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 2022

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

Regulations 2022

I Semester

Sl. No.	Course code	Course Title	L	T	P	C	Category
THEORY							
1	22MA12101	Engineering Mathematics I	3	1	0	4	BS
2	22PY12001	Engineering Physics	3	0	0	3	BS
3	22CS13001	Problem Solving Techniques Using C	3	0	0	3	ES
4	22EE33101	Basics of Electrical and Electronics Engineering	2	0	2	3	ES
5	22GE33101	Basic Civil and Mechanical Engineering	3	0	2	4	ES
6	22HS11001	Heritage of Tamils	1	0	0	1	HS
7	22SH61101	Induction Program	3	-	-	-	MC
PRACTICAL							
8	22PY22001	Physics Laboratory	0	0	3	1.5	BS
9	22CS23001	Problem Solving Techniques Laboratory	0	0	3	1.5	ES
		TOTAL	**18**	**1**	**10**	**21**	

MAHENDRA ENGINEERING COLLEGE
(Autonomous)

DEPARTMENT OF
ELECTRICAL AND ELECTRONICS ENGINEERING

Regulations 2022

II Semester

Sl. No.	Course code	Course Title	L	T	P	C	Category
THEORY							
1	22MA12201	Engineering Mathematics II	3	1	0	4	BS
2	22CY12001	Chemistry for Engineering	3	0	0	3	BS
3	22EN11001	Communicative English	3	0	0	3	HS
4	22GE13001	Engineering Graphics and Design	3	0	2	4	ES
5	22EE14201	Electric Circuit Analysis	3	0	0	3	PC
6	22HS11002	Tamils and Technology	1	0	0	1	HS
PRACTICAL							
7	22CY22001	Chemistry Laboratory	0	0	3	1.5	BS
8	22EE24201	Electric Circuits Laboratory	0	0	3	1.5	PC
9	22EN21001	Personality Development Practice Laboratory	0	0	2	1	HS
		TOTAL	**16**	**1**	**9**	**22**	

	MAHENDRA ENGINEERING COLLEGE (Autonomous)						
	DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING						
Regulations 2022							
III Semester							
Sl. No.	**Course code**	**Course Title**	**L**	**T**	**P**	**C**	**Category**
THEORY							
1	22MA12303	Differential Equations and Numerical Methods	3	1	0	4	BS
2	22EE13301	Analog Electronics	2	1	0	3	PC
3	22EE14301	Electromagnetic Fields	2	1	0	3	PC
4	22EE14302	DC Machines and Transformers	3	0	0	3	PC
5	22CY11001	Environmental Science and Engineering	3	-	-	-	MC
6		Open Elective I	3	0	0	3	OE
PRACTICAL							
7	22EE23301	Analog Electronics Laboratory	0	0	3	1.5	PC
8	22EE24301	DC Machines and Transformers Laboratory	0	0	3	1.5	PC
9	22EE24302	Electrical Winding Practices Laboratory	0	0	3	1.5	PC
		TOTAL	**16**	**3**	**9**	**20.5**	

MAHENDRA ENGINEERING COLLEGE
(Autonomous)

DEPARTMENT OF
ELECTRICAL AND ELECTRONICS ENGINEERING

Regulations 2022

IV Semester

Sl. No.	Course code	Course Title	L	T	P	C	Category
THEORY							
1	22EE13401	Digital Electronics	2	1	0	3	PC
2	22EE14401	Synchronous and Induction Machines	3	0	0	3	PC
3	22SH11006	Universal Human Values	2	1	0	3	HS
4		Program Elective I	3	0	0	3	PE
5		Open Elective II	3	0	0	3	OE
6		Open Elective III	3	0	0	3	OE
PRACTICAL							
7	22EE23401	Digital Electronics Laboratory	0	0	3	1.5	PC
8	22EE24401	Synchronous and Induction Machines Laboratory	0	0	3	1.5	PC
9	22EN60001	Professional Communication Skills	0	1	2	2	EEC
		TOTAL	**16**	**3**	**8**	**23**	

MAHENDRA ENGINEERING COLLEGE
(Autonomous)

DEPARTMENT OF
ELECTRICAL AND ELECTRONICS ENGINEERING

Regulations 2022

V Semester

Sl. No.	Course code	Course Title	L	T	P	C	Category
THEORY							
1	22EE14501	Power Electronics	2	1	0	3	PC
2	22EE14502	Control Systems	2	1	0	3	PC
3	22EE34501	Electrical Measurements and Instrumentation	2	0	2	3	PC
4		Program Elective II	3	0	0	3	PE
5		Open Elective IV	3	0	0	3	OE
6		Open Elective V	3	0	0	3	OE
7	22MC60001	Constitution of India	3	-	-	-	MC
PRACTICAL							
8	22EE24501	Power Electronics laboratory	0	0	3	1.5	PC
9	22EE24502	Control Systems Laboratory	0	0	3	1.5	PC
10	22EN60002	Interview Skills and Soft Skills	0	1	2	2	EEC
		TOTAL	**18**	**3**	**10**	**23**	

MAHENDRA ENGINEERING COLLEGE
(Autonomous)

DEPARTMENT OF
ELECTRICAL AND ELECTRONICS ENGINEERING

Regulations 2022

VI Semester

Sl. No.	Course code	Course Title	L	T	P	C	Category
THEORY							
1	22EE14601	Transmission and Distribution Systems	3	1	0	4	PC
2	22EE14602	Microcontroller based System Design	3	0	0	3	PC
3	22EE14603	Special Electrical Machines	3	0	0	3	PC
4	22ME15501	Managerial Skills, Project and Quality Management	3	0	0	3	HS
5		Program Elective III	3	0	0	3	PE
6		Open Elective VI	3	0	0	3	OE
PRACTICAL							
7	22EE24601	Microcontroller Laboratory	0	0	3	1.5	PC
8	22EE24602	Special Electrical Machines Laboratory	0	0	3	1.5	PC
9	22EE24603	Project Design Laboratory	0	0	3	1.5	PC
		TOTAL	**18**	**1**	**9**	**23.5**	

MAHENDRA ENGINEERING COLLEGE
(Autonomous)

DEPARTMENT OF
ELECTRICAL AND ELECTRONICS ENGINEERING

Regulations 2022

VII Semester

Sl. No.	Course code	Course Title	L	T	P	C	Category
THEORY							
1	22EE14701	Power System Operation and Analysis	3	1	0	4	PC
2	22EE14702	Power Systems Control and Protection	3	0	0	3	PC
3	22EE14703	Embedded Systems	3	0	0	3	PC
4	22EE14704	Solid State Drives	3	0	0	3	PC
5		Program Elective IV	3	0	0	3	PE
PRACTICAL							
6	22EE24701	Power System Simulation Laboratory	0	0	3	1.5	PC
7	22EE24702	Embedded Systems Laboratory	0	0	3	1.5	PC
8	22EE36701	Mini Project	0	0	6	3	EEC
		TOTAL	**15**	**1**	**12**	**22**	

MAHENDRA ENGINEERING COLLEGE
(Autonomous)

DEPARTMENT OF
ELECTRICAL AND ELECTRONICS ENGINEERING

Regulations 2022

VIII Semester

Sl. No.	Course code	Course Title	L	T	P	C	Category
THEORY							
1		Program Elective V	3	0	0	3	PE
2		Program Elective VI	3	0	0	3	PE
PRACTICAL							
3	22EE36801	Project Work	0	0	12	6	EEC
		TOTAL	**06**	**0**	**12**	**12**	

MAHENDRA ENGINEERING COLLEGE
(Autonomous)

DEPARTMENT OF
ELETRICAL AND ELECTRONICS ENGINEERING

Regulations 2022

Program Electives

Sl. No.	Course code	Course Title	L	T	P	C	Category
1	22EE15001	Electrical Safety	3	0	0	3	PE
2	22EE15002	Power Quality	3	0	0	3	PE
3	22EE15003	Electric Power Utilization and Conservation	3	0	0	3	PE
4	22EE15004	Control Systems Engineering	3	0	0	3	PE
5	22EE15005	Design of Electrical Machines	3	0	0	3	PE
6	22EE15006	High Voltage Engineering	3	0	0	3	PE
7	22EE15007	EV Batteries and Charging Systems	3	0	0	3	PE
8	22EE15008	Biomedical Instrumentation	3	0	0	3	PE
9	22EE15009	Control Engineering	3	0	0	3	PE
10	22EE15010	Industrial Automation and Control	3	0	0	3	PE
11	22EE15011	Power System Security	3	0	0	3	PE
12	22EE15012	Energy Management and Auditing	3	0	0	3	PE
13	22EE15013	EV Standards and Testing	3	0	0	3	PE
14	22EE15014	Power Systems Stability	3	0	0	3	PE
15	22EE15015	Digital Signal Processing	3	0	0	3	PE
16	22EE15016	EHV AC and DC Transmission	3	0	0	3	PE
17	22EE15017	Intelligent Controllers	3	0	0	3	PE

18	22EE15018	Green Energy Technologies	3	0	0	3	PE
19	22EE15019	Disaster Management	3	0	0	3	PE
20	22EE15020	Renewable and Non-Renewable Energy Sources	3	0	0	3	PE
21	22EE15021	Power System Restructuring	3	0	0	3	PE
22	22EE15022	Automotive Electronics	3	0	0	3	PE
23	22EE15023	Power Systems Dynamics and control	3	0	0	3	PE
24	22EE15024	Smart Grid Technologies	3	0	0	3	PE
25	22EE15025	Industry 4.0	3	0	0	3	PE
26	22EE15026	Electric vehicles	3	0	0	3	PE
27	22EE15027	Flexible AC Transmission Systems	3	0	0	3	PE
28	22EE15028	Distributed generation and Micro grid	3	0	0	3	PE
29	22EE15029	Web of Things	3	0	0	3	PE
30	22EE15030	Artificial Intelligence	3	0	0	3	PE

Semester wise Credit distribution

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	21	22	20.5	23	23	23.5	22	12	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	-	-	-	-	-	21
3	ES	11.5	4	-	-	-	-	-	-	15.5
4	PC	-	4.5	13.5	9	12	14.5	16		69.5
5	PE	-	-	-	3	3	3	3	6	18
6	OE	-	-	3	6	6	3	-	-	18
7	MC	-	-	EVS	-	COI	--	-	-	-
8	EEC	-	-	-	2	2		3	6	13
Total Credits		21	22	20.5	23	23	23.5	22	12	167

MAHENDRA ENGINEERING COLLEGE
(Autonomous)

Syllabus			Regulations 2022
Department	**MATHEMATICS**	**Programme Code**	**1051**

SEMESTER – I

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22MA12101	**ENGINEERINGMATHEMATICS-I (Common to all Branches)**	3	1	0	4	**100**

Objectives	To enable the students to: • Learn the types of matrices and linear algebra in a comprehensive manner. • Familiarize with functions of several variables, which is applied in electrical and communication branch engineering. • Define the geometric aspects of curvature, radius of curvature, evolutes and envelopes as application of differential calculus. • Explain different types of higher order ordinary differential equations with variable coefficients and various methods to solve the equations. • Learn the 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: 1. Solve the system of equations and determine rank, eigen values, eigen vectors and inverse of a given matrix and diagonalize symmetric matrix by orthogonaltrans formations. 2. Illustrate maxima and minima functions of several variables. 3. Apply the concepts of differential calculus in physical problems. 4. Solve the higher order differential equations with variable coefficients. 5. Compute the area and volume by using multiple integrals.

UNIT – I	**MATRICES**	**9+3**

Matrix and its types – Rank of matrix - Characteristic equation - Eigen values and Eigenvectors of the matrix - Cayley-Hamilton Theorem, Diagonalization of real and symmetric matrices by Orthogonal transformation – Reduce the quadratic form to canonical form.

UNIT – III	**APPLICATIONS OF DIFFERENTIAL CALCULUS**	**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	**ORDINARYDIFFERENTIALEQUATIONSOFHIGHERORDERS**	**9+3**

Second and Higher order linear differential equations with constant coefficients– Method of variation of parameters – Cauchy Euler equation, Legendre's type differential equations – System of simultaneous linear differential equations with constant coefficients.

UNIT – V	**MULTIPLEINTEGRALS**	**9+3**

Double integrals in Cartesian co-ordinates – Change of order of integration – Area as double integral – Triple integral in Cartesian co-ordinates – Volume as triple integral – Change of variables in double integrals.

	Total	**60 Hours**
TEXTBOOK:		
1	T. Veerarajan, Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2019.	
2	B.S.Grewal, Higher Engineering Mathematics, KhannaPublishers,44th Edition,2017.	
3	G.Balaji, Engineering Mathematics – I, G.Balaji Publication, 3rd Edition, 2015.	
REFERENCES:		
1	Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2016.	
2	G.B.Thomas and R.L. Finney, Calculus and Analyticgeometry,9th Edition,Pearson, Reprint,2002.	
3	Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill NewDelhi, 11th Reprint, 2016.	
4.	N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications,9th Edition, 2014.	

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 2022
DEPARTMENT:	SCIENCE & HUMANITIES		Programme Code & Name			ENGINEERING PHYSICS
SEMESTER-I						
COURSE CODE	**COURSE NAME**	**HOURS/WEEK**			**CREDIT**	**MAXIMUM MARKS**
		L	**T**	**P**	**C**	
22PY12001	**ENGINEERING PHYSICS (FOR ALL BRANCHES)**	3	0	0	3	**100**

Objective(s)	➢ To provide students with a fundamental knowledge of physics, together with problem-solving skills ➢ Understanding of Basics of Physics about lasers, Acoustics, Properties of matter, Semiconductor Physics and Quantum Physics. How these are used in information and communication technology.
Outcome(s)	After completing the course the students 1. Explain the basics of Laser, Fiber Optics and its types with its applications in various fields. 2. Describe the Acoustics and Ultrasonic's their applications in various engineering fields. 3. Summarize the Properties of materials and their uses. 4. Elaborate the basics concepts of Quantum Physics with their Applications. 5. Explain the basics of semiconducting materials and their applications in Solar.

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 AND ACOUSTICS**	(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. Classification of sound- decibel- Weber–Fechner law – Sabine's formula- derivation using growth and decay method – Absorption Coefficient and its determination –factors affecting acoustics of buildings and their remedies.		
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	**SEMICONDUCTOR PHYSICS**	(9 Hrs)
Intrinsic Semiconductors – Energy band diagram – direct and indirect semiconductors – Carrier Concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors. Photo current in a P- N diode – solar cell –photo detectors - LED – Organic LED – Laser diodes.-Photovoltaic applications: domestic lighting, street lighting, water pumping etc -solar PV power plant.		
Total		**45 Hours**

Text book :	
1.	Dr. Palanisamy P.K, "Engineering Physics", Scitech Publications, Chennai, 2010.
2.	Dr.G.Senthilkumar - Engineering Physics-VRB Publication & Co, Chennai- Latest edition 2019.
3.	Wahab, M.A. ―Solid State Physics: Structure and Properties of Materials. Narosa Publishing House, 2009
REFERENCES	
1.	Pillai S O, "Engineering Physics", New Age International Publishers, New Delhi, 2005.
2.	Satyaprakash-Engineering Physics-Pragati Prakashan,Meerut-I Edition 2003
3.	Dr.M.Arumugam-Engineering Physics - Anuradha Agencies, Kumbakonam-III Revised Edition 2002.
4.	D. Halliday, R. Resnick and J. Walker, Fundamentals of Physics, 6th Edition, John Wiley and Sons, 2001.

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	3	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO	**2.2**	-	-	-	-	-	-	-	-	1	-	1	-	-	-
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRAENGINEERING COLLEGE
(Autonomous)

Syllabus

Department	Electrical and Electronics Engineering	Programme Code	1051

I Semester

Course code	Course Name	Hours/week			Credit	Maximum
		L	T	P	C	
22CS13001	PROBLEM SOLVING TECHNIQUES USING C	3	0	0	3	100

Objectives	**To enable the students to:** • Understand the basics of algorithmic problem solving • Understand the basic concepts of C Programming. • Learn the arrays and functions in C • Be familiar with pointers and structures in C • Understand the file handling techniques and preprocessors in C
Outcomes	**At the end of the course the students will be able to:** 1. Develop Algorithms for real time problems through various Problem solving techniques 2. Define the syntax of C Programming 3. Summarize the use of functions and pointers in programming in C programming concepts 4. Apply the concepts of pointers and structure 5. Describe the fundamental concepts of files and preprocessors in C

UNIT-I	PROBLEM SOLVING ASPECTS	9

Problem Solving Aspects: Algorithms Pseudo code, Flowchart-Steps In Problem Solving-simple strategies for developing algorithms (iteration, recursion)- Programming methodologies - Illustrative problems: Exchanging The Values-Counting-Find minimum in a list - Factorial Computation-Fibonacci

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 – operators – Input and Output operations – Decision Making and Branching – Looping statements- Programming Examples

UNIT-III	ARRAYS AND FUNCTIONS	9

Arrays: Introduction –One-Dimensional Arrays-Two-Dimensional Arrays -Multidimensional Arrays - Strings: Operations of Strings. Function – definition of function – Declaration of function – Function prototype – Types of functions – Pass by value – Pass by reference – Recursion - Programming

UNIT-IV	POINTERS AND STRUCTURES	9

Pointers - Definition – Initialization - Pointers and arrays- Introduction to Structure – Structure definition – Structure declaration – Structure within a structure- Unions – Storage classes

UNIT-V	FILE PROCESSING AND PREPROCESSORS	9

Files: File modes - File functions - File operations - Text and Binary files, Command Line arguments –

C Preprocessor directives: Macros – Definition - types of Macros - Creating and implementing user

Total	**45 Hours**

TEXT BOOK :

1	Anita Goel and 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	Pradip Dey, 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.,
5	NPTEL course, Problem Solving Through Programming in C,
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	2	2	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	-	-	-	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)						
Syllabus-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
I Semester						
Course Code	**Course name**	**Hours/Week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE33101	**BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING (Integrated Course)**	**2**	**0**	**2**	**3**	**100**
Objective	• To elaborate the concept of DC circuits and wiring connection. • To understand the basic concepts of Semiconductor Devices • To Demonstrate simple electrical and electronic components					
Outcomes	1. Illustrate the concept of DC circuits to compute voltage, current & resistance. 2. Explain the working principle of semiconductor devices and SMPS 3. Demonstrate the simple electrical wirings and soldering practices 4. Design simple power supply using diodes 5. Demonstrate the functions of basic electronic components					
UNIT I	**BASIC CIRCUITS AND DOMESTIC WIRING**					**(8)**
Electrical circuit elements (R, L and C)-Dependent and independent sources – Ohm's Law-Kirchhoff's laws - mesh current and node voltage methods (Analysis with only independent source) - Phasors – RMS-Average values-sinusoidal steady state response of simple RLC circuits. Types of wiring- Domestic wiring - Specification of Wires-Earthing-Methods-Protective devices.						
UNIT II	**SEMICONDUCTOR DEVICES**					**(7)**
Basic Electronic Components: Resistance - Inductor - Capacitor -Types, Functions, Symbols - Color coding of Resistance – Review of insulator, conductor and semiconductor - Semiconductor types – Drift and Diffusion Currents - Study of CRO- Construction of PN junction diode- VI characteristics of PN junction diode- Zener diode as voltage regulator – Biasing LED- Switch mode Power Supply						
S.No	**LIST OF EXPERIMENTS**					**Hours**
1	Stair case wiring					**(30)**
2	Fluorescent lamp wiring					
3	Residential house wiring using switches, fuse, indicator and lamp					
4	Fan Regulator wiring					
5	Measurement of DC and AC voltage, current and power(using Energy meter) in electrical circuits					
6	Study of CRO- Lissajous pattern					
7	VI characteristics of PN junction Diode					
8	Zener diode as voltage regulator					
9	Biasing LED					
10	Soldering practice using discrete components					

Total	**45 Hours**
Text Books:	
1	Charles K. Alexander and Mathew N.O. Sadiku, Fundamentals of Electric Circuits, 5th edition, McGraw-Hill,2019.
2	Joseph Edministor and Nahvi (Mohmood), 'Theory & Problems of Electric Circuits', 5th edition, McGraw Hill, 2020.
3	V.K Mehta and Rohit Mehta, 'Principle of Electrical Engineering' S Chand & Company, 2008.
References	
1	Robert T. Paynter, "Introducing Electronics Devices and Circuits", Pearson Education, 7th Edition, 2006.
2	J. Millman& Halkins, SatyebrantaJit, "Electronic Devices & Circuits", Tata McGraw Hill, 2nd Edition, 2008.

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	3	-	-	-	-	1	-	-	2	1	-	1	1	-	-
CO4	2	2	3	-	-	1	-	-	2	1	-	1	1	-	-
CO5	3	-	-	-	-	1	-	-	2	1	-	1	1	-	-
CO	**2.6**	**2**	**3**	**-**	**-**	**1**	**-**	**-**	**2**	**1**	**-**	**1**	**1**	**-**	**-**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRAENGINEERINGCOLLEGE(Autonomous)						
Syllabus						
Department	**Electrical and Electronics Engineering**				**Programme Code**	**1051**
I Semester(Integrated Course)						
Course code	**Course Name**	**Hours/week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
22GE33101	**BASICS OF CIVIL AND MECHANICAL ENGINEERING** (Common to Non Circuit Branches	3	0	2	4	**100**
Objective(s)	• To understand the fundamental knowledge in civil engineering materials and structures • To learn the basic concepts surveying and IC engine. • To understand the fundamentals of various machining operations. • To fabricate simple components using sheet metal. • To understand the fundamentals of various carpentry joints.					
UNIT-I	**Civil Engineering Materials and Structures**					**9**
Materials: Bricks – stones – sand – cement – concrete – steel sections. **Structures:** Types, Bearing capacity – Requirement of good foundations. Brick masonry stone masonry – beams – columns – lintels – roofing and flooring – plastering – Types of Bridges and Dams – Basics of Interior Design and Landscaping.						
UNIT-II	**Surveying & IC Engine**					**9**
Surveying: Objects – types – classification – principles – measurements of distances angles – leveling – determination of areas. **IC Engine:** Internal combustion engines as auto mobile power plant–Working principle of Four stroke and two stroke cycles- Petrol and Diesel Engines — Comparison of four stroke and two stroke engines – Comparison of CI and SI engine.						
UNIT-III	**Power Plant Engineering**					**9**
Introduction,ClassificationofPowerPlants–Workingprincipleofsteam,Gas, Diesel, Hydro-electric andNuclearPowerplants–MeritsandDemerits–Pumps,turbinesandboilers–workingprincipleof Reciprocatingpumps (singleactinganddoubleacting)CentrifugalPump.						
Listof experiments						**18**
□Planning and cutting of wood. □Making of carpentry joints(T-joint, Lap-joint, Dovetail Joint) □Basic pipe connections and Mixed pipe material connection □Pipe connections with different joining components. □Modelling of King post and Queen post □Study of Weldingand sheet metal forming □Preparation of arc weldingofbuttjoints, lapjoints andteejoints. □SimpleTurningand Taperturning □DrillingPractice □Modelmaking– Trays,funnels,etc.						
Total **45 Hours**						

Outcome(s)	• List the types of building materials and explain the concepts of structures • Study the various types of surveying and explain the principles of IC engine. • Apply the different connections of plumbing works. • Constructthetruss framestructure. • Understandtheworkingprinciples ofmachiningoperations.

TEXT BOOKS:	
1	ShanmugamG and PalanichamyM S, "Basic Civil and Mechanical Engineering", Tata McGrawHillPublishingCo.,NewDelhi,2005.

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	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)

FS 68172

Regulations 2022

Batch 2022-2023 - II Semester
Batch 2023-2024 onwards - I Semester
(Common to all B.E./B.Tech. Programmes)

Course Code	Course Name	Periods/Week			Credit	Maximum Marks
		L	T	P	C	
22HS11001	தமிழர் மரபு	1	0	0	1	100

அலகு 1	மொழி மற்றும் இலக்கியம்	3

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்வியக்கங்கள் – சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் – பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலங்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு 2	மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை	3

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள் – பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – கடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு 3	நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்	3

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

அலகு 4	தமிழர்களின் திணைக் கோட்பாடுகள்	3

தமிழகத்தின் தாவரங்களும் விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும் கல்வியும் – சங்ககால நகரங்களும் துறைமுகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு 5	இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு	3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் – தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL – 15 PERIODS

TEXT BOOK AND REFERENCE BOOKS	
1.	தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2.	கணினித் தமிழ் – முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3.	கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4.	பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5.	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6.	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7.	Historical Heritage of the Tamils (Dr.S.V.Subaramanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8.	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9.	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10.	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12.	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

MAHENDRA ENGINEERING COLLEGE (Autonomous)-Syllabus						R 2022
DEPARTMENT:	SCIENCE & HUMANITIES		Programme Code & Name			PHYSICS LABORATORY

SEMESTER –I

COURSE CODE	COURSE NAME	HOURS/WEEK			CREDIT	MAXIMUM MARKS
		L	T	P	C	
22PY22001	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	1. The hands on exercises undergone by the students will help them to apply physics principles **2.** 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)

Total	**45 Hours**

REFERENCES

1.	Physics Laboratory Manual(2019), Department of Physics, Mahendra Engineering College, Namakkal.
2	GeetaSanon, BSc Practical Physics, 1st Edn. (2007), R. Chand & Co.
3	B. L. Worsnop and H. T. Flint, Advanced Practical Physics, Asia Publishing House, New Delhi.
4	Indu Prakash and Ramakrishna, A Text Book of Practical Physics, Kitab Mahal, New Delhi.
5	D. P. Khandelwal, A Laboratory Manual of Physics for Undergraduate Classes, Vani Publication House, 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)															

MAHENDRAENGINEERING COLLEGE
(Autonomous)

Syllabus

Department	Electrical and Electronics Engineering	Programme Code	1051

I Semester

Course Code	CourseName	Hours/Week			Credit	Maximum marks
		L	T	P	C	
22CS23001	PROBLEM SOLVING TECHNIQUES USING C LABORATORY	0	0	3	1.5	100

Objectives	**To enable the students to:** • Understand interfacing components of PC Motherboard. • Expertise in developing applications using Office Packages. • Formulate problems and implement algorithms using Raptor tool. • Make use of loops and functions in C. • Understand different types of statements, structures, unions and files.
Outcomes	**At the end of the course the students will be able to:** • Identify the interfacing components of PC • Demonstrate the applications of Office Packages • Obtain solutions for the real world problems using Raptor Tool and • Develop programs using decision making statements, loops and functions • Apply structures, unions and files various types of statements for problem solving

LISTOF EXPERIMENTS

1	Study and Identification of PC Motherboard and its Interfacing Components -
2	Prepare a Bio-data using Word Processor with Appropriate age, text and Table formatting options and send the same to recipients using Mail Merge
3	Create budget planning of your family with cell referencing, formulae, conditional formatting using Excel
4	Create a program flow to illustrate the use of Variables and Constants using Scratch Tool
5	Construct flowchart to find the Factorial for a given number using Raptor
6	Students mark generation using decision statements
7	Calculator using switch statement
8	Prime number generation and to check whether the number is Armstrong or not using looping
9	Greatest number using array (one dimensional)
10	Matrix addition / multiplication using array (two dimensional)
11	String functions
12	Factorial calculation and fibonacci series using function
13	Student mark sheet using structures
14	Copy text from one file to other file
	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	-
CO2	2	-	-	-	3	-	-	-	1	1	-	1	-	1	-

CO3	3	-	-	-	3	-	-	-	1	1	-	1	-	1	-
CO4	2	2	3	-	3	-	-	-	1	1	-	1	-	1	-
CO5	3	-	-	-	3	-	-	-	1	1	-	1	-	1	-
CO	**2.4**	**2**	**3**	**-**	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**1**	**-**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus					Regulations 2022	
Department	Electrical and Electronics Engineering	Programme Code			1051	
SEMESTER – II						
Course code	Course Name	Hours/week			Credit	Maximum marks
22MA12201	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. • Learn Laplace transform, inverse Laplace transform and its properties to solve differential equations. • Learn about Fourier transforms, inverse Fourier transform and its properties and apply convolution theorem and Parseval's identity to various functions • Know about functions of a complex variable, 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 1. Solve problems related to vector differentiation, line, surface and volume integrals and theorems involving them. 2. Describe Laplace transform and its properties inverse Laplace transform and the solution of linear differential equation using Lpaplace transform techniques. 3. Solve Fourier transforms , inverse Fourier transform and its properties and apply convolution theorem and Parseval's identity to various functions 4. Solve Analytic functions, harmonic functions, conformal mapping and its applications. 5. Expand the functions as Taylor's and Laurent's series and evaluate the complex integrals.

UNIT-I	**VECTOR CALCULUS**	**9+3**

Gradient Divergence and Curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs).Verification and application in evaluating line, surface and volume integrals.

UNIT -II	**LAPLACE TRANSFORM**	**9+3**

Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem, solving ODEs by Laplace Transform method.

UNIT-III	**FOURIER TRANSFORMS**	**9+3**

Fourier integral theorem (statement only)-Fourier transform pair (infinite) - Sine and cosine transforms-Properties-Transform of simple functions-Convolution theorem- Parseval'sidendity.

UNIT-IV	ANALYTIC FUNCTIONS	9+3
Functions of a complex variable, Cauchy-Riemann equations – Analytic functions – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping: w= z+c, cz, 1/z, and Bilinear transformation.		
UNIT -V	**COMPLEX INTEGRATION**	**9+3**
Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula(without proof) – Taylor and Laurent expansions –Types of Singularities-Singular points – Residues – Residue theorem(without proof) – Application of residue theorem to evaluate real integrals – Contour integration.		
	Total	**60Hours**

TEXT BOOK :	
1	Veerarajan T&Dr.K.Kannan., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2019.
2	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44thEdition,2017.
REFERENCES:	
1	Erwin kreyszig, Advanced Engineering Mathematics, 10thEdition, John Wiley & Sons, 2018.
2	V. Krishnamurthy, V. P. Mainra and J. L. Arora, " Anintroductionto Linear Algebra" , Affiliated East-West press,2005.
3	Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint,2010.
4.	N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Ninth Edition,2014.

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	2	-	-	-	-	1	-	-	-	-	-	1	-	-	-
CO3	3	-	-	-	-	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 2022
DEPARTMENT:	SCIENCE &HUMANITIES		Programme Code& Name			CY& CHEMISTRY
SEMESTER – II						
COURSE CODE	COURSE NAME	HOURS/WEEK			CREDIT	MAXIMUM MARKS
		L	T	P	C	
22CY12001	CHEMISTRY FOR ENGINEERING	3	0	0	3	100

Objectives	To make the students familiar with: 1. The treatment of water for potable and industrial purposes. 2. Provides students with an opportunity to identify different types of polymers in our surroundings. 3. The basic principles and preparatory method of Nanomaterial 4. Different types of batteries withConstruction and application. 5. The principles of corrosion and control techniques.
Outcomes	At the end of the course the student will be able to 1. Explain the basic principles of water quality parameters, their analysis and various water treatments Process for domestic and industrial applications. 2. Classify the reaction mechanism, synthesis and application of polymers. 3. Develop the basic concepts of nanoscience and nanotechnology in designing the nanomaterial for Engineering and Technology. 4. Compare the working principles of batteries and Supercapacitors with recycling methods. 5. Inspect the principles of corrosion in metals with control measures.

UNIT-I	WATER TECHNOLOGY	9 Hrs

Water: Sources and impurities - Water quality parameters - Definition and significance of-colour, odour, turbidity, pH, hardness, alkalinity, flouride and arsenic - 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) – WHO and BIS guidelines for drinking water.

UNIT-II	POLYMER CHEMISTRY	9 Hrs

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 - Properties of polymers: Tg, Tacticity, Molecular weight - weight average, number average and polydispersity index - Preparation, properties & applications of selected commodity and engineering polymers (Polystyrene, Teflon, Bakelite and Epoxy resin).

UNIT-III	NANOCHEMISTRY	9 Hrs

Introduction: Basics - difference 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, Chemical vapour deposition, electro deposition, precipitation, hydrothermal - Applications (Medicine, Agriculture and Electronics).

UNIT-IV	ENERGY STORAGE DEVICE	9 Hrs

Types of batteries - Primary battery - dry cell - Secondary battery - lead acid battery and Lithium ion batteries- Fundamentals, Construction and application - Thin Film solid state batteries – Recycling of Na-Air batteries – Battery used in EV application - Super Capacitors(Storage principle and types).		
UNIT-V	**CORROSION & ITS CONTROL**	9 Hrs
Corrosion:Chemical corrosion – Pilling Bedworth rule – electrochemical corrosion – different types – galvanic corrosion – differential aeration corrosion - Vapour Deposition Techniques - Physical and Chemical Vapour Deposition– factors influencing corrosion – corrosion control – sacrificial anode and impressed cathodic current methods– corrosion Inhibitors.		
	Total	**45 Hours**

Text book :	
1.	Jain P.C. and Monica Jain, "Engineering Chemistry", DhanpatRai Publishing Company (P) Ltd., New Delhi, 2018
2.	Dr.C.K.Charles and Dr.G.Ramachandran, "Applied Chemistry", CARS Publishers,Chennai,2015
3.	David Linden and Thomas B. Reddy "Handbookof Batteries", Third Edition McGraw-Hill New York.
REFERENCES	
1.	Dara S.S, Umare S.S, "Engineering Chemistry", S. Chand & Company Ltd., New Delhi 2018
2.	Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company, Ltd., New Delhi, 2008.
3.	Kannan P., Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2019
4.	T.R. Crompton "Battery Reference Book" Third Edition, British Library Cataloguing in Publication Data,2000.

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	-	-	-
CO4	3	-	-	-	-	-	1	-	-	-	-	1	-	-	-
CO5	3	-	-	1	-	-	1	-	-	-	-	1	-	-	-
CO	**2.6**	**-**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**

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

MAHENDRA ENGINEERING COLLEGE
(Autonomous)
SYLLABUS - REGULATION - 2022

FS 68172

SEMESTER – II

Course Code	Course Name	Hours / Week			Credit	Maximum Marks
		L	T	P	C	
22EN11001	**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 1. Recognize and comprehend the professional materials in English 2. Develop vocabulary skills and use words appropriately in different academic contexts. 3. Analyze and interpret the data with correct usage of grammar 4. Acquire effective LSRW skills with emerging technology 5. Demonstrate strong communication skills in both personal and professional life

UNIT I	**9 Hrs**
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	**9 Hrs**
Listening – Listening to Telephonic Conversations **Speaking** –Greetings and Welcome Address **Reading** – Predicting the Content of a Given Article – Newspaper Articles **Writing**- Recommendations, Composing E-Mail, Letter Writing- Invitation letter **Grammar & Vocabulary** – Sentence Pattern, Tenses, British Terms and American Equivalents	
UNIT III	**9 Hrs**
Listening - Listening to 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** –If Conditionals, Abbreviations and Acronyms	
UNIT IV	**9 Hrs**
Listening - Listening to Situation Based Dialogues **Speaking** – Talking part in Casual Conversation **Reading** - Reading Advertisements **Writing** – Paragraph Writing, and Job Application **Grammar & Vocabulary** – Concord, Gerunds and Infinitives, Synonyms and Antonyms	

UNIT V		9 Hrs
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** – Modal Verbs, Voice- Active Voice, Passive Voice and Impersonal Passive, Question tags and Nominal Compounds		
	Total Hours	**45**
Textbook:		
1	N.P.Sudharshana and C.Savitha, *English For Technical Communication*, Cambridge University Press, New Delhi, 2016	
2	Murphy, Raymond, *English Grammar in Use*, Fifth Edition. Cambridge University Press, New Delhi, 2019	
References:		
1	Meenakshi Raman and Sangeeta Sharma., *Technical Communication: Principles and Practice*, *Third Edition*. OUP, New Delhi, 2015.	
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. 1998	
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)

Syllabus

Department	Electrical and Electronics Engineering	Programme Code	1081

SEMESTER-II

Course Code	Course Name	Hours / Week			Credit	Maximum marks
		L	T	P	C	
22GE13001	ENGINEERING GRAPHICS AND DESIGN	3	0	2	4	100

Objective(s)

- Increase ability to communicate with people through drawing skills as per the BIS standard.
- Learn to sketch and take field dimensions.
- Learn to take data and transform it into graphic drawings.
- Learn basic Auto Cad skills.
- Learn basic Engineering Drawing formats.

Examination Pattern: Theoretical Mode

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

Curves used in engineering practices:

Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of squad and circle – Drawing of tangents and normal to the above curves.

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 — **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 Projection of Solids — **12**

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 — **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 — **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 — **60 Hours**

Outcome(s)

1. Students ability to indicate proper dimensions on drawings will improve
2. Students ability to perform basic sketching techniques will improve.
3. Students will become familiar with office practice and standards.
4. Students will become familiar with Auto Cad two dimensional drawings.
5. 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. Better hardware, with suitable graphics facility -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.	N S Parthasarathy and Vela Murali, "Engineering Drawing" Oxford University Press 2015.
2.	K. Venugopal & V. Prabhu Raja, "Engineering Graphics", New Age International (P) Limited, 2011
3.	K. V. Natrajan, "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2012
4.	M.S. Kumar, "Engineering Graphics", D.D. Publications, 2010.
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	-	-	-	-	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)						
Syllabus-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**	**1051**	
II Semester						
Course Code	**Course name**	**HOURS/WEEK**			**CREDIT**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE14201	**ELECTRIC CIRCUITS ANALYSIS**	**3**	**0**	**0**	**3**	**100**
Objective(s)	• To elaborate the concept of network theorems in DC circuit • To elaborate the concept of network theorems in AC circuit • To analyze the frequency response of resonance circuits. • To analyze the transient response of RL, RC and RLC circuits. • To elaborate the circuits of three phase.					
Outcome(s)	1. Illustrate the concept of circuit theory to compute voltage, current & resistance in DC circuits. 2. Illustrate the concept of circuit theory to compute voltage, current & impedance in AC circuits. 3. Analyze the frequency response of resonance circuits. 4. Analyze the transient response of RL, RC and RLC circuits. 5. Illustrate the concept of three phase circuits					
UNIT I	**NETWORK REDUCTION TECHNIQUES AND NETWORK THEOREMS (DC Circuits)**					**(9)**
Network reduction: voltage and current division for resistance- source transformation - series and parallel circuits of resistance - Network Theorems: Superposition, Thevenin's, Norton's Theorem, Maximum Power Transfer, Reciprocity and Millman's Theorem.						
UNIT II	**NETWORK REDUCTION TECHNIQUES AND NETWORK THEOREMS (AC Circuits)**					**(9)**
Network reduction: voltage and current division for impedance - star delta conversion - series and parallel circuits of impedance- Network Theorems: Superposition, Thevenin's, Norton's Theorem, Maximum Power Transfer, Reciprocity and Millman's Theorem.						
UNIT III	**RESONANCE AND APPLICATIONS**					**(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	**TRANSIENT RESPONSE**					**(9)**
Transient response of RL, RC and RLC circuits to DC excitation-Natural and forced oscillations - AC transients - application of 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 – phasor diagram of voltages and currents – power and power factor measurements in three phase circuits.						
					Total	**45 Hours**
TEXT BOOKS						
1.	Charles K. Alexander and Mathew N.O. Sadiku, Fundamentals of Electric Circuits, 5th edition, McGraw-Hill, 2019.					
2.	Joseph Edministor and Nahvi (Mohmood), 'Theory & Problems of Electric Circuits', 5th edition, McGraw Hill, 2020.					

3	David A Bell ," Electric circuits ", Oxford University Press, 2016
REFERENCES	
1.	Murthy K.V.V., Kamath M.S., Basic Circuit Analysis, Jaico Publishing House, 2011.
2.	William H. Hayt, Jr Jack E. Kemmerly and Steven M. Durbin, Engineering Circuit Analysis, 9th edition, Tata MC Graw Hill, 2016.
3.	David E. Johnson, Johny R. Johnson and John L. Hilburn, Electric Circuit Analysis,4th Ed, Prentice-HallInt.
4	Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", Tata McGraw Hill, 2007.
5	Chakrabati A, "Circuits Theory (Analysis and synthesis), DhanpathRai& Sons, New Delhi, 2009.
6	https://nptel.ac.in/courses/108/102/108102042/
7	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
(Autonomous)

FS 68172

Regulations 2022

Batch 2022-2023 - III Semester
Batch 2023-2024 onwards - II Semester
(Common to all B.E./B.Tech. Programmes)

Course Code	Course Name	Periods/Week			Credit	Maximum Marks
		L	T	P	C	
22HS11002	தமிழரும் தொழில்நுட்பமும்	1	0	0	1	100

அலகு 1	நெசவு மற்றும் பானைத் தொழில்நுட்பம்	3

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் – கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்

அலகு 2	வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்	3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு – சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் – மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ–சாரோசெனிக் கட்டிடக் கலை.

அலகு 3	உற்பத்தித் தொழில்நுட்பம்	3

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத் துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு 4	வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்	3

அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமிழித் தூம்பின் முக்கியத்துவம் – கல்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

அலகு 5	அறிவியல் தமிழ் மற்றும் கணித்தமிழ்	3

அறிவியல் தமிழின் வளர்ச்சி – கணித்தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

TOTAL – 15 PERIODS

TEXT BOOK AND REFERENCE BOOKS	
1.	தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2.	கணினித் தமிழ் – முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3.	கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4.	பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5.	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6.	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7.	Historical Heritage of the Tamils (Dr.S.V.Subaramanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8.	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9.	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10.	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12.	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

MAHENDRA ENGINEERING COLLEGE (Autonomous)-Syllabus						R 2022
DEPARTMENT:	**SCIENCE &HUMANITIES**		**Programme Code & Name**			**CY&CHEMISTRY**
SEMESTER – II						
COURSE CODE	**COURSE NAME**	**HOURS/WEEK**			**CREDIT**	**MAXIMUM MARKS**
		L	**T**	**P**	**C**	
22CY22001	**CHEMISTRY LABORATORY**	0	0	3	1.5	**100**
Objectives	▪ Educate the theoretical concepts experimentally ▪ To impart skills in measurements. ▪ To design and plan the experimental procedure and to record and process the results. ▪ To reach non trivial conclusions of significant of the experiments.					
Outcomes	On completion of this course, students will be able to 1. Demonstrate laboratory practices, handling glassware, equipment, and chemical reagents. 2. Experiment with different types of instruments for analysis of materials using small quantities Involved for quick and accurate results. 3. Analyze different types of titrations for estimation of materials using more quantities involved for good results.					
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 Rate of Corrosion of Mild steel by Weight loss method.					
6.	Determination of molecular weight of polyvinyl alcohol using Viscometry.					
7.	Estimation of Iron content of the given solution using Potentiometry.					
8.	Determination of strength of given hydrochloric acid using pH meter.					
9.	Conductometric titration a strong acid vs strong base.					
10.	Determination of strength of acids in a mixture using Conductometry.					
11.	Estimation of sulphate in a solution using Conductometry.					
12.	Estimation of iron content of the water sample using Spectrophotometry. (1,10- phenanthroline / thiocyanate method) – (**DEMO ONLY**)					
					Total	**45 Hours**
TEXT BOOK						
1.	Chemistry lab Manual, Department of Chemistry, Mahendra Engineering College, Mallasamudram, 2019.					
2.	Chemistry lab Manual, Department of Chemistry, Mahendra Engineering College, Mallasamudram, 2017.					
REFERENCES						
1.	Applied chemistry theory and practice by O. P. Vermani and A. K. Narula, second edition.					
2.	Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., "Vogel's Textbook of practical organic chemistry", LBS Singapore (1996).					
3.	Kolthoff I.M. and Sandell E.B. et al. Quantitative chemical analysis, Mcmillan, Madras 1980					

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	3	-	-	-	-	1	1	1	-	-	1	-	-	-
CO3	2	3	-	-	-	-	1	1	1	-	-	1	-	-	-
CO	**2.3**	**3**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**-**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2022						
Department	**Electrical and Electronics Engineering**	**Programme Code**				**1051**
II Semester						
COURSE CODE	**COURSE NAME**	**Hours/Week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE24201	**ELECTRIC CIRCUITS LABORATORY**	**0**	**0**	**3**	**1.5**	**100**
Objective(s)	• To analyze the verification of various electrical circuit theorems. • To apply the transient and frequency response of resonance circuits. • To compute the verification of three phase balanced and unbalanced star & delta connected networks.					
Outcome(s)	On completion of this course, students will be able to 1. Illustrate the given complex circuit to simple circuit by applying theorems and can verify the theoretical and practical outputs 2. Demonstrate the frequency response and transient response of the given RL, RC circuits and verify experimentally. 3. Demonstrate frequency response of series and parallel resonance circuits and verify experimentally.					

LIST OF EXPERIMENTS	
1.	Verification of ohm's laws and kirchoff's laws.
2.	Verification 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.	Verification of series and parallel circuit's characteristics.
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.	Verification 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	2	1	-	1	1	-	1
CO2	3	-	-	-	-	1	1	1	2	1	-	1	1	-	1
CO3	3	-	-	-	-	1	1	1	2	1	-	1	1	-	1
CO	**3**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**2**	**1**	**-**	**1**	**1**	**-**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE
(Autonomous)

Syllabus-Regulation 2022

Department	**English**

II Semester

Course Code	**Course Name**	**Hours/week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
22EN21001(R)	**PERSONALITY DEVELOPMENT PRACTICE LABORATORY**	0	0	2	1	**100**

Objectives	• Todeveloplisteningandspeakingskillsofstudentsforavarietyofpurposeslikemakingpresentations,attendinginterviewsandparticipatingindiscussions • To enhance the non-verbal and social interaction skills of students for becomingeffectivecommunicators • Toenablelearnerstohonetheirlinguistic(LSRW)skillswiththehelpofTechnology
Outcomes	**At the endof thecourse,thestudentswillbeableto** 1. Understandthelanguageproficiencyanditstechniques 2. Preparetheresumewithorganizeddetails 3. Developsoftskillstoexcelintheircareer

LISTOFEXERCISES

1.	Introductionto LSRW Skills
2.	Listening Comprehension
3.	Reading Comprehension
4.	CommonErrors in English
5.	Interview Skills
6.	Presentationskills
7.	BodyLanguage
8.	GroupDiscussion
9.	SoftSkills(Self-Confidence,TeamWork,TimeManagement,Adaptability,OpennesstoCriticism)
10.	CreativeWriting
	TotalHrs:45

REFERENCES:

1. Joshi,Manmohan,***SoftSkills***,1st Edition.Bookboon,2017

2. Raman,Meenakshi&SangeetaSharma.***TechnicalCommunication:PrinciplesandPractice,***
Ed.III,OxfordUniversityPress,NewDelhi.2015

OnlineWebsites:

https://www.ted.com/talkshttps://quizziz.comwww.pdfdrive.com

Activity:
Worksheetsforrelevanttopics

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	1	-	-	-
CO2	-	-	-	-	-	1	1	1	1	3	1	1	-	-	-
CO3	-	-	-	-	-	1	1	1	1	3	1	1	-	-	-
CO	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**1**	**3**	**1**	**1**	**-**	**-**	**-**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE(Autonomous)			
Syllabus			Regulations 2022
Department	MATHEMATICS	Programme Code	

SEMESTER-III

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
22MA12303	DIFFERENTIAL EQUATIONS AND NUMERICAL METHODS	3	1	0	4	100

Objective

To enable the students to:

- Learn about the techniques to solve partial differential equations.
- Study the method of separation of variables and solving boundary value problems using Fourier series.
- Acquire the knowledge of the solution of algebraic and transcendental equations and study the methods to solve linear system of equations by direct and iterative methods.
- 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.

Outcome

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

1. Formulate partial differential equations by eliminating arbitrary constants and functions.
2. Classify the types of PDE of second and higher order with constant coefficients
3. Determine the solution of algebraic and transcendental equations and system of linear equations numerically.
4. Acquire the knowledge of numerical differentiation and integration using finite differences.
5. Solve ordinary differential equations using numerical methods.

UNIT-I	PARTIAL DIFFERENTIAL EQUATIONS	9+3

Formation of partial differential equations by eliminating arbitrary constants and by eliminating arbitrary functions-Formation of Lagrange's linear equation-Homogeneous linear partial differential equations of second and higher order with constant coefficients.

UNIT-II	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

UNIT-III	NUMERICAL SCHEEMS OF SOLVING EQUATIONS	9+3

Solution of equation – Iteration method and Newton - Raphson method – Solution of linear system by Gaussian elimination and Gauss-Jordon method– Iterative method –Gauss Jacobi method and Gauss-Seidel method – matrix inversion by Gauss Jordon method .

UNIT-IV	NUMERICAL DIFFERENTIATION AND INTEGRATION	9+3

Differentiation using Newton's forward and backward interpolation formula –Numerical integration by Trapezoidal and Simpson's 1/3 and 3/8 rules – Two and Three point Gaussian quadrature formulae – Double integrals using Trapezoidal and Simpsons's rules.

UNIT-V	INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS	9+3
Single step methods: Taylor series method – Euler's method and Modified Euler method for first order equation – Fourth order Runge – Kutta method for solving first order equations –Multistep method: Milne's predictor and corrector methods.		
	Total	**60 Hours**

Text book :

1.	Veerarajan.T, " Transforms and Partial Differential Equations" , First Edition, Tata McGraw Hill, 2018.
2.	Dr.P.Kandasamy, Dr.K.Thilagavathy andDr.K.Gunavathy, "Engineering mathematics Volume-III",S.Chand& company Ltd. New Delhi, Revised Edition .

REFERENCES

1.	N.P. Bali and Manish Goyal, , Transforms and Partial Differential Equations Laxmi Publications, 2010
2.	Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2016.
3.	Sankara Rao K, "Numerical Methods for Scientisits and Engineering", 4th Edition, Printice Hall of India Private Ltd, New Delhi, 2017
4.	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	-	-	-	-	1	-	-	-	-	-	1	-	-	-
CO2	2	-	-	-	-	1	-	-	-	-	-	1	-	-	-
CO3	2	-	-	-	-	1	-	-	-	-	-	1	-	-	-
CO4	2	-	-	-	-	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)						
Syllabus-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
III Semester						
COURSE CODE	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE13301	**ANALOG ELECTRONICS**	**2**	**1**	**0**	**3**	**100**
Objectives	• To be familiar with the structure of basic electronic devices • To be exposed to the operation and application of electronic devices and their circuits • To analyze circuit characteristics with signal analysis using Op-amp lcs. • To design and construct application circuits with lcs as Op-amp, 555, 566 etc. • To study internal functional blocks and the applications of special ICs like timers, PLL circuits, regulator ICs and DAC/ADCs					
Outcomes	At the end of the course, learners will be able to 1. Explain the structure and underlying semiconductor physics concepts 2. Design circuits employing electronic devices. 3. Analyze, comprehend and design of analog electronic circuits involving OP-AMP. 4. Summarize the applications of Operational amplifier 5. Interpret the electronic circuits using timer 555 IC, PLL, voltage regulator & other specializes.					
UNIT I	**ELECTRONIC DEVICES AND THEIR CHARACTERISTICS**					**(9)**
PN junction diodes-structure, operation and VI characteristics: drift and diffusion current ,transient capacitance-BJT, JFET, MOSFET :structure, Operation and characteristics;biasing; UJT based relaxation oscillator						
UNIT II	**AMPLIFIER CIRCUITS**					**(9)**
BJT small signal model-Analysis of CE amplifier, Gain and Frequency response-Differential Amplifier-Multi-stage amplifier-Common mode and Differential mode analysis-Current mirror circuits-Introduction to internal circuit of typical OPAMP.						
UNIT III	**OP AMP AND CHARACTERISTICS**					**(9)**
Ideal OPAMP characteristics, DC characteristics, AC characteristics ,Voltage-series feedback and voltage-shunt feedback-Frequency response of OPAMP-Basic applications :inverting, non-inverting and differential amplifier circuits ,Adder- subtracter circuits-Differentiation and integrator circuits						
UNIT IV	**APPLICATION OF OPAMPS**					**(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-2Rladdertype),*ND* 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 monostablemultivibrator -566 Voltage Controlled Oscillator circuits –PLL Phase Locked Loop applications-Function generator circuit-Linear Voltage regulators						
					Total	**45 Hours**
TEXT BOOKS						

1.	DavidAbell,"Electroniccircuits",OxfordUniversityPress,2011
2.	Ramakant A Gayakwad," Opamps and Linear Integrated Circuits ",IV edition, Pearson Education/PHI,2009
3.	D.RoyChoudary, S.B.Jain," Linear Integrated Circuits", Third edition, New Age publishers, 2014.
REFERENCES	
1.	Millman and Halkias, " Integrated Electronics'' , McGraw Hill Publications
2.	Muhammad H,Rashid, "Linear Integrated Circuits " Cengage Learning, 2014
6.	NPTEL Link: 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	3	-	-	-	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)						
Syllabus-R2022						
Department	**Electrical and Electronics Engineering**	**Programme Code**				**1051**
III Semester						
Course Code	**Course Name**	**Hours/Week**			**Credit**	**Maximum Marks**
22EE14301	**ELECTROMAGNETIC FIELDS**	**L**	**T**	**P**	**C**	**100**
		2	**1**	**0**	**3**	

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 to magnetic field, boundary condition and inductance.
- To impart knowledge on the concepts of faraday's law, induced emf and Maxwell's Equation.
- To understand the concept 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 condition and inductance.
4. Analyze the concepts related to faraday's law, induced emf and Maxwell's Equation.
5. Illustrate 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 conductor, at any point along the axis of circular coil, at any point along the axis of solenoid, at the centre of toroidal 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", 5th Edition, International Version, Oxford University Press 2015
2	W.H.HaytJ.A.Buck and M.Jallel Akhtar, "Engineering Electromagnetics", 8th 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", 5th Edition, McGraw Hill Education (India) 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	-	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)						
Syllabus-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
III Semester						
COURSE CODE	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE14302	**DC MACHINES AND TRANSFORMERS**	**3**	**0**	**0**	**3**	**100**
Objectives	• To introduce magnetic-circuit analysis techniques and electromechanical energy conversion • To define EMF pattern of armature and field windings of DC generators. • To expose knowledge on operation and characteristics of DC machines. • To appraise the characteristics of various transformers. • To impart knowledge on testing of dc machines and transformers.					
Outcomes	At the end of the course, students shall be able to, 1. Describe the basics of magnetic circuits and rotating electrical machines 2. Explain the constructional details 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	**MAGNETIC CIRCUITS**					**(9)**
Faraday's and Lenz's law - Basic magnetic circuit analysis - B-H relations - flux linkage, inductance – Magnetization curve- AC Excitation - Principles of Energy conversion - Singly and Doubly excited magnetic field systems - Torque production in rotating machines and general analysis of electro mechanical system.						
UNIT II	**DC GENERATORS**					**(9)**
DC Generator – Construction, Principle of operation –EMF equation – Methods of Excitation - Types, No Load and Load Characteristics - Armature reaction., Commutation - Interpoles –Compensating Windings.						
UNIT III	**DC MOTORS**					**(9)**
DC motor - principle of operation – Torque equation – Types – Electrical & mechanical characteristics of DC Shunt, Series and Compound motor – Power Flow - Starting – Speed control - Ward-Leonard control - Constant torque and power control - DC servo motor – Permanent magnet motors-Applications.						
UNIT IV	**TRANSFORMER**					**(9)**
Transformers – principle of operation – Types – Basic construction – Phasor diagrams - Equivalent circuit - Regulation and Efficiency – Parallel operation - Auto Transformer – Three phase transformer Connections – tap changing transformers- Three-phase to single phase conversion -Special Transformers - Applications						
UNIT V	**TESTING OF DC MACHINES AND TRANSFORMERS**					**(9)**
Losses and Efficiency of DC Machines and Transformers – Condition for Maximum Efficiency- Testing of DC machines – Brake test, Swinburne's test and Hopkinson's test – Testing of transformers - polarity test, Open Circuit, Short Circuit test, Load test – Sumpner's test – Separation of losses – All day efficiency.						
					Total	**45 Hours**
TEXT BOOKS						

1.	Nagrath, I.J. and Kothari, D.P., 'Electrical Machines', Tata McGraw - Hill Education Private Limited Publishing Company Ltd., 4th Edition, 2010.
2.	Dr. P.S. Bhimbra, 'Electrical Machinery', Khanna Publications , 7th Edition, 2007.
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 Education Publications, 6th Edition, 2002.
2.	J.B. Gupta, 'Theory and Performance of Electrical Machines', S.K.Kataria and Sons, 2002
3.	S.Sarma&K.Pathak "Electric Machines", Cengage Learning India (P) Ltd., Delhi, 2011.
4.	NPTEL –Electrical Machines –I Links:http://nptel.ac.in/courses/108105017/http://nptel.ac.in/courses/108106071/
5.	MIT Open Course ware-Electrical Machines Link:https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-685-electric-machines-fall-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	-	-	-	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)-Syllabus						R 2022
DEPARTMENT:	**SCIENCE & HUMANITIES**		**Programme Code & Name**			**CY& CHEMISTRY**
SEMESTER-III						
COURSE CODE	**COURSE NAME**	**HOURS/WEEK**			**CREDIT**	**MAXIMUM MARKS**
		L	**T**	**P**	**C**	
22CY11001	**ENVIRONMENTAL SCIENCE AND ENGINEERING**	3	-	-	-	**100**
Objectives	To make the students familiar with : 1. The importance of Ecosystem and Natural resources. 2. The basic concepts of biodiversity and emphasize on the biodiversity of India and its conservation. 3. The causes, effects and prevention measures of environmental Pollution. 4. The influence of societal use of resources on the environment and introduce the legal provisions, National and International laws and conventions for environmental protection. 5. The effect of population dynamics on human and environmental health and inform about human right, value education and role of technology in monitoring human and environmental issues.					
Outcomes	At the end of the course the student will be able to 1. Explain basic knowledge about the importance of environment, ecosystem and Natural resources. 2. Classify the biodiversity and measure the variety of animals, plants and microbial species. 3. Identify the awareness about the different types of Pollution and know about control measures. 4. Organize the environmental impacts related to the society through WHO. 5. Inspect the awareness about population explosion, human welfare and role of information technology in environment.					
UNIT-I	**ENVIRONMENT, ECOSYSTEM AND NATRUAL RESOURCES**					9 Hrs
Definition, scope and importance of environment – Need for public awareness – Concept of an ecosystem – Structure and function of an ecosystem – Energy flow in the ecosystem – Ecological succession – food chains, food webs and ecological pyramids –Natural resources –Types and associated problems (Forest, Water, Food, Mineral and Energy resources).						
UNIT-II	**BIODIVERSITY & CONSERVATION**					9 Hrs
Introduction to biodiversity definition: genetic, species and ecosystem diversity – value of biodiversity – India as amega-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.						
UNIT-III	**ENVIRONMENTAL POLLUTION**					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 measures of municipal solid wastes – role of an individual in prevention						

of pollution – pollution case studies (vizag gas leakage) –disaster management: floods, earthquake and landslides.		
UNIT-IV	**SOCIAL ISSUES AND THE ENVIRONMENT**	9 Hrs
From unsustainable to sustainable development – water conservation strategy – Featureof LARR Act-Rights of a property holder - role of nongovernmental organizations- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies (Global warming). – Wasteland reclamation – consumerism and waste products – environment protection act.		
UNIT-V	**HUMAN POPULATION AND THE ENVIRONMENT**	9 Hrs
Definition – Population growth - variation among nations – population explosion – family welfare program – environment and human health – Human rights – value education – HIV /AIDS – women and child welfare – role of information technology in environment and human health.		
	Total	**45 Hours**
Text books :		
1.	Gilbert M.Masters, "Introduction to Environmental Engineering and Science", 3nd Edition, Pearson Education, 2014.	
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.	
REFERENCES		
1.	R.K. Trivedi, "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media.	
2.	Rajagopalan, R, "Environmental Studies-From Crisis to Cure", Oxford University Press (2005)	
3.	Dharmendra S. Sengar, "Environmental law", Prentice hall of India PVT LTD, New Delhi, 2007.	

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	-	-	-	2	-	-	-
CO2	2	-	-	-	-	2	3	1	-	-	-	2	-	-	-
CO3	2	-	-	-	-	2	3	1	-	-	-	2	-	-	-
CO4	2	-	-	-	-	2	3	1	-	-	-	2	-	-	-
CO5	2	-	-	-	-	2	3	1	-	-	-	2	-	-	-
CO	**2**	**-**	**-**	**-**	**-**	**2**	**3**	**1**	**-**	**-**	**-**	**2**	**-**	**-**	**-**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
III Semester						
COURSE CODE	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE23301	**ANALOG ELECTRONICS LABORATORY**	**0**	**0**	**3**	**1.5**	**100**
Objectives	1. To be familiar with the structure of basic electronic devices 2. To be exposed to the operation and application of electronic devices and their circuits 3. To analyze circuit characteristics with signal analysis using Op-amp lcs. 4. To design and construct application circuits with lcs as Op-amp, 555, etc. 5. To study internal functional blocks and the applications of special ICs like Timers, DAC/ADCs					
Outcomes	At the end of the course, students shall be able to, 1. Illustrate structure and underlying semiconductor physics concepts 2. Ability to design circuits employing electronic devices. 3. Demonstrate the analog electronic circuits involving OP AMP, 555 IC, ADC & DAC other specializes.					
ELECTRONIC DEVICES						
1.	Introductiontocircuitsimulationpackageby: i) PNjunction characteristics, ii) Transistor(CE Configurations)characteristics iii) JFETcharacteristics.					
2.	Frequencyresponseoftransistoramplifiercircuit.					
3.	LineandloadregulationofZenerregulator					
4.	UJT-relaxationoscillatorcircuit					
5.	Wienbridgeoscillator					
6.	Transistorized Differentialamplifier					
INTEGRATED CIRCUITS						
7	OPAMP based amplifier circuits : i) Inverting amplifier. ii)Non-inverting amplifier and voltage follower iii) Differential amplifier and Instrumentation amplifier.					
8	Design of Adder-Subtractor circuits.					
9	Square wave oscillator/ tri-angular wave oscillator. OPAMP based RC -phase shift oscillator					
10.	555 - timer IC based astable multi-vibrator					
11.	OPAMP based precision rectifier circuit/ clipper circuits.					
					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	3	-	-	-	-	-	-	1	2	1	-	1	1	-	2
CO2	2	2	3	-	-	-	-	1	2	1	-	1	1	-	2
CO3	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)						
Syllabus-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
III Semester						
COURSE CODE	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE24301	**DC MACHINES AND TRANSFORMERS LABORATORY**	**0**	**0**	**3**	**1.5**	**100**
Objectives	1. To impart knowledge on finding performance of a given DC machines under different load conditions. 2. To apply the testing procedures for a given DC Generator 3. To determine the parameters and performance of a single-phase transformer					
Outcomes	At the end of the course, students shall be able to, 1. Analyze the performance of a given DC machines under different load conditions. 2. Apply the testing procedures for a given 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 of DC shunt motor
3.	Load test on DC series motor
4.	Load test on DC Compound motor
5.	Open circuit and load characteristics of Separately excited DC shunt generator.
6.	Open circuit and load characteristics of Self excited DC shunt generator.
7.	Load characteristics of DC compound generator with differential and cumulative connections.
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 R-2022						
Department	**Electrical and Electronics Engineering**				**Programme Code**	**1051**
III Semester						
Course Code	**Course name**	**HOURS/WEEK**			**CREDIT**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE24302	**ELECTRICAL WINDING PRACTICES LABORATORY**	**0**	**0**	**3**	**1.5**	**100**
Outcomes	On successful completion of this course, the student will be able to 1. Interpret simple electrical circuits 2. Demonstrate basic circuit components and how to connect them to make a real electrical circuit 3. Illustrate characteristics of various electrical machines. 4. Design Transformer and induction motor winding **5.** Demonstrate the components of Clamp meter, Megger and Multimeter, Blue print, and PCB Board.					
1	Choice of wire gauges, resistor color coding and fuses for a given circuit.					
2	Measurement of power factor, RMS, peak and frequency and measurement of inductance and capacitance.					
3	Speed control of ceiling fan and fan wiring					
4	V-I Characteristics of DC/AC generator and motor					
5	DC Machine wiring(12v, 24v)					
6	Small range transformer winding					
7	Induction motor winding					
8	Soldering and De-soldering Practices					
9	Inductor design					
10	Study of Clamp meter, Megger and Multimeter, Blue print(Electrical wiring diagram) and PCB Design					
					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	1	2
CO2	2	3	-	-	1	-	-	-	1	1	-	1	1	1	2
CO3	3	-	-	-	1	-	-	-	1	1	-	1	1	1	2
CO	**2**	**3**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**1**	**1**	**2**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
IV Semester						
Course Code	**Course name**	**HOURS/WEEK**			**CREDIT**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE13401	**DIGITAL ELECTRONICS**	**2**	**1**	**0**	**3**	**100**
Objective(s)	• To expose knowledge on philosophy of number systems, codes and digital logic families. • To design combinational logic circuits using logic gates. • To impart knowledge on synchronous sequential circuits • To introduce 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 – multiplexers and demultiplexers - code converters, adders, subtractors.						
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).						
					Total	**45 Hours**

TEXT BOOKS	
1.	Raj Kamal, 'Digital systems-Principles and Design', Pearson Education 2nd edition, 2007.
2.	M. Morris Mano, 'Digital Design with an introduction to the VHDL', Pearson Education, 2013.
3.	Comer, "Digital Logic & State Machine Design, Oxford, 2012.
4.	Video Reference / NPTEL (for each Unit)

	https://onlinecourses.nptel.ac.in/noc20_cs67/preview
REFERENCES	
1.	Mandal, "Digital Electronics Principles & Application", McGraw Hill Edu,2013.
2.	William Keitz, "Digital Electronics-A Practical Approach with VHDL", Pearson, 2013.
3.	Floyd and Jain, 'Digital Fundamentals', 8th edition, Pearson Education, 2003.
4.	Anand Kumar, "Fundamentals of Digital Circuits", PHI, 2013.
5.	Charles H.Roth,Jr,LizyLizy Kurian John, "Digital System Design using VHDL", Cengage, 2013.
6.	Gaganpreet Kaur, "VHDL Basics to Programming", Pearson, 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	-	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)						
Syllabus-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
IV Semester						
Course Code	**Course name**	**HOURS/WEEK**			**CREDIT**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE14401	**SYNCHRONOUS AND INDUCTION MACHINES**	**3**	**0**	**0**	**3**	**100**

Objective(s)	• To describe construction and performance of salient and non salient type synchronous generators. • To discuss the basic principles and performance of synchronous motor. • To discuss the basic principles and performance of induction machines. • To explain the Starting and speed control of three-phase induction motors. • To understand the construction, principle of operation and performance of single phase induction motors and special machines.
Outcome(s)	At the end of the course, students shall be able to, 1. Discuss the alternator types, and their performance. 2. Illustrate the construction, working principle, excitation and performance of Synchronous Motor. 3. Explain the construction, working principle, developing equivalent circuit and performance of three Phase Induction motor. 4. Summarize different types of starters used in three phase induction motor and various speed control methods. 5. Interpret the working principles of different types of single phase induction motors and various special electrical machines.

UNIT I	**SYNCHRONOUS GENERATOR**	**(9)**

Constructional details – Types of rotors –winding factors- emf equation – Synchronous reactance Armature reaction – Phasor diagrams of non salient pole synchronous generator connected to infinite bus--Synchronizing and parallel operation – Synchronizing torque -Change of excitation and mechanical input- Voltage regulation – Electromotive Force, Magneto motive Force, Zero Power Factor and American Standard Association(ASA)methods – steady state power angle characteristics– Two reaction theory –slip test -short circuit transients - Capability Curves.

UNIT II	**SYNCHRONOUS MOTOR**	**(9)**

Principle of operation – Torque equation – Operation on infinite bus bars - V and Inverted V curves – Power input and power developed equations – Starting methods – Current loci for constant power input, constant excitation and constant power developed-Hunting – natural frequency of oscillations – damper windings- synchronous condenser.

UNIT III	**THREE PHASE INDUCTION MOTOR**	**(9)**

Constructional details – Types of rotors - Principle of operation – Slip –cogging and crawling- Equivalent circuit – Torque-Slip characteristics - Condition for maximum torque – Losses and efficiency – Load test - No load and blocked rotor tests - Circle diagram – Separation of losses – Double cage induction motors –Induction generators – Synchronous induction motor.

UNIT IV	**STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR**	**(9)**

Need for starting – Types of starters – DOL, Rotor resistance, Autotransformer and Star-delta starters– Speed control – Voltage control, Frequency control and pole changing – Cascaded connection-V/f control – Slip power recovery scheme- -Braking of three phase induction motor: Plugging, dynamic braking and regenerative braking.

UNIT V	**SINGLE PHASE INDUCTION MOTORS AND SPECIAL**	**(9)**

	MACHINES	
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 – Capacitor-start capacitor run Induction motor- Shaded pole induction motor - Linear induction motor – Repulsion motor - Hysteresis motor - AC series motor- Two phase Servo motor - Stepper motors - Universal motor- introduction to magnetic levitation systems.		
	Total	**45 Hours**

TEXT BOOKS	
1.	Bimbra P. S., Electrical Machinery, 7/e, Khanna Publishers, 2011.
2.	Nagrath J. and D. P. Kothari, Theory of AC Machines, Tata McGraw Hill, 2006.
3.	A.E. Fitzgerald, Charles Kingsley, Stephen. D.Umans, 'Electric Machinery', Tata Mc Graw Hill publishing Company Ltd, 2003
4.	D.P. Kothari and I.J. Nagrath, 'Electric Machines', Tata McGraw Hill Publishing Company Ltd, 2002.
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, 2009.
3.	Charless A. Gross, "Electric /Machines, "CRC Press, 2010.
4.	K. Murugesh Kumar, 'Electric Machines', Vikas Publishing House Pvt. Ltd, 2002.
5.	Syed A. Nasar, Electric Machines and Power Systems: Volume I, Mcgraw -Hill College; International ed Edition, January 1995.
6.	Alexander S. Langsdorf, Theory of Alternating-Current Machinery, Tata McGraw Hill Publications, 2001.
7.	https://nptel.ac.in/courses/108/105/108105131/

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	3	-	-	-	-	-	-	-	-	1	-	1	1	-	1
CO3	2	-	-	-	-	-	-	-	-	1	-	1	1	-	1
CO4	3	-	-	-	-	-	-	-	-	1	-	1	1	-	1
CO5	3	-	-	-	-	-	-	-	-	1	-	1	1	-	1
CO	**2.6**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**1**	**-**	**1**

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

Regulations 2022

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
22SH11006	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:

1. Distinguish between values and skills, and highlight the need for Universal Human Values.
2. Describe the need for Harmony and distinguish between happiness and accumulation of physical facilities, etc.
3. Relate the value of harmonious relationship in family, society based on trust and respect for happiness and prosperity in their life and profession.
4. Outline the role of a human being in ensuring harmony in nature for co-existence.
5. 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)						
Syllabus-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
IV Semester						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE23401	**DIGITAL ELECTRONICS LABORATORY**	**0**	**0**	**3**	**1.5**	**100**
Objectives	• To have hands on experience in studying the characteristics of Boolean function and code conversion • To construct Adder ,Subtractor,codeconverters, Multiplexers and De-multiplexers • To have hands on experience in checking the parity checker and encoder • To study the practical knowledge in design flip-flop, counters and shift registers					
Outcomes	students shall be able to, 1. Demonstrate the characteristics of Boolean function 2. Design Adder,Subtractor,codeconverters,Multiplexers&Demultiplexers 3. Design parity checker, decoders, encoders, flip-flops, counters and shift register					

LIST OF EXPERIMENTS

1.	Verification of Logic Gates
2.	Realization of a Boolean function: To simplify the given expression and to realize it using Basic gates and Universal gate
3.	Adders and Subtractors
4.	Code converters: Excess-3 to BCD Binary to Gray code converter Gray code to binary converter
5.	Parity generator and parity checking.
6.	Encoders and Decoders
7.	Multiplexer and Demultiplexer a.To design and set up a 4:1 ;8:1Multiplexer b. To design and set up a 1:4;1:8 Demultiplexer
8.	Verification of FlipFlops Conversion of one type of FlipFlop to another
9.	Counters: Design and implementation of 4-bit modulo counters as synchronous and Asynchronous types using FF IC's and specific counter IC.
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**

REFERENCES

1.	http://vlabs.iitb.ac.in/vlabs-dev/labs/digital-electronics/index.html
2.	https://de-iitr.vlabs.ac.in/List%20of%20experiments.html

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	1	-	1
CO2	2	2	3	-	-	1	-	1	2	1	-	1	1	-	1
CO3	2	2	3	-	-	1	-	1	2	1	-	1	1	-	1
CO	**2.3**	**2**	**3**	**-**	**-**	**1**	**-**	**1**	**2**	**1**	**-**	**1**	**1**	**-**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
IV Semester						
Course Code	**Course name**	**HOURS/WEEK**			**CREDIT**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE24401	**SYNCHRONOUS AND INDUCTION MACHINES LABORATORY**	**0**	**0**	**3**	**1.5**	**100**
Objective(s)	• To determine the regulation of a given alternator using different methodologies • To validate the performance of a given synchronous motor under various excitation conditions • To illustrate the methodologies to change and control the speed of a given induction motor • To determine the performance of single phase Induction Machines • To determine the performance of three phase Induction Machines					
Outcome(s)	At the end of the course, students shall be able to, 1. Analyze the regulation of a given alternator using different methodologies. 2. Analyze the performance of synchronous machines. 3. Analyze the performance single phase, Three Phase induction motor and methodologies to change and control the speed of the induction motor					
1.	Regulation of three phase alternator by Electromotive Force, Magneto motive Force methods.					
2.	Regulation of three phase alternator by Zero Power Factor and American Standard Association methods.					
3.	Regulation of three phase salient pole alternator by slip test.					
4.	Measurements of negative sequence and zero sequence impedance of alternators.					
5.	V and Inverted V curves of Three Phase Synchronous Motor.					
6.	Load test on three-phase induction motor.					
7.	No load and blocked rotor test on three-phase induction motor (Determination of equivalent circuit parameters).					
8	Separation of No-load losses of three-phase induction motor.					
9.	Load test on single-phase induction motor.					
10.	No load and blocked rotor test on single-phase induction motor.					
11.	Study of Induction motor Starters					
	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)															

MAHENDRA ENGINEERING COLLEGE
(Autonomous)

Syllabus-Regulation 2022

Department	**English**

Semester–IV
(CommontoallB.E./B.Tech.Programmes)

Coursecode	**CourseName**	**Hours/week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
22EN60001(R)	**PROFESSIONALCOMMUNICATIONSKILLS** (CommontoallB.E./B.Tech.DegreeProgrammes)	0	1	2	2	**100**
Objectives	➢ Tofamiliarizestudentswiththestagedynamics ➢ Tohelpthelearnerstoimprovetheircreativeskills ➢ Tomakethemacquiretheabilitytospeak effectivelyinreallifesituations					
Outcomes	**At the end of thecourse,thelearnerswillbeableto:** 1. Applysuitablevocabularyinacademic andworkplacecontexts 2. Demonstratecommunicationskillseffectivelyinbothoralandwrittenformats 3. Createdocumentsprofessionallyandmakepresentations effectively					

LISTOFEXERCISES

1.	IntroductiontoProfessionalCommunication andSWOTAnalysis
2.	ReadingComprehension
3.	ListeningComprehension
4.	StageDynamics (BodyLanguage andParalanguage-Presentation)
5.	FramingQuestions (WHQuestions&‘Yes’ or‘No’Questions)
6.	NarrativeTechniques (Structure,Grammar&Vocabulary-NarratingtheExperience)
7.	MasterofCeremonySkills(Practice)
8.	PictureDescription
9.	CreativeWriting
10.	ExtemporeSpeech

TotalHrs:30

Textbook:	
1	Joshi,Manmohan,*SoftSkills*,1st Edition.Bookboon,2017
References:	

1	Muralikrishna,&SunitaMishra,*CommunicationSkillsforEngineers*.Pearson,NewDelhi,2011.
2	Barun K.Mitra,PersonalityDevelopmentandSoftSkills,OxfordUniversityPress,New Delhi,2011
OnlineWebsites:	
1	https://www.ted.com/talks
2	https://joshtalks.com
3	https://quizziz.com
4	www.pdfdrive.com
5	www.talkingbooks.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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
V Semester						
Course Code	**COURSE NAME**	**Hours/Week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE14501	**POWER ELECTRONICS**	**2**	**1**	**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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
V Semester						
Course code	**Course name**	**Hours/Week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
22EE14502	**CONTROL SYSTEMS**	**2**	**1**	**0**	**3**	**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-R2022						
Department	**Electrical and Electronics Engineering**				**Programme Code**	**1051**
V Semester						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE34501	**ELECTRICAL MEASUREMENTS AND INSTRUMENTATION**	**2**	**0**	**2**	**3**	**100**
Objectives	1. To study the basic elements of instruments and various measurement techniques 2. To learn various transducers and the data acquisition systems 3. To apply the concepts of various measurement techniques 4. To demonstrate the concepts of various transducers 5. To demonstrate the concepts of the data acquisition systems					
Outcomes	At the end of the course, students shall be able to, 1. Explain the concepts of instruments and measurement techniques 2. Illustrate various transducers and data acquisition systems 3. Apply the concepts of measurement techniques using various bridges 4. Analyze the functionality of various transducers 5. Develop the data acquisition systems for various systems					
UNIT I	**MEASUREMENT SYSTEMS AND BRIDGES**					**9**
Functional elements of instrument – Units and standards of measurements – Static and dynamic characteristics – Errors in measurement – Calibration methodology-DC and AC bridges- transformer ratio bridges- self-balancing bridges.						
UNIT II	**ELECTRICAL AND ELECTRONIC INSTRUMENTS**					**9**
Digital voltmeters – Integrating type, successive approximation type DVM – Digital multi-meters – Frequency meter – Power factor meter – CT and PT – Dynamometer type wattmeter – Single phase induction type energy meter.						
UNIT III	**TRANSDUCERS AND DATA ACQUISITION SYSTEMS**					**9**
Transducers – Selection of transducers – Resistive, capacitive & inductive transducers – Piezoelectric, Hall effect, optical and digital transducers – Instrumentation Amplifier- Introduction to sensors and actuators-Elements of data acquisition system-Data Loggers – A/D, D/A converters.						
					Theory	**27 Hours**

TEXT BOOKS

1. A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation', DhanpatRai and Co, 2004.
2. J. B. Gupta, 'A Course in Electronic and Electrical Measurements', S. K. Kataria& Sons, Delhi, 2003.
3. Doebelin E.O. and Manik D.N., Measurement Systems – Applications and Design, Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd., 2007.

REFERENCES

1. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw Hill, II Edition 2004.
2. D.V.S. Moorthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt Ltd, 2007.
3. A.J. Bouwens, 'Digital Instrumentation', Tata McGraw Hill, 2001.
4. E-Resources Reference, https://www.youtube.com/watch?v=xPyBrUv1gy8 https://www.youtube.com/watch?v=EXtfLWBIxHc

5.	https://nptel.ac.in/courses/108/105/108105153/

LIST OF EXPERIMENTS		
1.	Bridge Networks –AC Bridges	
2.	Bridge Networks –DC Bridges	
3.	Transducers: (a) Temperature (b) Pressure (c) Displacement	
4.	Instrumentation Amplifier	
5.	Analog to Digital Converters and Digital to Analog Converters (ADCs and DACs)	
6.	Measurement of three phase power and power factor	
	Laboratory	**18 Hours**
	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
CO2	3	-	-	-	-	-	-	-	-	-	-	1	1	-	1
CO3	3	-	-	-	-	-	-	-	-	-	-	1	1	-	1
CO4	2	3	-	-	-	-	-	-	1	1	-	1	1	-	1
CO5	2	2	3	-	-	-	-	-	1	1	-	1	1	-	1
CO	**2.2**	**2.5**	**3**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**1**	**-**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRAENGINEERINGCOLLEGE (Autonomous)						
Regulations2022						
V Semester						
Course code	**Course Name**	**Periods/week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
22MC60001	**CONSTITUTION OF INDIA**	3	-	-	-	**100**
Objectives	1. To know about the salient features of the Constitution of India. 2. To gain knowledge about structure and functions of Union Government. 3. To learn about the structure and functions of State Government. 4. To understand about amendments in Indian Constitution, Judicial review. 5. To study in detail about the Indian society.					
Outcomes	**On completion of the course, the learners should be able to:** 1. Summarize the features of the Indian Constitution and observe the fundamental duties, rights and responsibilities. 2. Explain the functioning of IndianparliamentarysystemattheCenterandtheresponsibilitiesofimportant functionaries. 3. Describe the functioning of State Government and important functionaries. 4. Recognize Amendments in Indian Constitution and Judicial review. 5. Illustrate the composition and features of Indian society.					
UNIT-I	**INTRODUCTIONABOUTINDIANCONSTITUTION**					9
Historical Background–Constituent Assembly of India–Role and salient features-Philosophical Foundations of the Indian Constitution–Preamble–Fundamental Rights–irective Principles of State Policy– Fundamental Duties–Citizenship –Constitutional Remedies for citizens.						
UNIT-II	**STRUCTUREAND FUNCTIONOFUNION GOVERNMENT**					9
Parliamentary system – Legislature, Executive. Union Government – Structures of the UnionGovernment.FunctionsandResponsibilitiesofPresident–VicePresident –Prime Minister–Cabinet –Council of Ministers, Union Territories.						
UNIT-III	**STRUCTUREAND FUNCTIONOFSTATEGOVERNMENT**					9
StateLegislature-StateGovernment–StructureandFunctions–Governor–ChiefMinister–Cabinet–Special Provisions (Article370.371,371J) for some States. Judicial System in States–High Courts and other Subordinate Courts Judicial review.						
UNIT-IV	**CONSTITUTIONFUNCTIONS,AMENDMENTSANDREVIEW**					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 – TheSupremeCourtofIndia–TheHon'bleChiefJusticeofIndiaandHon'bleJudgesoftheSupreme Court. Judicial Review of Parliamentary and Executive functions.						
UNIT-V	**INDIANSOCIETY**					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	DurgaDasBasu,"IntroductiontotheConstitutionofIndia",PrenticeHall ofIndia,NewDelhi
2	R.C.Agarwal,(1997)"IndianPoliticalSystem",S.ChandandCompany,NewDelhi.
REFERENCES:	
1	Sharma,BrijKishore,"IntroductiontotheConstitutionofIndia:,PrenticeHallofIndia,New Delhi.
2	MaciverandPage,"Society:AnIntroductionAnalysis",MacMilanIndiaLtd.,NewDelhi.
3	K.L.Sharma,(1997)"SocialStratificationinIndia: IssuesandThemes",JawaharlalNehru University,NewDelhi.
4	U.R.Gahai,"IndianPoliticalSystem",NewAcademicPublishingHouse,Jalaendhar
5	R.N.Sharma,"IndianSocialProblems",MediaPromotersandPublishersPvt.Ltd.

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
V Semester						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE24501	**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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
V Semester						
COURSE CODE	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE24502	**CONTROL SYSTEMS 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. • To develop compensators, controllers, linear and digital systems using simulation software.
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. 3. Design the various compensators, controllers to improve system performance using simulation software.

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 Position Control Systems.
6.	DC Position Control Systems.
7.	Simulate and design PI and PID controllers
8.	Mathematical modeling and simulation of Electrical and Electro-Mechanical systems.
9.	Stability analysis of linear systems using simulation tools.
10.	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)															

MAHENDRAENGINEERINGCOLLEGE
(Autonomous)

Syllabus-Regulation 2022

Department	**English**

Semester–V
(CommontoallB.E./B.Tech.Programmes)

Course Code	**CourseName**	**Hours/week**			**Credit**	**Maximummarks**
		L	**T**	**P**	**C**	
22EN60002(R)	**INTERVIEWSKILLSANDSOFTSKILLS** (CommontoallB.E./B.Tech.DegreeProgrammes)	0	1	2	2	**100**

Objectives	➢ Toimprovethelearnersreadingfluencyskillsthroughextensivereading ➢ Tohelpthelearnersobtainspeakingskillsinbothformalandinformalsituation. ➢ Tomakethemacquirepresentationskillsandinterviewskillstofacechallenges inthecareeraspects
Outcomes	**At the end of thecourse,thelearnerswillbeableto:** 1. Analysethecontent and applyknowledgeandskillsefficientlywherevernecessary. 2. Createprofileand others essentialdocuments. 3. Demonstratesoftskillseffectivelyatthetimeofinterviewand workplace.

LISTOFEXERCISES

1.	Introductionto EmployabilitySkills
2.	ReadingComprehension
3.	ListeningComprehension
4.	ProfessionalEmailWriting
5.	PreparingOnePageResume
6.	InterviewSkills (MockInterview&InterviewEtiquette)
7.	CorporateSkills(PoliteExpressions,TelephoneEtiquette,OnlineEtiquette&PPT Presentation)
8.	GroupDiscussion
9.	SoftSkills(Interpersonal,Intrapersonal,Leadership,DecisionMakingandProblemSolving)
10.	PublicSpeaking

TotalHrs:30

Textbook:	
1	Joshi,Manmohan,*SoftSkills*,1st Edition.Bookboon,2017

References:	
1	Raman,Meenakshi&SangeetaSharma, *TechnicalCommunication:PrinciplesandPractice,*Ed.III,OxfordUniversityPress,NewDelhi.2015.
2	BarunK.Mitra,PersonalityDevelopmentandSoftSkills,OxfordUniversityPress,NewDelhi,2011
OnlineWebsites:	
https://www.ted.com/talks	
https://www.joshtalks.com	
https://quizziz.com	
www.pdfdrive.com	
www.talkingbooks.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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
VI Semester						
Course Code	**Course name**	**HOURS/WEEK**			**CREDIT**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE14601	**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 – R2022						
Department	**Electronics and Electronics Engineering**				**Programme Code**	**1051**
VI Semester						
Course code	**Course Name**	**Hours/week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
22EE14602	**MICROCONTROLLER BASED SYSTEM DESIGN**	3	0	0	3	**100**
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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE14603	**SPECIAL ELECTRICAL MACHINES**	**3**	**0**	**0**	**3**	**100**
Objectives	• To learn the concepts of permanent magnets and to study the construction, operation, characteristics and control of permanent magnet brushless DC motor. • To gain the knowledge on construction, operation characteristics and control of permanent magnet synchronous motor. • To study the construction, operation, characteristics and power converters of switched reluctance motor. • To acquire the knowledge on the construction and operation of stepper motor. • To discuss the operation and characteristics of other special machines.					
Outcomes	At the end of the course, students will be able to, 1. Explain the operation, characteristics and control of permanent magnet brushless DC motor 2. Describe the construction, operation performance characteristics of permanent magnet synchronous motor and its power controllers. 3. Illustrate the construction, operation and converter of switched reluctance motor drive. 4. Discuss the construction, operation, characteristics and control of stepper motor. 5. Select the special electrical machines for particular application.					
UNIT I	**PERMANENT MAGNET BRUSHLESS DC MOTORS**					**9**
Fundamentals of Permanent Magnets- Types- Principle of operation- Magnetic circuit analysis- EMF and Torque equations- Characteristics and control -Applications.						
UNIT II	**PERMANENT MAGNET SYNCHRONOUS MOTORS**					**9**
Principle of operation – EMF and torque equations - Phasor diagram - Power controllers–performance characteristics – Digital controllers – Constructional features, operating principle and characteristics of synchronous reluctance motor. -Applications.						
UNIT III	**SWITCHED RELUCTANCE MOTORS**					**9**
Constructional features –Principle of operation- Torque prediction –performance Characteristics- Power controllers – Control of SRM drive- Sensor less operation of SRM – Applications.						
UNIT IV	**STEPPER MOTORS**					**9**
Constructional features –Principle of operation –Types – Torque equation – Linear and Non- linear analysis – Characteristics – Drive circuits – Closed loop control – Applications.						
UNIT V	**OTHER SPECIAL ELECTRICAL MACHINES**					**9**
Principle of operation and characteristics of Hysteresis motor – AC series motors – Linear induction motor – Applications.						
					Total	**45 Hours**
TEXT BOOKS						
1.	T.J.E. Miller, Brushless magnet and Reluctance motor drives, Claredon press, London, 1989.					
2.	R.Krishnan, Switched Reluctance motor drives, CRC press, 2001.					

3.	T.Kenjo, Stepping motors and their microprocessor controls, Oxford University press, New Delhi, 2000.
4.	K. Venkataratnam, Special Electrical Machines, Universities Press, 2014.
REFERENCES	
1.	T.Kenjo and S.Nagamori, Permanent magnet and Brushless DC motors, Clarendon press, London, 1988.
2.	R.Krishnan, Electric motor drives, Prentice hall of India, 2002.
3.	D.P.Kothari and I.J.Nagrath, Electric machines, Tata Mc Graw hill publishing company, New Delhi, Third Edition, 2004.
4.	Irving L.Kosow, Electric Machinery and Transformers, Pearson Education, Second Edition, 2007.
5	https://nptel.ac.in/courses/108102156

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	2	1	1
CO3	3	-	-	-	-	-	-	-	-	-	-	1	2	1	1
CO4	2	-	-	-	-	-	-	-	-	-	-	1	2	1	1
CO5	2	-	-	-	-	-	-	-	-	-	-	1	2	1	1
CO	**2.2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**1**	**1**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

Regulations 2022						
Department		**Programme Code**				
Course Code	**Course Name**	**Hours/Week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22MBAT6S06	**MANAGERIAL SKILLS, PROJECT AND QUALITY MANAGEMENT**	**3**	**0**	**0**	**3**	**100**
Mandatory Credit Course to All UG Programmes to be offered in V/ VI/VII Semester						
Objectives	This course is designed to: 1. Develop knowledge and skills needed for the successful managerial performance. 2. Develop team building and communication skills in learners for working in multi-disciplinary teams. 3. Enable the learners to plan, schedule and manage projects. 4. Facilitate budgeting and finance, and evaluate projects 5. Understand the importance of quality concepts and principles.					
Outcomes	Upon completion of this course, the Learners will be able to : CO1: Demonstrate applicable knowledge and skills needed for managerial effectiveness. CO2: Demonstrate team building and communication skills for working in multi-disciplinary teams. CO3: Plan, schedule and manage projects CO4: Plan budgeting, manage finance and evaluate projects CO5: Summarize the quality concepts and principles.					
UNIT-I	**INTRODUCTION TO MANAGERIAL SKILLS**					**9**
Introduction to Self Awareness – Self Portrait – Self Assessment – Life-long learning. Definition of Life Skills and Managerial Skills–Need and Importance of Skills. Decision Making and Problem Solving: Problem Analysis –Techniques – Steps; Problem solving: Characteristics of Complex problems – Problem Solving Strategies – Barriers.; Lateral thinking Need and Importance of Lateral Thinking; Logic and Rationality – Functions – Personal and Work ethics-Case study						
UNIT-II	**TEAM BUILDING AND EFFECTIVE COMMUNICATION**					**9**
Team Building: Developing teams and team work, advantages of team, leading team, team membership, traits of working in multi-disciplinary teams. Effective Communication: Need and Importance – Techniques and Types - Verbal and Non-Verbal Communication - Barriers to communication – Overcoming barriers – Multiple Intelligences – 360 degree evaluation, Case Study.						
UNIT-III	**PROJECT MANAGEMENT**					**9**
Project: Meaning and Importance of terms 'Event', Activity'. 'Time". Identification of project opportunities, Screening of Project Ideas. Criteria for project selection, Project planning and						

scheduling – Application of CPM and PERT – Examples and case studies.		
UNIT-IV	**BUDGETING AND FINANCE**	**9**
Introduction to Budgeting and Finance, kinds of Project Evaluation, Evaluation Techniques – Non-discounted cash flow methods, Discounted cash flow Methods, Evaluation of Project cost, Capital budgeting and its methods. Financial management of Projects. Project Risk and its mitigation – Examples and case studies.		
UNIT-V	**QUALITY CONCEPTS AND PRINCIPLES**	**9**
Introduction - Need for Quality - Evolution of Quality - Definition of Quality - Dimensions of Manufacturing Quality and Service Quality. TQM culture, Leadership – quality council, employee involvement, motivation, empowerment, recognition and reward Performance appraisal - Continuous process improvement, 6σ, 5s, Kaizen - Case Study.		
	Total	**45 HOURS**

TEXTBOOKS:	
1	David A.Whetten and Kim S.Cameron, Developing Management Skills, – PHI, 2011.
2	Harper, Nancy Life Skills: Essential for Personal Growth on the Ever Changing Road of Life. Bloomington, IN: Author House, 2011.
3	Adair, J. Decision Making and Problem Solving. UK: Kogan Page Publishers.2013.
4	James R Evans, Quality Management, Cengage Learning India Private Limited 2010.
5	Janakiraman. B and Gopal .R.K., "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
6	Prasanna Chandra "ProjectPlanning, Analysis, Selection, Financing, Implementation and Review, Tata Mcgraw-Hill, 2002
REFERENCES:	
1	Kallet, Michael Think Smarter: Critical Thinking to Improve Problem-Solving and Decision Making Skills. New Jersey: John Wiley & Sons, 2014.
2	Adair, J. & Allen, M. Time Management and Personal Development. London: Hawksmere, 1999.
3	Hattie, John Self-Concept. New York: Psychology Press, 2014.
4	Mcgrath E.H., S.J., Basic Managerial Skills for all, 9th Edition, PHI, 2012
5	Amitava Mitra, Fundamentals of Quality Control & Improvement, Wiley Publications, 2012.

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
VI Semester						
COURSE CODE	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE24601	**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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
VI Semester						
Course Code	**Course name**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE24602	**SPECIAL ELECTRICAL MACHINES LABORATORY**	**0**	**0**	**3**	**1.5**	**100**
Objectives	• 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	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.					

LIST OF EXPERIMENTS	
1.	Study of dual core detail of DSP controller.
2.	Study of IPM power module.
3.	Load characteristics of switched reluctance motor.
4.	Speed control of 1 HP 3 phase AC motor with IPM power module.
5.	Speed control of 1HP brushless dc motor with eddy current load set up.
6.	Load characteristics of 5-Phase Induction motor in open loop mode.
7.	Speed control of 3 phase Linear Induction motor.
8.	Microprocessor based stepper motor controller.
9.	Simulation of load characteristics of PMSM motor.
10	Simulation of load characteristics of switched reluctance motor.
Total	**45 Hours**

REFERENCES	
1.	https://www.iitg.ac.in/.../courses/electrical_machines_laboratory.pdf
2.	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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**	**1051**	
VI Semester						
Course Code	**Course name**	**Hours/Week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE24603	**PROJECT DESIGN LABORATORY**	**0**	**0**	**3**	**1.5**	**100**
Objective(s)	• To learn the concepts of regulated power supply unit and gate driver circuits. • To acquire knowledge on isolation circuits using opto-couplers and driver circuit for DC-DC converters. • To know the concepts of converters and electrical machines for Electric Vehicles					
Outcomes(s)	At the end of the course, students will be able to: 1. Develop regulated power supply units 2. Design isolation circuits using opto-couplers and driver circuit for DC-DC converter 3. Design a UPS system for domestic applications and Electric Vehicles					
(Batch of students have to choose any one experiment from each module and Every batch has to complete at least 3 experiments)						
Module 1						
1.	Design and fabricate a regulated power supply of 0-5V, 1A					
2.	Design and fabricate a regulated power supply of 0-12V, 1A					
Module 2						
3.	Design and fabricate a gate driver circuit for DC to DC converters.					
4.	Design and fabricate an isolation circuit using opto couplers.					
Module 3						
5.	Design and fabricate an Electric Vehicles.					
6.	Design and Fabricate a Domestic UPS.					
					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	2	3	-	1	-	-	1	1	1	1	1	2	1	2
CO2	2	2	3	-	1	-	-	1	1	1	1	1	2	1	2
CO3	2	2	3	-	1	1	-	1	1	1	1	1	2	1	2
CO	**2**	**2**	**3**	**-**	**1**	**1**	**-**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**2**
Correlation levels:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)			
Syllabus-R2022			
Department	**Electrical and Electronics Engineering**	**Programme Code**	**1051**
VII Semester			

Course Code	Course name	HOURS/WEEK			CREDIT	Maximum Marks
		L	T	P	C	
22EE14701	**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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
VII Semester						
Course Code	**Course name**	**HOURS/ WEEK**			**CREDIT**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE14702	**POWER SYSTEM CONTROL AND PROTECTION**	**3**	**0**	**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
CO1	1	2	3	-	-	-	-	-	-	-	-	1	2	1	2
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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
VII Semester						
COURSE CODE	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE14703	**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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
VII Semester						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE14704	**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-R2022						
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)															

AHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
VII Semester						
COURSE CODE	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE24702	**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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
VII Semester						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE36701	**MINI PROJECT**	**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 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)															

<table>
<tr><td colspan="7">MAHENDRA ENGINEERING COLLEGE
(Autonomous)</td></tr>
<tr><td colspan="7">Syllabus-R2022</td></tr>
<tr><td>Department</td><td colspan="3">Electrical and Electronics Engineering</td><td colspan="2">Programme Code</td><td>1051</td></tr>
<tr><td colspan="7">VIII Semester</td></tr>
<tr><td>Course code</td><td>Course name</td><td colspan="4">Hours/Week</td><td>Credit</td><td>Maximum marks</td></tr>
<tr><td rowspan="2">22EE36801</td><td rowspan="2">PROJECT WORK</td><td>L</td><td>T</td><td>P</td><td>C</td><td rowspan="2">100</td></tr>
<tr><td>0</td><td>0</td><td>12</td><td>6</td></tr>
<tr><td>Objective(s)</td><td colspan="6">• 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</td></tr>
<tr><td>Outcome(s)</td><td colspan="6">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. Prepare the possibility of publishing papers in peer reviewed journals/conference proceedings</td></tr>
<tr><td colspan="7">• 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.</td></tr>
<tr><td colspan="5">Total</td><td colspan="2">180 Hours</td></tr>
</table>

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	2	3	2	1	1	1	2	1	3	1	2	2	2
CO	**2**	**2**	**2.25**	**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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
COURSE CODE	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE15001	**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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE15002	**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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
COURSE CODE	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE15003	**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 R-2022						
Department	**Electronics Communication Engineering**			**Programme Code**		**1041**
Program Elective						
Course code	**Course name**	**Hours/Week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE15004	**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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE15005	**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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE15006	**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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course code	**Course name**	**Hours/Week**			**Credit**	**Maximum marks**
22EE15007	**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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE15008	**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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
COURSE CODE	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE15009	**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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE15010	**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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE15011	**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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course code	**Course name**	**Hours/Week**			**Credit**	**Maximum marks**
22EE15012	**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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course code	**Course name**	**Hours/Week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
22EE15013	**EV STANDARDS AND TESTING**	**3**	**0**	**0**	**3**	**100**
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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Electives						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE15014	**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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE15015	**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-R2022			
Department	**Electrical and Electronics Engineering**	**Programme Code**	**1051**

Program Elective

Course Code	Course name	HOURS/WEEK			CREDIT	Maximum Marks
		L	T	P	C	
22EE15016	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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE15017	**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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
PROFESSIONAL ELECTIVE						
Course Code	**Course name**	**HOURS/WEEK**			**CREDIT**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE15018	**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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
COURSE CODE	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE15019	**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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
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		L	**T**	**P**	**C**	
22EE15020	**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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
COURSE CODE	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE15021	**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-R2022						
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-R2022					
Department	**Electrical and Electronics Engineering**	**Programme Code**		**1051**	
Program Elective					
Course Code	**Course name**	**HOURS/WEEK**		**CREDIT**	**Maximum Marks**
		L	**T**	**P**	**C**
22EE15023	**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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course code	**Course name**	**Hours/Week**			**Credit**	**Maximum marks**
22EE15024	**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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE15025	**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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course code	**Course name**	**Hours/week**			**Credit**	**Maximum marks**
22EE15026	**ELECTRIC VEHICLES**	**L**	**T**	**P**	**C**	**100**
		3	**0**	**0**	**3**	
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)															

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course code	**Course name**	**Hours/Week**			**Credit**	**Maximum marks**
22EE15027	**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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE15028	**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-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
COURSE CODE	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE15029	**WEB OF THINGS**	**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/	

MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus-R2022						
Department	**Electrical and Electronics Engineering**			**Programme Code**		**1051**
Program Elective						
Course Code	**COURSE NAME**	**Hours/week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22EE15030	**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)															