**					**9**
Classical Planning – Types – Partial Order Planning – Graph Plan and SAT Plan – Natural Language Processing Basics: Syntax – Semantics – Introduction to Statistical NLP.						
UNIT V	**LEARNING AND APPLICATIONS**					**9**
Logical Formulation of Learning – Knowledge in Learning – Explanation-based Learning – Learning using Relevance Information – Application with NLP: Developing a Simple Chatbot – Types of Chatbot.						
					Total	**45 Hours**
TEXT BOOKS						
1.	Stuart J. Russell, Peter Norvig, “Artificial Intelligence - A Modern Approach”, Third Edition, Pearson Publishers, 2015.					
2.	Elaine Rich, Kevin Knight, Shiva shankar B. Nair, “Artificial Intelligence”, Third Edition, Tata McGraw-Hill Education, 2008.					

3.	DheepakKhemani, “A first course in Artificial Intelligence”, McGraw Hill Education Pvt Ltd., NewDelhi, 2013
4.	https://nptel.ac.in/courses/106105077
REFERENCES	
1.	Steven Bird, Ewan Klein and Edward Loper, “Natural Language Processing with Python”, O’Reilly, 2009, https://www.nltk.org/book/.
2.	Nils J. Nilsson, “Artificial Intelligence: A New Synthesis”, Morgan Kaufmaan Publishers Inc; Second Edition, 2003.
3.	NPTEL, “Artificial Intelligence”, http://nptel.ac.in/courses/106105079/2.

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	1	1	1	1
CO2	3	-	-	-	-	-	-	-	-	-	-	1	1	1	1
CO3	3	-	-	-	-	-	-	-	-	-	-	1	1	1	1
CO4	3	-	-	-	-	-	-	-	-	-	-	1	1	1	1
CO5	3	-	-	-	-	-	-	-	-	-	-	1	1	1	1
CO	**2.8**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE15031	**BUILDING MANAGEMENT SYSTEM**	**3**	**0**	**0**	**3**	**100**
Objectives	• Introduce the concept and importance of Building Management Systems (BMS) in modern infrastructure. • Familiarize students with various subsystems — HVAC, lighting, security, fire, and energy management. • Develop understanding of communication protocols and system integration in smart buildings. • Enable students to design, analyze, and simulate simple BMS configurations. • Highlight sustainability, automation, and IoT-based developments in intelligent buildings.					
Outcomes	After completion the course, students will be able to 1. Explain the fundamentals, architecture, and need for Building Management Systems. 2. Analyze various building services controlled through BMS. 3. Identify and interpret sensors, controllers, and communication protocols used in automation. 4. Design a basic integrated BMS layout incorporating multiple subsystems. 5. Evaluate BMS performance considering energy efficiency, safety, and sustainability.					
UNIT I	**INTRODUCTION TO BUILDING MANAGEMENT SYSTEMS**					**9**
Building Management Systems- Functions and benefits of BMS in modern infrastructure- Architecture and components of BMS- Control hierarchy: field devices, controllers, supervisory systems- Overview of automation and control strategies- Case studies of BMS applications in commercial and industrial buildings						
UNIT II	**BUILDING SERVICES AND SUBSYSTEMS**					**9**
HVAC system operation and control- Lighting control systems- Fire detection and alarm systems Access control and security systems (CCTV, biometric systems)- Elevators, water supply, and plumbing system automation- Integration of subsystems within BMS						
UNIT III	**SENSORS, ACTUATORS, AND CONTROLLERS**					**9**
Sensors: temperature, humidity, occupancy, light, pressure, smoke, etc.- Actuators and field devices – valves, dampers, relays, motors- Programmable Logic Controllers (PLC) and Distributed Control Systems (DCS)- Control loops – open and closed loop concepts- Controller algorithms: P, PI, PID control in BMS applications- Calibration and maintenance of sensors						
UNIT IV	**COMMUNICATION PROTOCOLS AND SYSTEM INTEGRATION**					**9**
Data communication fundamentals in BMS- Protocols: BACnet, Modbus, KNX, LonWorks, DALI, ZigBee- Supervisory Control and Data Acquisition (SCADA) for building management- Network architecture: topology, gateways, and interoperability- Integration with IoT platforms and cloud-based monitoring- Cybersecurity considerations in BMS networks						

UNIT V	SMART BUILDINGS AND ENERGY MANAGEMENT	9
Concept of smart and sustainable buildings - Energy monitoring and performance optimization - Integration with renewable energy systems (solar PV, wind, etc.) - Demand-side management and energy analytics - Case studies on intelligent building design and green building standards (LEED, IGBC) - Future trends: AI, IoT, and digital twins in building automation		
	Total	**45 Hours**

TEXT BOOKS	
1.	Hordeski, M.F., *Smart Buildings: Advanced Materials and Nanotechnology to Improve Energy Efficiency and Environmental Performance*, The Fairmont Press, 2019.
2.	McDowall, R., *Fundamentals of HVAC Systems*, Elsevier, 2020.
3.	McGowan, J.J., *Direct Digital Control: A Guide to Distributed Building Automation*, Fairmont Press, 2011.
REFERENCES	
1.	Guy Wiring, *Building Automation: Control Devices and Applications*, Cengage Learning, 2014.
2.	Barrie Gill, *Building Management Systems*, Butterworth-Heinemann, 2015.
3.	Albert Ting-pat So & Wai Lok Chan, *Intelligent Building Systems*, Kluwer Academic, 2001.
4.	National Building Code (NBC) – BIS Standards on Building Automation and Safety.

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	1	-	-	-	-	-	-	1	1	1	1
CO2	3	2	3	-	1	-	-	-	-	-	-	1	1	1	1
CO3	1	2	3	-	1	-	-	-	-	-	-	1	1	1	1
CO4	2	3	-	-	1	-	-	-	-	-	-	1	1	1	1
CO5	3	-	-	-	1	-	-	-	-	-	-	1	1	1	1
CO	**2.4**	**2.3**	**3**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2024						
Department	**Electrical and Electronics Engineering**				**Programme Code**	**1051**
Program Elective						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
24EE15032	**MACHINE LEARNING**	**3**	**0**	**0**	**3**	**100**
Objectives	• Introduce the fundamentals and types of machine learning approaches. • Enable understanding of various algorithms for supervised and unsupervised learning. • Develop skills to apply regression, classification, and clustering models to real-world problems. • Familiarize students with neural networks and deep learning concepts. • Enable students to implement, evaluate, and optimize machine learning models using modern tools.					
Outcomes	After completion the course, students will be able to 1. Explain the concepts, scope, and applications of Machine Learning. 2. Apply supervised learning algorithms for classification and regression problems. 3. Apply unsupervised learning and dimensionality reduction techniques. 4. Analyze and design artificial neural network models for prediction tasks. 5. Evaluate and optimize ML model performance and understand its ethical implications.					
UNIT I	**INTRODUCTION TO MACHINE LEARNING**					**9**
Introduction: AI vs ML vs DL- Types of Learning: Supervised, Unsupervised, Reinforcement - Steps in a Machine Learning project- Applications in Electrical Engineering (fault detection, energy forecasting, control systems)- Overview of datasets, features, and labels- Tools and frameworks: Python, Scikit-learn, TensorFlow						
UNIT II	**SUPERVISED LEARNING**					**9**
Regression models: Linear Regression, Polynomial Regression- Classification models: K-Nearest Neighbour, Decision Trees, Random Forest, Support Vector Machines (SVM)- Overfitting and underfitting concepts- Bias-variance trade-off- Performance metrics: Accuracy, Precision, Recall, F1-score						
UNIT III	**UNSUPERVISED LEARNING AND FEATURE ENGINEERING**					**9**
Clustering: K-Means, Hierarchical, DBSCAN- Dimensionality reduction: Principal Component Analysis (PCA), LDA- Feature selection and extraction- Applications in anomaly detection and load profiling- Data preprocessing: normalization, encoding, scaling						
UNIT IV	**NEURAL NETWORKS AND DEEP LEARNING**					**9**
Biological vs Artificial Neurons- Perceptron, Multilayer Perceptron (MLP)- Backpropagation algorithm- Activation functions and loss functions- Introduction to Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN)- Case studies in image and signal classification						
UNIT V	**MODEL EVALUATION, OPTIMIZATION, AND APPLICATIONS**					**9**
Cross-validation and hyperparameter tuning- Ensemble methods: Bagging, Boosting (AdaBoost, Gradient Boosting)- Model interpretability and explainability-Ethical considerations in ML: bias, privacy, fairness- Applications in smart grids, predictive maintenance, and energy management systems-Future trends: Edge ML, Federated Learning						
					Total	**45 Hours**

TEXT BOOKS	
1.	Tom M. Mitchell , *Machine Learning*, McGraw Hill, 2017.
2.	Ethem Alpaydin , *Introduction to Machine Learning*, MIT Press, 2020.
3.	Aurélien Géron , *Hands-on Machine Learning with Scikit-Learn, Keras & TensorFlow*, O'Reilly, 2023.
REFERENCES	
1.	Bishop C.M., *Pattern Recognition and Machine Learning*, Springer, 2019.
2.	Sebastian Raschka & Vahid Mirjalili, *Python Machine Learning*, Packt, 2022.
3.	Haykin S., *Neural Networks and Learning Machines*, Pearson, 2019.

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	1	-	-	-	-	-	-	1	1	1	1
CO2	2	3	-	-	1	-	-	-	-	-	-	1	1	1	1
CO3	2	3	-	-	1	-	-	-	-	-	-	1	1	1	1
CO4	1	2	3	-	1	-	-	-	-	-	-	1	1	1	1
CO5	1	2	3	-	1	-	-	-	-	-	-	1	1	1	1
CO	**1.8**	**2**	**3**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															