DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY

CIRCULAR NO.SU/Engg./B.Tech./02/2019

It is hereby informed to all concerned that, the syllabi prepared by the Board of Studies & recommended by the Dean, Faulty of Science & Technology the **has accepted the following syllabi in accordance with Choice Based Credits & Grading System for all Branches of B.Tech. Final Year** in his emergency powers under section 12(7) of the Maharashtra Public Universities Act, 2016 on behalf of the Academic Council and Management Council as enclosed herewith:-

Sr.No.	Syllabi as per CBC & GS
[1]	**Final Year B.Tech.[Civil Engineering],**
[2]	**Final Year B.Tech. [Mechanical Engineering],**
[3]	**Final Year B.Tech. [Agricultural Engineering],**
[4]	**Final Year B.Tech.[Electrical Engineering],**
[5]	**Final Year B.Tech. [Plastic & Polymer Engineering],**
[6]	**Final Year B.Tech [Electronics & Telecommunication Engg.],**
[7]	**Final Year B.Tech. [Computer Science Engineering].**

This is effective from the Academic Year 2019-2020 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO.SU/2019/ 820-30
Date:- 24-07-2019.

Deputy Registrar,
Syllabus Section

Copy forwarded with compliments to :-
1] **The Principals, affiliated concerned Colleges, Dr. Babasaheb Ambedkar Marathwada University.**
2] The Director, University Network & Information Centre, UNIC, with **a request to upload this Circular on University Website.**
   Copy to :-
1] The Director, Board of Examinations & Evaluation,
2] **The Section Officer, [Engineering Unit] Examination Branch,**
3] The Section officer, [Eligibility Unit],
4] **The Programmer [Computer Unit-1] Examinations,**
5] **The Programmer [Computer Unit-2] Examinations,**
6] The In-charge, [E-Suvidha Kendra],
7] The Public Relation Officer,
8] The Record Keeper,

1

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD.

Curriculum of

Final Year B.Tech

Electrical Engineering

Under Choice Based Credit & Grading System

UNDER THE FACULTY OF SCIENCE & TECHNOLOGY.

[Effective from 2019-20 & onwards]

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

[FACULTY OF SCIENCE AND TECHNOLOGY]

PROPOSED SYLLABUS
Of
Final Year B. Tech. (Electrical Engineering)
(w.e.f. academic year 2019-20)

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
Faculty Of Science And Technology
Proposed Structure w.e.f. 2019-20
Final Year B. Tech. (Electrical Engineering)

Course Code	SEMESTER-VII					Contact Hrs / Week			Examination Scheme				
	Course	L	T	P	Total	CT	TH	TW	PE	Total	Credits	Duration of Theory Exam
EED401	Switchgear and Protection	4	-	-	4	20	80	-	-	100	4	3 Hrs
EED402	Advanced Control System	4	-	-	4	20	80	-	-	100	4	3 Hrs
EED403	Power System Operation & Control	4	-	-	4	20	80	-	-	100	4	3 Hrs
*	Open Elective II	4	-	-	4	20	80	-	-	100	4	3 Hrs
EED441 - EED443	Elective III	4	-	-	4	20	80	-	-	100	4	3 Hrs
EED444 - EED446	Elective IV	2	-	-	2	10	40	-	-	50	2	2 Hrs
EED421	Lab: Switchgear and Protection	-	-	2	2	-	-	25	25	50	1	
EED422	Lab: Advanced Control System	-	-	2	2	-	-	50	-	50	1	
EED423	Lab: Power System Operation &Control	-	-	2	2	-	-	25	25	50	1	
EED424	Lab: Simulation Tools for Interfacing			2	2			50	50	100	1	
EED425	Project II	-	-	4	4	-	-	100	100	200	4	
	Total of semester-VII	**22**	**-**	**12**	**34**	**110**	**440**	**250**	**200**	**1000**	**30**	

Course Code	SEMESTER-VIII					Contact Hrs / Week			Examination Scheme				
	Course	L	T	P	Total	CT	TH	TW	PE	Total	Credits	Duration of Theory Exam
EED471	In-Plant Training	-	-	-	-	-	-	300	300	600	24	NA
	Total of Semester-VIII							**300**	**300**	**600**	**24**	
	Grand Total of VII & VIII	**22**	**-**	**12**	**34**	**110**	**440**	**550**	**500**	**1600**	**54**	

L: Lecture hours per week   T: Tutorial hours per week   P: Practical hours per week   CT: Class Test
TH: University Theory Examination   TW: Term Work   PE: Practical/Oral Examination

ElectiveIII

Course Code	EED441	EED442	EED443
Course	Utilization of Electrical Energy	High Voltage Engineering	Power Quality

Elective IV

Course Code	EED444	EED445	EED446
Course	Advanced Industrial Automation	Industrial Safety and Health	Electrical Transport System

*Open Elective II

Sr. No.	Name of Course	Department	*Course Code
1	Fundamentals of Bioenergy	AED	AED431
2	Solid Waste Management	CED	CED431
3	Big Data Analytics	CSED	CSE431
4	Data Science	ETC	ETC431
5	Energy planning and conservation	EED	EED431
6	Operations Research	MED	MED431
7	Polymer Recycling and Waste Management	PPED	PPE431

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
(Faculty of Science & Technology)
Syllabus of Final Year B.Tech. (Electrical Engineering)Semester-VII

CourseCode:EED401　　　　　　　　　**Course: Switchgear and Protection**
Teaching Scheme　　　　　　　　　　**Class Test: 20 Marks**
Theory: 04 Hrs/week　　　　　　　　**Theory Examination Duration: 3Hrs**
Credits: 04　　　　　　　　　　　　**Theory Examination: 80 Marks**

Prerequisites	:	Different types of faults in power system, Various switchgears and their use in substation, Principle and working of rotating machines and transformer with vector groups
Objectives	:	1. To elaborate construction and working principle of different types of a HVCBs 2. To describe the need of protective Relaying and operating principles of different types of relays. 3. Study different type of faults in transformer, alternator and various protective schemes related to them. 4. Learn transmission line protection schemes, and characteristics of different types of distance relays.
Unit–I	:	**Fundamentals of protective relaying** Need for protective system, nature & causes of fault, types of faults, effects of faults, evolution of protective relaying, classification of relays, zones of protection, primary and backup protection, essential qualities of protective relaying. Zone of protection. Various basic operating principles of protection-over current,(current graded & time graded), directional over current, differential, distance, induction type relay, torque equation in induction type relay, Current and time setting in induction relays **10 Hrs**
Unit-II	:	**Fundamentals of arc interruption:** Ionization of gases, deionization, Electric arc formation, Current interruption in AC circuit breaker, high & low resistance principles, arc interruption theories, arc voltage, recovery voltage, definition of re-striking voltage and RRRV, current chopping, interruption of capacitive current, resistance switching. **10Hrs**
Unit-III	:	**Circuit Breakers:** Different ratings of circuit breaker (like rated voltage, rated current, rated frequency, rated breaking capacity, symmetrical and unsymmetrical breaking, making capacity, rated interrupting duties, rated operating sequence, short time rating). Classification of high voltage circuit breaker. Working and constructional features of ACB, SF6VCB-advantages, disadvantages and applications. Auto reclosing. **09 Hrs**
Unit–IV	:	**Transformer Protection–** Types of faults in transformer. Percentage differential protection in transformers, Restricted Earth Fault protection. Incipient faults, Buchholz relay. Protection against over fluxing. Protection against inrush current. **05 Hrs**

Unit–V	:	**Alternator Protection-**Various Faults in Alternator, Abnormal operating conditions- stator faults, longitudinal percentage differential scheme and transverse percentage differential scheme. Rotor faults-abnormal operating conditions, inter turn fault, unbalance loading, over speeding, loss of excitation, protection against loss of excitation using offset Mho relay, loss of primemover.**3-Phase Induction Motor Protection-** Abnormal conditions & causes of failures in3-phaseInductionmotor, single phasing protection, Overload protection, Short circuit protection. **08 Hrs**
Unit–VI	:	A) **Busbar Protection:** Differential protection of bus bars. Selection of C.T. ratios for busbar protection. High impedance differential relay, Substation protection. B) **Transmission line**: over current protection for feeder using directional &non- directional over current relays, Introduction to distance protection, impedance relay, reactance relay, mho relay . **06Hrs**

Text Books, Reference Books, e-books, e-journals	:	Sr. No.	Title	Author	Publication
		1.	Switchgear Protection &Power Systems	S. Rao	Khanna Publications
		2.	Fundamentals of Power System Protection	Y. G. Paithankar, S. R. Bhide	Prentice Hall of India
		3.	Protection and Switchgear	B.Bhalja, R.P. Maheshwari	Oxford University Press
		4.	Power System Protection & Switchgear	Badri Ram,D. N. Vishwakarma	Tata McGraw Hill
		5.	ProtectiveRelaying:Principles and Applications	J. Lewis Blackburn, Thomas J. Domin	CRC Press
		6.	DigitalProtection of power System	Prof. Dr.S. A. Soman, IIT Mumbai	A Web course
		7.	Computer relaying for Power System	A.G. Phadkeand J.S. Thorp	John Willy &Sons Inc New York
		8.	The Art and Science of Protective Relaying	Crussel Mason	Wiley Eastern Limited.

Additional References	:	1. www.cdeep.iitb.ac.in/nptel/Electrical%20Engineering/Power%20System%20Protection/Course_home_L27.html

Section A: Unit-I, II and III; **Section B**: Unit-IV, V and VI.

Pattern of Question Paper:

The 6 units in the syllabus shall be divided in two equal parts i.e.3 units respectively. Question paper shall be set having two sections A and B. Section- A questions shall be set on first part and Section-B questions on second part. Question paper should cover the entire syllabus.

For 80 Marks Paper:

1. Ten questions
2. Five questions in each section
3. Question no. 1 from section-A and Question no. 6 from section-B be made compulsory and should cover complete syllabus of the respective section for 10 marks each.
4. Remaining questions will be of 15 marks each.

5. Any two questions of 15 marks from remaining questions in each section are to be solved.

<table>
<tr><td colspan="2" align="center">Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
(Faculty of Science &Technology)
Syllabus of Final Year B.Tech. (Electrical Engineering)Semester– VII</td></tr>
<tr><td>Course Code: EED402
Teaching Scheme
Theory: 04 Hrs/week
Credits: 04</td><td>Course: Advanced Control System
Class Test: 20 Marks
Theory Examination Duration:03Hrs
Theory Examination: 80 Marks</td></tr>
</table>

Prerequisites	:	To know knowledge of State space analysis, nonlinear systems and digital control systems.
Objectives	:	1. To study an overview of State-Space Analysis of Systems 2. To learn the design using conventional methods. 3. To know a basic knowledge in describing function analysis 4. To learn advanced control system of fuzzy logic and neural Network
Unit – I	:	**Compensation Technique** Approaches and preliminary consideration. Design of Linear Control System, Common compensating network, Transfer function of Lag, Lead and Simple lag-lead network. Design using Bode diagram. Physical realization of compensators using active and passive elements. Tachometer feedback compensation. **08Hrs**
Unit – II	:	**Introduction to state space analysis** Important definitions – state, state variable, state vector, state space, state equation, output equation. State space representation for electrical network, nth order differential equation, and transfer function. Conversion of transfer functions to state model and vice versa. Concept of diagonalization, eigen values, eigenvectors, diagonalization of system matrices with distinct and repeated eigen values, Vander Monde matrix. Solution of homogeneous and non-homogeneous state equation in standard form, state transition matrix, its properties, Evaluation of STM using Laplace transform method and infinite series method. **08Hrs**
Unit – III	:	**Design of Control System Using State Space Technique:** Concept of controllability and observability, controllability and observability Tests, condition for controllability and observability from the system matrices in canonical form, Jordan canonical form, effect of pole zero cancellation on the controllability and observability of the system, duality property. Pole placement design by state variable feedback. Necessity of an observer, design of full order observer. **08Hrs**
Unit – IV	:	**Non linear Control System Analysis** Introduction, classification, common type of non-linearities observed in physical systems, peculiar behaviour of nonlinear system- Spurious (sub harmonics) response, jump resonance, limit cycle, amplitude as function of frequency oscillation, nonlinear spring mass system, sub harmonic oscillation, asynchronous quenching, frequency entrainment etc. Analysis of NLCs using phase plane and describing methods for Ideal Relay.

				08Hrs	
Unit – V	**:**	**Digital Control System** Introduction, Configuration of the basic digital control scheme. Advantages and limitations of digital control; data conversion and quantization, Sampling & Reconstruction processes, Shannon's Sampling theorem, practical aspects of choice of sampling rate. Zero order hold (ZOH) and it's transfer function, Review of z-transform, difference equations and solution using z transform method. **08Hrs**			
Unit – VI	**:**	**Analysis and Design of Digital Control System** Pulse transfer function and z transfer function, General procedure for obtaining Pulse-transfer function, pulse transfer function of ZOH, sampled data closed loop systems, characteristic equation, causality and physical realizability of discrete data system, realization of digital controller by digital programming, direct digital programming, cascade digital programming, parallel digital programming, Digital PID controller. **08 Hrs**			
TextBooks, Reference, e-books,e-journals	**:**	**Sr. No.**	**Title**	**Author**	**Publication**
		1.	Modern Control Engineering	Ogata K.	Prentice Hall of India
		2.	Control System Engineering	Nagarath&Gopal	Wiley Eastern
		3.	Automatic Control Engineering	Benjamin C. Kuo	Prentice Hall of India
		4.	Digital Control System	Benjamin C. Kuo	Prentice Hall of India
		5.	Automatic Control Systems	Kuo B.C	Prentice Hall of India
		6.	Discrete-Time Control Systems	Ogata K.	Prentice Hall of India
		7.	Control Engineering – Theory and Practice	M. N. Bandyopadhyay	Prentice Hall of India

Section A: Unit-I, II and III; **Section B**: Unit-IV, V and VI.

Pattern of Question Paper:
The 6 units in the syllabus shall be divided in two equal parts i.e.3 units respectively. Question paper shall be set having two sections A and B. Section- A questions shall be set on first part and Section-B questions on second part. Question paper should cover the entire syllabus.

For 80 Marks Paper:

1. Ten questions
2. Five questions in each section
3. Question no. 1 from section-A and Question no. 6 from section-B be made compulsory and should cover complete syllabus of the respective section for 10 marks each.

4. Remaining questions will be of 15 marks each.
5. Any two questions of 15 marks from remaining questions in each section are to be solved.

Dr.Babasaheb Ambedkar Marathwada University, Aurangabad		

Dr.Babasaheb Ambedkar Marathwada University, Aurangabad
(Faculty of Science &Technology)
Syllabus of Final Year B.Tech. (Electrical Engineering)Semester– VII

Course Code: EED403	**Course: Power System Operation and Control**
Teaching Scheme	**Class Test: 20 Marks**
Theory: 04 Hrs/week	**Theory Examination Duration: 3Hrs**
Credits: 04	**Theory Examination: 80 Marks**

Prerequisites	**:**	Must have knowledge of Power system Transmission and Distribution, Power System Analysis, Control System, AC Machines and Power Electronics
Objectives	**:**	1. To develop skills for performing power system stability studies. 2. To provide knowledge of various power system operations and controls.
Unit – I	**:**	**Power System Stability:** Introduction to stability, dynamics of synchronous machine, swing equation, power angle equation and curve, types of power system stability (concepts of steady state, transient, dynamic stability), equal area criterion, applications of equal area criterion (sudden change in mechanical input, effect of clearing time on stability, critical clearing angle, short circuit at one end of line, short circuit away from line ends and reclosure), solution of swing equation by point by point method, methods to improve steady state and transient stability. **8 Hrs**
Unit – II	**:**	**Reactive Power and Voltage Control:** Necessity of reactive power control, Sources of reactive power, reactive power generation by a synchronous machine, effect of excitation, loading capability curve of a generator, power factor correction, voltage regulation, compensation in power system (series and shunt compensation using capacitors and reactors), Problems with Series Compensation, synchronous condenser and synchronous phase modifier, TAP changing transformer. **08 Hrs**
Unit – III	**:**	**FACTs Technology:** Problems of AC transmission system, evolution of FACTs technology, basic description and definition of basic types of FACTs controller, principle of operation, circuit diagram and applications of SVC, TCSC, STATCOM and UPFC. **08 Hrs**
Unit – IV	**:**	**Automatic Generation and Control (AGC):** Concept of AGC, complete block diagram representation of load-frequency control of an isolated power system, steady state and dynamic response, control area concept, two area load frequency control. Schematic and block diagram of alternator voltage regulator scheme. **08 Hrs**
Unit -V	**:**	**Economic Load Dispatch and Unit Commitment:** Economic load dispatch**:** Introduction, revision of cost curve of thermal and hydropower plant, plant scheduling method, equal incremental cost method, method of Lagrange multiplier (neglecting transmission losses), Bmn coefficient, economic scheduling of thermal plant considering effect of transmission losses, penalty factor, numerical. Unit commitment: Concept of unit commitment, constraints on unit

		commitment – spinning reserve, thermal and hydro constraints, methods of unit commitment – priority list and dynamic programming. **08 Hrs**		
Unit -VI	:	**Computer control of power system:** Energy Control: Interchange of power between interconnected utilities, economy interchange evaluation, interchange evaluation with unit commitment, types of interchange, capacity and diversity interchange, energy banking, emergency power interchange, inadvertent power exchange, power pools. Energy control center and its functions, SCADA and EMS, reliability of power system, Hierarchical levels for reliability study, Reliability evaluation of generation system, loss of load probability (LOLP), loss of load expectation (LOLE), Expected Energy Not Supplied(EENS), reliability indices (ASAI, CAIDI, SAIDI, SAIFI), hierarchy of power system operation and control in India, **08 Hrs**		

Text Books, Reference e-books, e-journals	:	**Sr. No.**	**Title**	**Author**	**Publication**
		1.	Power Generation, Operation and Control	Allen. J. Wood and Bruce F. Wollenberg	John Wiley & Sons, Inc
		2.	Power System Analysis: Operation and Control	P S R Murthy	Prentice Hall of India
		3.	Power system operation and control	Dr. B. R. Gupta and Vandana Singhal	S. Chand & Company Ltd
		4.	Modern Power System Analysis	D.P. Kothari and I.J. Nagrath	Tata McGraw
		5.	Operations and Control In Power Systems	P S R Murthy	B S Publication
		6.	Elements of Power System Analysis	Stevenson W.D	TMH
		7.	The Electric Power Engineering, Hand Book	L.L. Grigsby	CRC Press & IEEE Press
		8.	Power System Analysis	Hadi Saadat	
		9.	Power System Stability and Control	P. Kundur	MC Craw Hill Publisher, USA
		10.	Electric Energy Systems theory an introduction	Olle. I. Elgerd	Tata McGraw Hill
Additional References	:	1.	https://nptel.ac.in/downloads/108101039/		

Section A: Unit-I, II and III; **Section B**: Unit-IV, V and VI.

Pattern of Question Paper:
The 6 units in the syllabus shall be divided in two equal parts i.e.3 units respectively. Question paper shall be set having two sections A and B. Section- A questions shall be set on first part and Section-B questions on second part. Question paper should cover the entire syllabus.

For 80 Marks Paper:

1. Ten questions
2. Five questions in each section

3. Question no. 1 from section-A and Question no. 6 from section-B be made compulsory and should cover complete syllabus of the respective section for 10 marks each.
4. Remaining questions will be of 15 marks each.
5. Any two questions of 15 marks from remaining questions in each section are to be solved.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
(Faculty of Science& Technology)
Syllabus of Final Year B. Tech. (All) Semester-VII

Course Code: AED431	Course: Open Elective- II (Fundamentals of
Teaching Scheme	Bioenergy)
Theory: 04 Hrs/Week	Class Test: 20 Marks
Credits: 04	Theory ExaminationDuration: 3 Hrs
	Theory Examination: 80 Marks

Objectives	1. Understand bioenergy technologies, processes, reactions and energy conversion rates for Anaerobic Digestion, gasification, pyrolysis (fast, intermediate and slow) and combustion. 2. To study the wells, bore wells and well development. 3. Know what constitutes a suitable feedstock for bioenergy applications
Unit-I	**Introduction to bioenergy:** Introduction,Unit of Energy and Introduction of Bioenergy, How Biomass Formed on the Earth, Road Map of Bioenergy, Basic Biomass Technology (Resources and Production) Exploration of Photosynthesis Process, In Photosynthesis Oxygen Comes from Water Molecule **08 Hrs**
Unit-II	**Bioethanol:** Basic concept of Cellulosic Bioethanol Process, Pretreatment and Enzyme treatment of Cellulosic Bioethanol Process,Fermentation and Distillation in Cellulosic Bioethanol Production,Basic concept of Plant Design, Pilot Plant and Scale-up **08Hrs**
Unit-III	**Biogas:** Basic concept in anaerobic digestion and biogasification, Biochemical methane potential assay and calculations for biogasification feasibility analysis, Design and operation of biogasification systems, Biogas utilization, Biomass production System and their Categorization, Important Parameters for Selecting Biomass Crops, Factors Determining the Conversion Process - I **08 Hrs**
Unit-IV	**Biodiesel:** Biodiesel production processes, Biodiesel characterization , Biodiesel feedstocks ,Environmental permitting and safety considerations for biodiesel production **08 Hrs**
Unit-V	**Thermo Chemical Processes:** Basic concepts in gasification and pyrolysis, Gasification and pyrolysis systems, Spark Ignition Engine, Compression Ignition Engine, Gasification Types - Up Drift Gasifier **08 Hrs**
Unit-VI	**Bioenergy distritribution and end use for a sustainable future :** Down Draft and cross flow gasifier, operation and performance of gasifier , fludized bed gasification, its operation and performance, Biological root of gasification **08 Hrs**

	Sr. No.	Title	Authors	Publication
Text Books, Reference e-books, e-journals	1	Introduction to Bioenergy (Energy and the Environment)	Vaughn C. Nelson (Author), Kenneth L. Starcher	-
	2	Bioenergy: Biomass to Biofuels	Anju Dahiya	-
	3	Bioenergy: Principles and Applications	Yebo Li and Samir Kumar Khanal	-

Section A: Unit-I, II and III; **Section B**: Unit-IV, V and VI.

Pattern of Question Paper:
The 6 units in the syllabus shall be divided in two equal parts i.e.3 units respectively. Question paper shall be set having two sections A and B. Section- A questions shall be set on first part and Section-B questions on second part. Question paper should cover the entire syllabus.

For 80 Marks Paper:

1. Ten questions
2. Five questions in each section
3. Question no. 1 from section-A and Question no. 6 from section-B be made compulsory and should cover complete syllabus of the respective section for 10 marks each.
4. Remaining questions will be of 15 marks each.
5. Any two questions of 15 marks from remaining questions in each section are to be solved.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
(Faculty of Science & Technology)
Syllabus of Final Year B. Tech. (All) Semester VII

Course Code: CED431	**Course: Open Elective-II (Solid Waste Management)**
Teaching Scheme	**Class Test: 20 Marks**
Theory: 04 Hrs/week	**Theory Examination Duration: 03 Hrs**
Credits: 04	**Theory Examination: 80 Marks**

Prerequisites	None
Objective	1. To get introduced to the generation, collection and management of the various types of solid waste and different waste management techniques.
Unit-I	**Introduction to Solid Waste Management (SWM):** Need and Objectives of SWM, Waste Management Hierarchy, Functional elements, Environmental impact of mismanagement. Solid waste: Sources, types, Composition, Quantities, Physical, chemical and Biological properties. **08 Hrs**
Unit-II	**Generation of solid waste:** Factors affecting. Storage and collection: General considerations for waste storage at source, Types of collection systems. Collection System, Transfer station: Meaning, Necessity, Transportation of solid waste: Means and Methods, Routing of vehicles **08 Hrs**
Unit-III	**Segregation and Material Recovery:** Objectives, Stages of segregation, sorting operations, Guidelines for sorting for materials recovery, E waste management, Biomedical waste management **08 Hrs**
Unit-IV	**Waste processing:** processing technologies: Composting, thermal conversion technologies incineration, treatment of biomedical wastes. Energy recovery from solid waste: Parameters affecting energy recovery, Bio-methanation, Fundamentals of thermal processing, Pyrolysis, Incineration, Advantages and disadvantages of various technological options. **08 Hrs**
Unit-V	**Disposal:** Landfills and its introduction, Definition, Essential components, Site selection, Land filling methods, Leachate analysis and landfill gas management, treatment & disposal, Determination of capacity of landfill disposal site. **08 Hrs**
Unit-VI	**Hazardous waste management:** Types of hazardous waste (such as nuclear, biomedical and industrial waste,), problems and issues related to hazardous waste management, Need for hazardous waste management, Legislations on management and handling of HW, Hazardous Characteristics, reduction of wastes at source, Recycling and reuse, labeling and handling of hazardous wastes, incineration, solidification and stabilization of hazardous waste. **08 Hrs**
Text	**Sr. No.**	**Title**	**Authors**	**Publication**

Books, Reference e-books, e-journals	1.	Tchobanoglous, Integrated Solid Waste Management	Hilary Theisen and Samuel A, Vigil, George	McGraw- Hill
	2.	Manual on Municipal Solid waste management	--	CPHEEO, Government of India
	3.	Hazardous waste Management	Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans	Mc-Graw Hill
	4.	Solid waste Engineering	Vesilind P.A., Worrell W and Reinhart	Thomson Learning Inc
	5.	Hazardous Waste Management	Charles A. Wentz	McGraw Hill

Section A: Unit-I, II and III; **Section B**: Unit-IV, V and VI.

Pattern of Question Paper:
The 6 units in the syllabus shall be divided in two equal parts i.e.3 units respectively. Question paper shall be set having two sections A and B. Section- A questions shall be set on first part and Section-B questions on second part. Question paper should cover the entire syllabus.

For 80 Marks Paper:

1. Ten questions
2. Five questions in each section
3. Question no. 1 from section-A and Question no. 6 from section-B be made compulsory and should cover complete syllabus of the respective section for 10 marks each.
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Dr.Babasaheb Ambedkar Marathwada University, Aurangabad	
(Faculty of Science and Technology)	
Syllabus of Final Year B. Tech. (All) Semester-VII	
CourseCode: CSE431	**Course: Open Elective-II (Big Data Analytics)**
Teaching Scheme	**Class Test: 20Marks**
Theory: 04 Hrs/week	**Theory Examination Duration: 03 Hrs**
Credits:04	**Theory Examination: 80Marks**

Prerequisites	:	Knowledge of Programming Language (Java preferably), SQL
Objectives	:	1. To understand the Big Data Platform and its Use cases 2. To understand the basics of Apache Hadoop and HDFS 3. To apply analytics on Structured, Unstructured Data.
Unit-I	:	**Fundamentals Of Big Data** The Evolution of Data Management, Understanding the Waves of Managing Data, Defining Big Data, Four Vs , Big Data Management Architecture. Big Data Types: Defining Structured Data, Defining Unstructured Data, Big Data Applications. **08 Hrs**
Unit-II	:	**Big Data Technology Landscape:** Big Data Technology Components: Exploring the Big Data Stack, Virtualization, Understanding the Basics of Virtualization, Managing Virtualization with the Hypervisor, Abstraction and Virtualization, Implementing Virtualization to Work with Big Data. **08 Hrs**
Unit-III	:	**Data Analytics:** **Predictive Analytics:** Linear Regression, Logistic Regression, Decision Trees, **Descriptive Analytics:** Association Rules, Sequence Rules, Segmentation, **Social Network Analytics:** Social Network Definitions, Social Network Metrics, Social Network Learning, Relational Neighbor Classifier,Business Process Analytics, Web Analytics **08 Hrs**
Unit-IV	:	**Hadoop And Map Reduce:** History of Hadoop, Analyzing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, Hadoop Storage, Common Hadoop Shell commands, Hadoop Architecture, Hadoop MapReduce Paradigm: Map and Reduce tasks , Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats **08 Hrs**
Unit-V	:	**Hdfs(Hadoop Distributed File System):** The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Sqoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures. **08 Hrs**
Unit-VI	:	**Hadoop Eco System:** **Pig :** Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. **Hive :** Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. **Hbase :** HBasics, Concepts, Clients, Example, Hbase Versus RDBMS. **08 Hrs**

Sr. No.	Title	Authors	Publication
1.	Big Data Analytics	Seema Acharya, SubhasiniChellappan	Wiley
2.	Hadoop: The Definitive Guide	Tom White	O'reily Media
3.	Analytics in a Big Data World: The Essential Guide to DataScience and its Applications	Bart Baesens	Wiley
4.	Intelligent Data Analysis	Michael Berthold, David J. Hand	Springer
5.	Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics	Bill Franks	John Wiley & sons
6.	Making Sense of Data	Glen J. Myat	John Wiley & sons
7.	Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses	Michael Mineli, Michele Chambers, Ambiga Dhiraj	Wiley

(The "Text Books, Reference e-books, e-journals" label spans all the above rows.)

Section A: Unit-I, II and III; **Section B**: Unit-IV, V and VI.

Pattern of Question Paper:
The 6 units in the syllabus shall be divided in two equal parts i.e.3 units respectively. Question paper shall be set having two sections A and B. Section- A questions shall be set on first part and Section-B questions on second part. Question paper should cover the entire syllabus.

For 80 Marks Paper:

1. Ten questions
2. Five questions in each section
3. Question no. 1 from section-A and Question no. 6 from section-B be made compulsory and should cover complete syllabus of the respective section for 10 marks each.
4. Remaining questions will be of 15 marks each.
5. Any two questions of 15 marks from remaining questions in each section are to be solved.

Dr.Babasaheb Ambedkar Marathwada University, Aurangabad
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Syllabus of final year B. Tech. (All) Semester-VII

Course Code:ETC431	**Course: Open Elective - II (Data Science)**
Teaching Scheme	**Class Test: 20 Marks**
Theory: 04Hrs/week	**Theory Examination Duration: 03 Hrs**
Credits:04	**Theory Examination: 80 Marks**

Prerequisites	:	Programming Concepts, Data Structure, Basic Linear Algebra, Basic Probability and Statistics
Objectives	:	1. Describe what Data Science is and the skill sets needed to be a data scientist 2. Explain the significance of exploratory data analysis in data science 3. Apply basic machine learning algorithm. 4. Identify approaches used for feature generation. 5. Create effective visualization of given data.
Unit-I	:	**Introduction:** Introduction, big data and data science hype, datafication, current landscape of perspective. **8 Hrs**
Unit-II	:	**Statistical Inference and Exploratory data analysis:** Populations and samples, statistical modeling, probability distributions, fitting a model, Introduction to R. Basic Tools (Plots, Graphs and summary statistics) of EDA, philosophy of EDA, the data science process, Case Study. **8 Hrs**
Unit-III	:	**Machine Learning Algorithm and its Usage:** Linear Regression, k-nearest Neighbors(k-NN), k-means. Spam filtering, naïve Bayes and its application for spam filtering, Data Wrangling: Tools and API for scrapping the web. **8 Hrs**
Unit-IV	:	**Feature Generation and Selection:** Feature generations algorithms, feature selection algorithms: filters, wrappers, decision trees, random forest. Algorithmic ingredients of a recommendation engine, dimensionality reduction, singular value decomposition, principal component analysis. **8 Hrs**
Unit-V	:	**Mining Social Network:** Social Networks as graphs, clustering of graphs, direct discoveries of communities in graphs, portioning of graphs, neighborhood properties of graphs. **8 Hrs**

Unit-VI	:	Data visualization and ethical issues: Basic principles, ideas and tools for data visualization, creation of visualization for complex data set. Case study. Privacy, security and ethics of data science. **8 Hrs**		
Text Books, Reference e-books,e-journals		**Sr. No.**	**Title**	**Authors**	**Publication**

		Sr. No.	Title	Authors	Publication
		1.	Doing Data Science, Straight Talk From The Frontline	Cathy O'Neil and Rachel Schutt	O'Reilly
		2.	Mining of Massive Datasets. v2.1	Jure Leskovek, Anand Rajaraman and Jeffrey Ullman	Cambridge University Press
		3.	Machine Learning: A Probabilistic Perspective	Kevin P. Murphy	Cambridge, Mass: MIT Press
		4.	Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking.	Foster Provost and Tom Fawcett	O'Reilly

Section A: Unit-I, II and III; **Section B**: Unit-IV, V and VI.

Pattern of Question Paper:
The 6 units in the syllabus shall be divided in two equal parts i.e.3 units respectively. Question paper shall be set having two sections A and B. Section- A questions shall be set on first part and Section-B questions on second part. Question paper should cover the entire syllabus.

For 80 Marks Paper:

1. Ten questions
2. Five questions in each section
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5. Any two questions of 15 marks from remaining questions in each section are to be solved.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad		
(Faculty of Science & Technology)		
Syllabus of Final Year B. Tech. (All) Semester – VII		
Course Code: EED431	Course: Open Elective-II (Energy Planning and Conservation)	
Teaching Scheme	Class Test: 20 Marks	
Theory: 04 Hrs/week	Theory Examination Duration: 3Hrs	
Credits: 04	Theory Examination: 80 Marks	

Prerequisites	:	Should have knowledge of Electrical/ Mechanical Appliances, various types of energy utilization.
Objectives	:	1. Identify the demand supply gap of energy in Indian scenario. 2. Understanding basics of energy audit . 3. Understand various opportunities in in energy saving for industry
Unit-I	:	**Energy Policy:** National & State Level Energy Issues, National & State Energy Policy, Industrial Energy Policy, Energy Security, Energy Vision. Energy Pricing & Impact of Global Variations. Energy Productivity (National & Sector wise productivity). **08Hrs**
Unit-II	:	**Energy action planning:** Energy Action Planning: Key elements, Force field analysis, Energy policy purpose, perspective, Contents, Formulation, Ratification, Organizing - location of energy management, Top management support, Managerial function, Roles and responsibilities of energy manager, Accountability. Motivating-motivation of employees. **8Hrs**
Unit - III	:	**Importance of Energy management:** Energy Management : Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance. **08Hrs**

Unit - IV	:	Elements of Energy conservation:
		General energy problem, , Scope for energy conservation and its benefits, Energy conservation Principle – Maximum energy efficiency, Maximum cost effectiveness, Mandatory provisions of Energy Conservation act 2001, Features of Energy Conservation act-Standards and labelling, designated consumers, Energy Conservation Building Codes (ECBC). **8 Hrs**
Unit -V	:	Energy Audit & Measuring Instruments
		Basic measurements – Electrical measurements, Light, Pressure, Temperature and heat flux, Velocity and Flow rate, Vibrations. Instruments Used in Energy systems: Load and power factor measuring equipments, Wattmeter, flue gas analysis, Temperature and thermal loss measurements, air quality analysis etc. **8 Hrs**
Unit -VI	:	Lighting and Lighting System:
		Lightings Levels, Fixtures Lighting techniques – Natural , CFL, LED lighting sources and fittings, Day lighting, Timers, Energy Efficient Windows. **8 Hrs**

Text Books, Reference Books, e-books, e-journals	:	Sr. No.	Title	Author	Publication
		1.	Bureau of Energy efficiency hand books No 1 & 2	BEE OF INDIA	BEE OF INDIA
		2.	Energy Management Handbook	Wayne C. Turner	Tata McGraw Hill
		3.	Energy management	Paul O Callaghan	
		4.	Bureau of Energy efficiency hand books No 3,	BEE OF INDIA	BEE OF INDIA

Additional References	:	1. https://www.beeindia.gov.in/content/energy-auditorsinformation as & when available.

Section A: Unit-I, II and III; **Section B**: Unit-IV, V and VI.

Pattern of Question Paper:

The 6 units in the syllabus shall be divided in two equal parts i.e.3 units respectively. Question paper shall be set having two sections A and B. Section- A questions shall be set on first part and Section-B questions on second part. Question paper should cover the entire syllabus.

For 80 Marks Paper:

1. Ten questions

2. Five questions in each section

3. Question no. 1 from section-A and Question no. 6 from section-B be made compulsory and should cover complete syllabus of the respective section for 10 marks each.

4. Remaining questions will be of 15 marks each.

Any two questions of 15 marks from remaining questions in each section are to be solved

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad	
(Faculty of Science & Technology)	
Syllabus of Final Year B. Tech. (All) Semester-VII	
Course Code: MED431	**Course: Open Elective-II (Operations Research)**
Teaching Scheme	**Class Test: 20 Marks**
Theory: 04 Hrs/week	**Theory Examination Duration: 03 Hrs**
Credits: 04	**Theory Examination: 80Marks**
Objectives :	1. To familiarize the students with formal quantitative approach to problem solving 2. To formulate real life engineering problems 3. To solve engineering problems using various Operations Research Techniques
Unit-I :	**Introduction to Operations Research :** Basics definition, scope, objectives, phases, models, applications and limitations of Operations Research. **02 Hrs**
Unit-II :	**Linear Programming Problem :** Formulation of LPP, Graphical solution of LPP, Simplex Method, Artificial variables, Big-M method, two-phase method, degeneracy and unbound solutions. **12 Hrs**
Unit-III :	**Transportation Model :** Transportation Problem: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test – the stepping stone method or MODI method. Degeneracy in Transportation Problem. Assignment Problem: Hungarian Method to solve Assignment Problem, Travelling Salesman as an Extension of Assignment Problem. **10 Hrs**
Unit-IV :	**Inventory Control, Replacement Analysis and Theory of Games :** Inventory Models: Economic Order Quantity Models, Quantity Discount Models, Stochastic

		Inventory Models, Multi Product Models, Inventory Control Models in Practice. Replacement Analysis: Replacement of Items that Deteriorate, Replacement of Items that Fail Suddenly. Theory of Games: Introduction, Minimax and Maximin Principle, Solution of Game with Saddle Point, Solution by Dominance. **08 Hrs**
Unit-V	:	**Queuing model and Sequencing model :** Queuing Systems And Structures, Notation Parameters, Single Server and Multi Server Models, Poisson Input, Exponential Service, Constant Rate Service, Infinite Population Sequencing Model: Introduction, n jobs through two machines, n jobs through three machines, two jobs through m machines and n jobs through m machines. **08 Hrs**
Unit-VI	:	**Network Models:** Fulkerson's rule, concept and types of floats, float calculations, CPM and PERT, Crashing cost and crashing Network **08 Hrs**

	Sr. No.	Title	Author	Publication
Text Books, Reference Books, e- books, e- Journals	1	Operations Research	Taha H.A.	Ninth Edition, Prentice Hall Of India.
	2	Introduction to Operations Research	Frederick S. Hillier and Gerald J. Lieberman	Seventh Edition, Tata McGraw-Hill
	3	Operations Research	P.K. Gupta, D.S Hira	Fourth Edition S. Chand & Co.
	4	Operations Research	Man Mohan, P. K. Gupta, Kanti Swarup	12th Edition, S. Chand & Co.
	5	Operations Research Principles and Practice	Ravindran, Phillips and Solberg	Second Edition, Mc. WSE Willey
	6	Operations Research: Applications and Algorithms	Wayne L. Winston, Jeffrey B. Goldberg	Fourth edition, Thomson Brooks
	7	Operations Research: Theory, Methods and Applications	S. D. Sharma, Himanshu Sharma	Kedar Nath Ram Nath
	8	PERT and CPM: Principles and Applications	L. S. Srinath	Third Edition, ffiliated East-West Press Private Limited,
	9	Project Planning and Control with PERT & CPM	Dr. B.C. Punmia& K.K. Khandelwal	Fourth Edition, Firewall Media

Additional References	:	1. nptel.iitm.ac.in
		2. ocw.mit.edu
		3. https://www.journals.elsevier.com/journal-of-operations-management
		4. https://pubsonline.informs.org/journal/opre
		5. https://www.theorsociety.com/

Section A: Unit-I, II and III; **Section B**: Unit-IV, V and VI.

Pattern of Question Paper:

The 6 units in the syllabus shall be divided in two equal parts i.e.3 units respectively. Question paper shall be set having two sections A and B. Section- A questions shall be set on first part and Section-B questions on second part. Question paper should cover the entire syllabus.

For 80 Marks Paper:

1. Ten questions
2. Five questions in each section
3. Question no. 1 from section-A and Question no. 6 from section-B be made compulsory and should cover complete syllabus of the respective section for 10 marks each.
4. Remaining questions will be of 15 marks each.
5. Any two questions of 15 marks from remaining questions in each section are to be solved.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad	
(Faculty of Science & Technology)	
Syllabus of Final Year B. Tech. (All) Semester-VII	

Course Code: PPE431	Course: Open Elective-II (Polymer Recycling and Waste Management)
Teaching Scheme	**Class Test: 20 Marks**
Theory: 4 Hrs/week	**Theory Examination Duration: 3 hrs**
Credits: 4	**Theory Examination: 80 Marks**

Objectives	:	1. To learn the need for polymer recycling, techniques employed and applications. 2. To learn the need and various methods/techniques involved in polymer waste management.
Unit-I	:	**Significance of recycling:** Global plastics production and composition, global plastics waste composition, quantities and disposal, identification codes of plastics for recycling. Recycling process: collection, sorting and segregation of waste, recycling methods: Primary, secondary, tertiary and quaternary recycling, landfilling. **08 Hrs**
Unit-II	:	**Recycling equipment/machinery:** Equipment for primary and secondary recycling: shredder, granulator, pulverizer, cutter, extruder. Classification and types of reactors for tertiary recycling. **09 Hrs**
Unit-III	:	**Recycling of plastics from urban waste:** Rheology, density and mechanical behavior of recycled plastics, hydrolytic treatment of plastics waste containing paper, processing of mixed plastics waste, recycling additives. **07 Hrs**
Unit-IV	:	**Recycling techniques:** Recycling techniques of PE packaging films and woven sacks, PET bottles and films, PP battery cases, PVC products and thermosetting plastics. **08 Hrs**
Unit-V	:	**Municipal solid waste management and treatment techniques:** Collection, storage, transportation and disposal of municipal solid waste, sorting of MSW, types of vehicles and equipment for primary collection, secondary collection and transport. Different treatment techniques: a) Composting: techniques such as windrow, aerated static pile, in vessel, decentralized, bin and vermicomposting.

		b) Bio-methanation: merits, applicability, process and types of anaerobic digester systems. c) Refuse derived fuel: classification, composition, production process and uses. d) Sanitary landfilling: requirements, layout, leachate management, waste placement and inspection. **11 Hrs**			
Unit-VI	:	**Tools for combating polymer waste:** Combating tools for waste management: extended producer responsibility, product stewardship, shared producer responsibility, usage of green products and usage of biodegradable or environmentally degradable polymers for waste reduction. **05 Hrs**			

		Sr. No.	Title	Author	Publication
Text Books, Reference Books, e- books, e- Journals	:	1	Plastics Fabrication and Recycling	Manas Chanda and Salil K. Roy	CRC Press
		2	Introduction to Plastics Recycling	VannessaGoodship	Smithers Rapra
		3	Recycling of Polymers	Raju Francis	Wiley-VCH
		4	Recycling of Plastic Materials	Francesco Paolo La Mantia	Chemtec Publishing
		5	Feedstock Recycling and pyrolysis of waste plastics	John Schiers& W. Kaminsky	John Wiley and Sons
		6	Mixed Plastic Recycling Technology	B. Hegberg, G. Brenniman	Noyes Data Corporation
		7	Plastics Waste: Recovery of Economic value	Jacob Leidner	Marcel Decker Inc.
		8	Management of municipal solid waste	T. V. Ramchandra	TERI Press
		9	Waste Management	Martin F. Lehmann	I. A. Publishers
		10	Environmental Waste Management	Ram Chandra	CRC Press
		11	Plastic Waste	Jacob Leidner	Marcel Decker Inc.

Section A: Unit-I, II and III; **Section B**: Unit-IV, V and VI.

Pattern of Question Paper:

The 6 units in the syllabus shall be divided in two equal parts i.e.3units respectively. Question paper shall be set having two sections A and B. Section- A questions shall be set on first part andSection-Bquestionsonsecondpart.Questionpapershouldcovertheentire syllabus.

For 80 Marks Paper:

1. Ten questions
2. Five questions in each section
3. Question no. 1 from section-A and Question no. 6 from section-B be made compulsory and should cover complete syllabus of the respective section for 10 marks each.

4. Remaining questions will be of 15 marks each.
5. Any two questions of 15 marks from remaining questions in each section are to be solved.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
(Faculty of Science& Technology)
Syllabus of Final Year B.Tech. (Electrical Engineering) Semester-VII

Course Code: EED441		**Course: Elective-III (Utilization of Electrical Energy)**
Teaching Scheme		**Class Test:20Marks**
Theory: 04 Hrs/week		**Theory Examination Duration:03 Hrs**
Credits: 04		**Theory Examination:80Marks**

Prerequisites	:	Should have Knowledge of Electrical Drives, Electrical Machines.
Objectives	:	1. To understand Characteristics, speed control and load conditions of Electric drives for choosing right drives 2. To understand operation and types of Electric heating and welding 3. To understand special features of traction motors and methods of electric braking.
Unit – I	:	**Electric heating:** Resistance heating, Direct and Indirect resistance heating, Heat Control, Method of heat control a) Using selector switch b) using tapped transformer, Induction Heating, principles of operation, basic construction and application of induction furnace, High frequency eddy current heating, Dielectric heating, principle and operation, Arc heating, basic principle, types, operation and control of Arc furnaces. **8Hrs**
Unit-II	:	**Electric welding:** Electric welding, resistance and arc welding, electric welding Equipment, comparison between A.C. and D.C. Welding. **8Hrs**
Unit-III	:	**Illumination:** Definitions of flux, solid angle, luminous intensity, illumination, luminous efficiency, depreciation factor, coefficient of utilization, space to height ratio, reflection factor; Laws of illumination. Different sources of light: Incandescent lamp, fluorescent lamp, comparison between them. Incandescent and discharge lamps – their construction and characteristics; mercury vapour lamp, sodium lamp, halogen lamp, compact fluorescent lamp, metal halide lamp, LEDs, LASERs Comparison of all above luminaries. **8Hrs**
Unit-IV	:	**Electric traction:** History of Indian railways. Traction systems - Steam engine drive, electric drive, diesel electric drive, types of diesel locomotives, Advantages of electric traction, Brief treatment to - Indian railway engine coding terminology, WDM,WDP,WDG series and their capacity Introduction to metro system, mono rail system. Systems of track electrification: D.C. system, single phase low frequency A.C. system. **8Hrs**

Unit-V	:	**Traction Motors, Control of Traction Motors& Train Lighting:** Desirable characteristic of traction motors. Suitability of D.C. series motor, A.C. series motor, 3 phase induction motor and linear induction motor for traction. Control of traction motors –Series parallel control, Shunt and bridge transition (Numerical), Electrical breaking, Regenerative breaking in traction, Suitability of different motors for braking. Train lighting system. **8Hrs**
Unit-VI	:	**Hybrid and electric vehicle (HEV):**History of hybrid and electric vehicle, purpose of hybrid and electric vehicle, Basic designs of hybrids and electric vehicle, power electronics converters used in HEV(Boost, Buck-boost and Dual active bridge converter), electric machines used in HEV(PM & BLDC), Energy storage(LI-ion and fuel cell) used in HEV, Regenerative braking, advantage and disadvantage of HEV. **8Hrs**

Text Books, Reference Books,e-books,e-Journals	:	Sr. No.	Title	Author	Publication
		1.	Utilization of Electrical Power	Er. R. K.Rajput	Laxmi Publications.
		2.	M & Science of Utilization of electrical Energy	Paab	DhanpatRai&Sons
		3.	Utilization of Electric Power and ElectricTraction	J.B. Gupta	Kataria& Sons publishers
		4.	Generation, Distribution and Utilization of electrical Energy	C.L. Wadhwa	New Age International (P) Limited Publishers
		5.	Electric and Hybrid Vehicles: Design Fundamentals	Iqbal Hussein	CRC Press
Additional Reference	:	1. nptel.iitm.ac.in 2. www.ebookee.org			

Section A: Unit-I, II and III; **Section B**: Unit-IV, V and VI.

Pattern of Question Paper:
The 6 units in the syllabus shall be divided in two equal parts i.e.3 units respectively. Question paper shall be set having two sections A and B. Section- A questions shall be set on first part and Section-B questions on second part. Question paper should cover the entire syllabus.

For 80 Marks Paper:

6. Ten questions
7. Five questions in each section
8. Question no. 1 from section-A and Question no. 6 from section-B be made compulsory and should cover complete syllabus of the respective section for 10 marks each.
9. Remaining questions will be of 15 marks each.
10. Any two questions of 15 marks from remaining questions in each section are to be solved.

Course Code: EED442	Course: Elective-III(High Voltage Engineering)
Teaching Scheme	Class Test: 20 Mark
Theory: 04 Hrs/week	Theory Examination Duration:03Hrs
Credits: 04	Theory Examination: 80 Mark

Prerequisites	:	Should have knowledge of electric materials, basic concepts of power system and EMF theory.
Objectives	:	1. Generation and Measurement of over voltages in laboratories. 2. Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics. 3. Testing of HV apparatus and control methods to over voltages
Unit – I	:	**Electric Field Strength and Breakdown in Gases:** Electric field stress, Control of Electric field stress, Ionization process in gas, Townsend's Theory, current growth equation in presence of primary and secondary ionization processes, limitations of Townsend's theory, Streamer mechanism of breakdown, Paschen's Law and its limitations. **08 Hrs**
Unit – II	:	**Breakdown in Liquid Dielectrics:** pure and commercial liquids, Different breakdown theories: Breakdown in pure liquid and breakdown in commercial liquids: suspended particle theory, cavitations and bubble theory, Thermal mechanism of breakdown and Stressed oil volume theory. **Breakdown in Solid Dielectrics:** Intrinsic breakdown: electronic breakdown, avalanche or streamer breakdown, electromechanical breakdown, thermal breakdown, treeing and tracking phenomenon, Partial discharge (Internal discharge), Introduction of composite dielectric material, breakdown in composite dielectrics. **10 Hrs**
Unit - III	:	**Lightning and Switching Over Voltages:** Natural Causes of over voltages, lightning phenomenon, mechanisms of lightning strokes, Over voltage due to switching surges and methods to minimize switching surges. **06Hrs**
Unit – IV	:	**Generation of High Voltage and Current:** **A)** Generation of high ac voltages-Cascading of transformers, series and parallel resonance system. **B)** Generation of impulse voltages and current-Impulse voltage definition, wave front and wave tail time, Multistage impulse generator, Marx circuit, Tripping and control of impulse generators, Generation of high impulse current **C)** Generation of high dc voltages: rectifier circuits, Cock-roft voltage multiplier. **08 Hrs**

Unit – V	:	**Measurement of High Voltage and High Current:** Measurements of high direct current voltages, electrostatic volt meter, generating voltmeter, peak reading voltmeter, Spark gaps for measurement of high ac, dc and impulse voltages. **06Hrs**
Unit – VI	:	**High Voltage Testing of Electrical Apparatus and H V Laboratories:** Testing of insulators and bushings-Disruptive discharge voltage, withstand voltage, 50% & 100% flashover voltages, creepage voltages, a.c test voltages, impulse voltages, power frequency tests, impulse tests, Testing of isolators and circuit breakers-Introduction, short circuit tests, testing of cables-preparation of the cable samples, dielectric power factor tests, high voltage tests on cables, testing of surge arresters and transformer-Impulse testing of transformers. Radio interference measurements. **10Hrs**

Text Books, Reference Books, e- books, e- Journals	:	Sr.No.	Title	Author	Publication
		1.	High Voltage Engineering	Naidu M. S., Kamaraju V	Tata McGraw-Hill
		2.	High Voltage Engineering	Wadhwa C.L.,	New Age International
		3.	High Voltage - Insulation Engineering	Ravindra Arora and Wolfgang Mosch,	New Age International
		4.	High Voltage Engineering: Fundamentals	Kuffel, E., Zaengl W.S., Kuffel J.,	Newnes
		5.	Extra High Voltage AC Transmission Engineering	Rakosh Das Begamudre,	New Age International
		6.	High Voltage Engineering	Prof. D. V. Razevig Translated from Russian by Dr. M. P. Chourasia	Khanna

Additional Reference	:	1. https://nptel.ac.in/courses/108104048/ 2. http://vlabs.iitkgp.ernet.in/vhv/# 3. http://vp-dei.vlabs.ac.in/Dreamweaver/

Section A: Unit-I, II and III; **Section B**: Unit-IV, V and VI.

Pattern of Question Paper:
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For 80 Marks Paper:

1. Ten questions
2. Five questions in each section
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Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
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Syllabus of Final YearB. Tech. (Electrical Engineering) Semester – VII

CourseCode: EED443		**Course: Elective-III(Power Quality)**
Teaching Scheme		**Class Test: 20Marks**
Theory: 04 Hrs/week		**Theory Examination Duration:03 Hrs**
Credits: 04		**Theory Examination: 80Marks**

Prerequisites	:	To study the various issues affecting power quality, production, monitoring and suppression and analysis of harmonics.
Objectives	:	1. To study the production of voltages sags, over voltages and harmonics and methods of control. 2. To study various methods of power quality monitoring.
Unit - I	:	**Basics of power quality and standards:** Introduction and importance of Power Quality, symptoms of poor power quality. Various power quality issues such as transients, short duration voltage variations, long duration voltage variations, voltage imbalance, voltage fluctuations, voltage flicker and waveform distortion. Relevant power quality standards such as IEEE 1159- 2009 and IEEE 519- 2014. Grounding and power quality issues. **10 Hrs**
Unit - II	:	**Voltage sag:** Origin of voltage sags and interruptions, voltage sag characteristics- magnitude, duration, phase angle jump, point on wave initiation and recovery, missing voltage. Area of vulnerability, equipment behaviour under voltage sag, ITIC curve, voltage sag monitoring and mitigation techniques. **10 Hrs**
Unit - III	:	**Transient Over Voltages and Flickers:** Classification of transients, sources of transient over voltages, computer tools for transient analysis, techniques for over voltage protection. Voltage flickers – sources of flickers, quantifying flickers and mitigation techniques. **08 Hrs**
Unit - IV	:	**Fundamentals of Harmonics:** Harmonic distortion – voltage and current distortion, power system quantities under non sinusoidal condition – active, reactive and apparent power, power factor – displacement and true power factor, harmonic phase sequences and triplen harmonics, harmonic indices, sources of harmonics, effect of harmonic distortion. **08 Hrs**
Unit - V	:	**Measuring and control of harmonics:** Concept of point of common coupling and harmonic evaluation, principles of controlling harmonics, Harmonic study procedures and computer tools for harmonic analysis, Devices for controlling harmonic distortion design of filters for harmonic reduction. **08 Hrs**

Unit - VI	:	Measuring and solving power quality problems:
		Introduction, power quality measurement devices – harmonic analyzer, transient disturbance analyzer, oscilloscopes, data loggers and chart recorders, true rms meters, power quality measurements, number of test location, test duration, instrument setup and guidelines. **04 Hrs**

Text Books, Reference Books, e- books, e- Journals	:	Sr.No.	Title	Author	Publication
		1.	Power System Quality Assessment	J. Arrillaga, M. R. Watson, S. Chan	John Wiley and Sons.
		2.	Understanding Power Quality Problems, Voltage Sag and Interruptions	M. H. J. Bollen	New York: IEEE Press, 2000, Series on Power Engineering.
		3.	Electrical Power System Quality	R. C. Dugan, Mark F. McGranghan, Surya Santoso, H. Wayne Beaty,	2nd Edition, McGraw Hill Publication.
		4.	Power System Harmonics: Computer Modelling& Analysis	EnriquesAcha, Manuel Madrigal	John Wiley and Sons Ltd
		5.	Power Quality in Power Systems and Electrical Machines	Ewald F. Fuchs, Mohammad A. S. Masoum	Elsevier Publication.
		6.	Electric Power Quality	G. J. Heydt	Stars in Circle Publications
		7.	IEEE recommended practices and requirements for harmonics control in electrical power system		IEEE Std. 519-1992

Additional References	:	1. nptel.iitm.ac.in 2. ocw.mit.edu 3. https://www.journals.elsevier.com. 4. https://www.theorsociety.com/

Section A: Unit-I, II and III; **Section B**: Unit-IV, V and VI.

Pattern of Question Paper:
The 6 units in the syllabus shall be divided in two equal parts i.e.3 units respectively. Question paper shall be set having two sections A and B. Section- A questions shall be set on first part and Section-B questions on second part. Question paper should cover the entire syllabus.

For 80 Marks Paper:

1. Ten questions
2. Five questions in each section

3. Question no. 1 from section-A and Question no. 6 from section-B be made compulsory and should cover complete syllabus of the respective section for 10 marks each.
4. Remaining questions will be of 15 marks each.
5. Any two questions of 15 marks from remaining questions in each section are to be solved.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
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Syllabus of Final YearB. Tech. (Electrical Engineering) Semester – VII

Course Code: EED444		**Course: Elective-IV(Advanced Industrial Automation)**
Teaching Scheme		**Class Test:10Marks**
Theory: 02Hrs/week		**Theory Examination Duration:02Hrs**
Credits: 02		**Theory Examination:40Marks**

Prerequisites	:	To understand the knowledge of basic industrial automation, PLC Controller, industry standard protocols.
Objectives	:	1. The trend in the Industry for automation is changing one and student will able to develop the skill set for latest development of automation.
Unit -I	:	**Basic of Automation:** Introduction of sensors, actuators, control loop, concept of process variables, set point, controlled variable, manipulated variable, load variable. Representation of process loop components using standard symbols (basic with reference to control loop),and Examples of process loops like temperature, flow, level, pressure etc. Hierarchical levels of automation, introduction to plant automation. **04Hrs**
Unit -II	:	**Transmitters and Converters:** Need of transmitter(concept of field area & control room area)Need for standardization of signals, current, voltage and pneumatic signal standards, concept to live & dead zero, DPT, span & zero adjustment, Two wire transmitter, SMART transmitter: Comparison with conventional transmitter. **03Hrs**
Unit -III	:	**Converters:** Block schematic converters, Difference between converter &transmitter, Pneumatic to current converter, current to pneumatic converter. Switches: Temperature, pressure, Level switch, Proximity switch, Reed switch, Contactors. **03Hrs**
Unit -IV	:	**Actuators:** Types of control valves, Control valve terminology Range ability, turn down, valve capacity, Air to open, Air to close, valve gain etc. Control valve characteristics: Inherent & installed control valve accessories. Positioners: Application/Need, Types, Effect on performance of control valves. Volume boosters, Pressure boosters, Reversingrelay,Solenoidvalves,Airlock,positionindicatingswitches, Electro-pneumatic converter, hand wheel. **05Hrs**

Unit -V	:	Programmable LogicController(PLC):			
		Continuous versus Discrete Process Control, ladder diagram using standard symbols, architecture of PLC, types of Input& Output modules(AI, DI, AO,DO), types of Timer, Counter, Specification, manufacturers, PLC ladder diagram and instructions, PLC programming in Electrical applications, **Industry Standard Protocols:** HART protocol, field bus standards like Device Net, Profibus, Profinet, Control net, CAN, industrial Ethernet. **05 Hrs**			
Unit -VI	:	SCADA and DCS:			
		Supervisory control system and data acquisition(SCADA): Introduction to SCADA, SCADA architecture, creation of data base, interfacing with PLC.DCSintroduction,functions,advantagesandlimitations,DCSasanautomation tool to support Enterprise Resources Planning, DCS Architecture of different makes. **04Hrs**			
Text Books, Reference Books,e-books,e- Journals	:	Sr.No.	Title	Author	Publication
		1.	Process Control Instrumentation Technology	Curtis D. Johnson	PHI7th edition.
		2.	Introduction to Programmable Logic Controller Thomson Learning.	Garry Denning	
		3.	Control Valve Handbook	Emerson Process Management	4th edition.
		4.	Applied Instrumentation in Process Industry"	Andrew and Williams	Gulf Publication.
		5.	Instrumentation Engineers Handbook: Process	B. G. Liptak	
		6.	Introduction to Programmable logic controllers	Krishna Kant	(Delmar Publisher)
		7.	Computer Based Process control	Ravindran, Phillips and Solberg	PHI 8. Mechatronics, HMT, TMH
Additional References	:	1. nptel.iitm.ac.in 2. https://www.journals.elsevier.com/journal-of-industrailautomation. 3. https://pubsonline.informs.org/journal/opre 4. https://www.theorsociety.com/			

Section A: Unit-I, II and III; **Section B**: Unit-IV, V and VI.

Pattern of Question Paper:
The 6 units in the syllabus shall be divided in two equal parts i.e.3 units respectively. Question paper shall be set having two sections A and B. Section- A questions shall be set on first part and Section-B questions on second part. Question paper should cover the entire syllabus.

For 80 Marks Paper:

1. Ten questions
2. Five questions in each section
3. Question no. 1 from section-A and Question no. 6 from section-B be made compulsory and should cover complete syllabus of the respective section for 10 marks each.
4. Remaining questions will be of 15 marks each.
5. Any two questions of 15 marks from remaining questions in each section are to be solved.

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Course Code: EED445	**Course: Elective IV (Industrial Safety & Health)**
Teaching Scheme	**Class Test: 10Marks**
Theory: 02 Hrs/week	**Theory Examination Duration:02Hrs**
Credits: 02	**Theory Examination: 40Marks**

Prerequisites	:	Should have knowledge of Industrial Safety & Health along with the preliminary concepts.
Objectives	:	1. To help students to understand the fundamentals of Safety &health Management 2. To know the scope and nature of occupational health and safety. 3. To know the moral-social-economic reasons for maintaining safety and the basic approach to prevention of accidents and illness at work place.
Unit – I	:	**Introduction to health & safety:** Integrated Management System -Need for integration of Safety, Health, Role of top management, Role of National Government, Fundamentals of Safety. **4 Hrs**
Unit – II	:	**Scope & Nature of occupational health & safety**: The scope and nature of occupational health and safety, moral,social, economic reasons for maintaining safety, Definitions: Health, Safety, Welfare, Risk, occupational illness, occupational accident **4Hrs**
Unit – III	:	**Introduction to Health & Safety Management System**: Safety Management, Hazard, Trigger, Risk, Heinrich Triangle, Frank Bird Triangle, Domino Theory. **4Hrs**
Unit – IV	:	**Safety Management**: Approaches to prevent accident, Safety Department, Organisation structure, Responsibilities of Safety Managers. **4 Hrs**
Unit – V	:	**Role of National Government & International bodies** : Role of National Governments & International bodies in Health & Safety Role of ILO, ILO

		Conventions & Recommendations			
					4 Hrs
Unit – VI	:	**Responsibly:** Responsibilities of Government- Social organizations & Public Authorities, Role of enforcement agencies, Consequence of non-compliance, Barriers to good standards of safety.			
					4 Hrs
	:	Sr.No.	Title	Author	Publication
Text Books, Reference Books, e- books, e- Journals		1.	Industrial Safety Management	LM Deshmukh	Tata McGraw-Hill
		2.	Industrial safety & Management	A.K.Gupta	Laxmi Publication
		3.	Industrial safety ,health and Environmental management systems	S.S.Rao	Khanna Publishers
		4.	Management of International Health & Safety	Roger Passey	RRC International, Inc
Additional References	:	1. ILO Convention – 155 & Recommendation – 164 2. Indian Factories Act 1948			

Section A: Unit-I, II and III; **Section B**: Unit-IV, V and VI.

Pattern of Question Paper:
The 6 units in the syllabus shall be divided in two equal parts i.e.3 units respectively. Question paper shall be set having two sections A and B. Section- A questions shall be set on first part and Section-B questions on second part. Question paper should cover the entire syllabus.

For 40 Marks Paper:

1. Ten questions
2. Five questions in each section
3. Question no. 1 from section-A and Question no. 6 from section-B be made compulsory and should cover complete syllabus of the respective section for 06 marks each.
4. Remaining questions will be of 07 marks each.
5. Any two questions of 07 marks from remaining questions in each section are to be solved.

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CourseCode:EED446	Course: Elective IV(Electrical Transport System)
Teaching Scheme	Class Test: 10Marks
Theory: 02Hrs/week	Theory Examination Duration:02Hrs
Credits: 02	Theory Examination:40Marks

Prerequisites	:	Knowledge of Electrical machines and motor, Study about power electronics and solar system.
Objectives	:	1. To explore soft computing tools for intelligent control. 2. To study optimization techniques. 3. To apply artificial neural network and machine learning tools for system identification and control.
Unit–I	:	**Electric Vehicles:** Introduction**,** Layout of an Electric Vehicle**,** Performance of Electric Vehicles**,** Energy Consumption**,** Advantages and Limitations**,** Specifications**,** System Components**,** Electronic Control System **05Hrs**
Unit-II	:	**Hybrid Vehicles:** Concepts of Hybrid Electric Drive Trains, Architectures of Series Hybrid Electric Drive Trains, Architectures of Parallel Hybrid Electric Drive Trains, Merits and Demerits, Series Hybrid Electric Drive Train Design, Parallel Hybrid Electric Drive Train Design. **05 Hrs**
Unit-III	:	**Fuel cells and solar cells**: Photovoltaic Cells, Tracking, Efficiency, Solar Cars, Fuel Cell - Construction & Working, Equations, Possible Fuel Sources, Fuel Reformer, Design, Cost Comparison. **04Hrs**
Unit–IV	:	**Electric Propulsion System and Motor Control system:** DC Motors Characteristics, Speed and Torque equations, Control System Principle, Regenerative Braking. **04Hrs**
Unit–V	:	**Energy Storages:** Electrochemical Batteries**,** Types of Batteries**,** Electro Chemical Reactions, Thermodynamic Voltage, Specific Energy, Specific Power**,** Energy Efficiency, Ultra Capacitors. **03Hrs**

Unit–VI	:	**Energy Generators:** DC Generators, AC Generators, Voltage and Frequency Regulations. 06 Hrs		

Text Books, Reference Books, e- books,e-Journals	:	Sr.No.	Title	Author	Publication
		1.	Modern Electric, Hybrid Electric and Fuel cell vehicles: Fundamentals, Theory and Design	Mehrdad Ehsani, Yimin Gao, Sebatien Gay and Ali Emadi	CRC Press
		2.	Electric Vehicle Technology – Explained	James Larminie and John Loury	John Wiley & Sons Ltd
		3.	Electric Vehicle Battery Systems	Sandeep Dhameja	Butterworth – Heinemann
		4.	Electric and Hybrid – Electric Vehicles	Ronald K Jurgen	SAE
		5.	Light Weight Electric/Hybrid Vehicle Design	Ron Hodkinson and John Fenton	Butterworth – Heinemann
		6.	Electric and Hybrid Vehicles-Design Fundamentals	Iqbal Husain	CRC Press

Section A: Unit-I, II and III; **Section B**: Unit-IV, V and VI.

Pattern of Question Paper:
The 6 units in the syllabus shall be divided in two equal parts i.e.3 units respectively. Question paper shall be set having two sections A and B. Section- A questions shall be set on first part and Section-B questions on second part. Question paper should cover the entire syllabus.

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1. Ten questions
2. Five questions in each section
3. Question no. 1 from section-A and Question no. 6 from section-B be made compulsory and should cover complete syllabus of the respective section for 06 marks each.
4. Remaining questions will be of 07 marks each.
5. Any two questions of 07 marks from remaining questions in each section are to be solved

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Course Code:EED421   **Course Laboratory: Switchgear and Protection**
Teaching Scheme   **TermWork: 25 Marks**
Practical:02Hrs/week   **Practical Examination: 25 Marks**
Credits: 01

Objectives	:	To aware and develop among students about switchgear and protection by experiment
List of Practicals **(Minimum-08)**	:	1. Study of switchgear testing kit. 2. Study of Fuse, MCB &their testing. 3. Study & testing of contactors. 4. Study & testing of MCCB. 5. Study & testing of ACB. 6. Study & testing of 3 Phase induction motor simulation study kit 7. Study and application of directional over current relay 8. Microprocessor under voltage/Overvoltage relay kit 9. Percentage differential protection of transformer. 10. Protection of alternator. 11. Protection of Transmission line using Impedance relay 12 Study & testing of Negative Sequence Relay 13. Study of various LT switchgears like RCCB, timers.

Text Books, Reference Books, e- books, e-Journals	:	Sr. No.	Title	Author	Publication
		1.	Switchgear Protection & Power Systems	S. Rao	Khanna Publications
		2.	Fundamentals of Power System Protection	Y. G. Paithankar, S. R. Bhide	Prentice Hall of India
		3.	Protection and Switchgear	Bhavesh Bhalja, R.P. Maheshwari, N.G.	Oxford University Press
		4.	Power System Protection & Switchgear	Badri Ram, D. N. Vishwakarma	Tata McGraw Hill
		5.	rotective Relaying: Principles and Applications	J. Lewis Blackburn , Thomas J. Domin	, CRC Press
		6.	Digital Protection of power System	Prof. Dr S.A. Soman	
		7.	Computer relaying for Power System, Research Studies	A.G. Phadke and J.S. Thorp	John Willy & Sons Inc New York
		8.	The Art and Science of Protective Relaying	Crussel Mason	Wiley Eastern

Additional References	:	1. http://www.cdeep.iitb.ac.in/nptel/Electrical%20Engineering/Power%20System%20Protection/Course_home_L27.html

The assessment of Term work shall be done based on following.

- Continuous assessment
- Performing the experiments in the laboratory

- The Practical/Oral examination shall be conducted on the syllabus and term work mentioned above.

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Course code: EED422	Course Laboratory: Advanced Control System
Teaching Scheme Practical: 02Hrs/week Credits: 01	Term Work: 50 Marks

Objectives	:	1. To aware and doing practical of control system II theory concept by experiment/ modeling
List of Practicals **(Minimum-08)**		**Compulsory** 1. Op-amp based realization of highly under damped second order plant. Find out frequency response of the system experimentally 2. Design a lead/lag compensator for given specifications for the plant in Experiment1 using MATLAB. 3. Realize the compensator designed in experiment 2 using op-amp circuits and find out frequency response of the plant and the compensator in closed loop and verify step and frequency response.
		Any Five 1. Check for observability and Controllability in MATLAB. 2. Verify State feedback control using pole placement. 3. Convert a continuous time system into digital control system and check response using software. 4. Design State observer and validate it by software. 5. Software programming for determination of state space representation for given transfer function and vice-versa 6. Software programming for determination of STM. 7. Study of non linearity using OPAMPs and verification of those by software. 8. Implementation of digital PID controller for physical system. 9. Effect of sampling and verification of sampling theorem.

Text Books, Reference Books, e-books, e-Journals		Sr. No.	Title	Author	Publication
		1.	Modern Control Engineering	Ogata K.	Prentice Hall
		2.	Control System Engineering	Nagarath& Gopal	Wiley Eastern
		3.	Automatic Control Engineering	Benjamin C. Kuo	Prentice Hall
		4.	Digital Control System	Benjamin C. Kuo	Prentice Hall

The assessment of Term work shall be done based on following.

- Continuous assessment
- Performing the experiments in the laboratory
- The Practical/Oral examination shall be conducted on the syllabus and term work mentioned above.

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Course Code: EED423   **Course Laboratory: Power System Operation and Control**
Teaching Scheme   **Term work: 25Marks**
Practical: 02Hrs/week   **Practical Examination: 25 Marks**
Credits: 01

Objectives	:	1. To understand and develop among students about power system operation and control by experiment
List of practicals **(Minimum-08)**	:	1. To determine Steady state Stability of synchronous motor (performance). 2. To determine Steady state stability of medium transmission line (performance). 3. To plot swing curve by Point by Point method for transient stability analysis. 4. To apply equal area criteria for analysis stability under sudden rise in mechanical power input. 5. To apply equal area criteria for stability analysis under fault condition. 6. To study reactive power compensation using any device. 7. To study Lagrange multiplier technique for economic load dispatch. 8. To develop dynamic programming method for unit commitment. 9. To study load frequency control using approximate and exact model. 10. To study load frequency control with integral control. 11. To study the two area load frequency control.

Text Books, Reference Books,e-books,e-Journals	:	Sr.No.	Title	Author	Publication
		1.	Switchgear Protection & Power Systems	S. Rao	Khanna Publications
		2.	Fundamentals of Power System Protection	Y. G. Paithankar, S. R. Bhide	Prentice Hall of India
		3.	Protection and Switchgear	BhaveshBhalja, R.P. Maheshwari, N.G. Chothani	Oxford University Press
		4.	Power System Protection & Switchgear	Badri Ram, D. N. Vishwakarma	Tata McGraw Hill
		5.	rotective Relaying: Principles and Applications	J. Lewis Blackburn , Thomas J. Domin	, CRC Press
		6.	Digital Protection of power System	Prof. Dr S.A. Soman	
		7.	Computer relaying for Power System, Research Studies	A.G. Phadke and J.S. Thorp	John Willy & Sons Inc New York
		8.	The Art and Science of Protective Relaying	Crussel Mason	Wiley Eastern

Additional References		1. http://www.cdeep.iitb.ac.in/nptel/Electrical%20Engineering/Power%20System% 20Protection/Course_home_L27.html

The assessment of Term work shall be done based on following.

- Continuous assessment
- Performing the experiments in the laboratory
- The Practical/Oral examination shall be conducted on the syllabus and term work mentioned above

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Course Code: EED424	**Course Laboratory: Simulation Tools for Interfacing**
Teaching Scheme	**Term work: 50 Marks**
Practical: 02Hrs/week	**Practical Examination: 50 Marks**
Credits: 01	

Objectives	**:**	To understand and develop among students about simulation software interfacing with hardware
List of practical **(Minimum-08)**	**:**	1. Write a program for generating continuous and discrete signal in Scilab. 2. Simulation of Single phase Half controlled rectifier using R and RL loadScilab. 3. Simulation of Single phase Full controlled rectifier using R and RL loadScilab. 4. Simulation of Single phase inverter using R and RL load. 5. Interfacing Arduino with Scilab. 6. Interfacing Arduino with Scilab for blinking LED. 7. Interfacing Arduino with Scilab to control DC motor. 8. Interfacing Arduino with Scilab to control servo motor. 9. Developing Raspberry Pi 3 into a Portable PC. 10. IoT using Raspberry pi 3 (controlling LED)

Text Books, Reference Books,e-books,e-Journals	**:**	**Sr. No.**	**Title**	**Reference**
		1.	Scilab user guide	Scilab.org
		2.	Arduino user guide	
		3.	Raspberry pi 3 B+ user guide	www.raspberrypi.org

The assessment of Term work shall be done based on following.

- Continuous assessment
- Performing the experiments in the laboratory
- The Practical/Oral examination shall be conducted on the syllabus and term work mentioned above

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Course Code: EED425		**Course: Project II**
Teaching Scheme		**Term Work: 100 Marks**
Practical: 04Hrs/week		**Practical Examination: 100Marks**
Credits: 04		
Objectives	**:**	1. The practical implementation of theoretical knowledge gained during the study to till date is important for engineering education. The student should be able implement their ideas/real time industrial problem / current application of their engineering branch which they have studied in curriculum. 2. To motivate students for creativity. 3. To create awareness regarding latest technology 4. To have common platform for interaction about emerging technology. 5. To inculcate qualities of team work. 6. To explore related information using books, research papers, journals & websites. 7. To improve presentation and communication skills.

List of Practicals	**:**	**Guidelines For Students And Faculty:**
		
		1. Students shall complete the Project-II in continuation of the work planned in third year under the course Project-I
		2. Each student/group is required to-
		    a. Submit a report with latest status of the project work.
		    b. Give a 10 minutes presentation through OHP, PC, and Slide projector followed by a 10 minute discussion in the second week of their academic semester.
		    c. Submit a report on the project topic with a list of required hardware, software or other equipment for executing the project in the third week of their academic semester.
		    d. Start working on the project and submit initial development and CPM/PERT planning drawing in the fourth week of their academic semester.
		    e. Preparation of PCB layout, wiring diagram, purchase of components, software demo, flowchart, algorithm, program/code, assembling, testing, etc. should be submitted by student/s within next five/Six weeks and minimum one page report should be there for each major activity.
		    f. Overall assembling, wiring, code writing, testing, commissioning along with performance analysis, should be completed within next two weeks.
		    g. In the last week, student/group will submit final project report to the guide.
		
		3. Every assigned faculty/s should maintain record of progress of each student or group.

The format and other guidelines for the purpose of the Project Submission in hard bound copies should be as follows

REPORT STRUCTURE
Index/Contents/Intent
List of Figures
List of Tables
List of Symbols / Abbreviations

1. Introduction
2. Literature survey
3. System development
4. Performance analysis
5. Conclusions

References
Appendices
Acknowledgement

1. INTRODUCTION

1.1 Introduction

1.2 Necessity

1.3 Objectives

1.4 Theme

1.5 Organization

2. LITERATURE SURVEY
Literature Survey

Related information available in standard Books, Journals, Transactions, Internet Websites *etc.* till date (More emphasis on last three to five years)

3. SYSTEM DEVELOPMENT

Model Development
- Mechanical / Fabricated

- Analytical

- Computational

- Experimental

- Mathematical

- Software

(out of above methods at least one method is to be used for the model development) Some mathematical treatment or related information is required to be embodied.

4. PERFORMANCE ANALYSIS

- Analysis of system developed either by at least two methods depending

upon depth of standard

- These methods normally used are Analytical /Computational/Statistical/Experimental/ or Mathematical

Results at various stages may be compared with various inputs
- Output at various stages with same waveforms or signals or related information/parameters

- Comparison of above results by at least two methods and justification for the differences or error in with theory or earlier published results

5. CONCLUSIONS

5.1 Conclusions

5.2 Future Scope

5.3 Applications

Contributions (if any,)
The innovative work/invention/new ideas generated from the analysis of the work which can be taken from the conclusions

REFERENCES
- Author, "Title", Name of Journal/Transactions/ Book, Edition/Volume, Publisher, Year of Publication, page to page (pp.__).

These references must be reflected in text at appropriate places in square bracket In case of web pages complete web page address with assessing date has to be enlisted
List of references should be as per use in the text of the report

APPENDICES
Related data or specifications or referred charts, details computer code/program, *etc*.

ACKNOWLEDGEMENTS
Expression of gratitude and thankfulness for helping in completion of the said task with name & signed by the candidate
- General Guidelines

Text should be printed on front and correct side of the watermark on quality bond paper
Paper size- A4, 75 to 85 gsm
paper Left Margin-1.5"
Right Margin-3/4"
    Top
    Margin-1"
    Bottom Margin-1"
- Pagination

First page of every chapter need not be printed but counted, second page onwards page number to printed at bottom center place.
All Greek words must be italic

Report Heading -ALL CAPITAL—16 Font
Chapter heading -ALL CAPITAL—14 Font

	Subchapter –Title Case-12 Font Sub-Subchapter –First Alphabet Capital case-12 Font Page numbers for Index/Contents/Intent should be in roman All text should be in times new roman Cover page should have complete symbol of institute Suitable flap (bookmark) with name of the candidate, Department and Institute name and symbol can be used with nylon strip. For more information and sample of hard copy please contact the respective Head of the Department.

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Course Code: EED471	**Course: In-Plant Training**
Teaching Scheme	**Term Work: 300 Marks**
Credits: 24	**Practical Examination: 300Marks**

Rationale	**(a)**	The techniques and processes of production of goods and services do not demand only technical skills, but also a cluster or conglomerate of skills. A significant part of which is related to the total humanistic growth of the man. Such conglomerate skills technical and humanistic cannot obviously be acquired through pure academic learning of concepts in formalized and institutional courses and in isolation of the actual work situation. It, therefore, naturally follows that no technical education will be complete till it has two components, one learning of concepts vis-a vis acquiring conceptual skill and other application of the concepts in real work situation vis-a vis acquiring manipulative or practicing skills. Technical education needs to have a complement of learning of the techniques of applying the concepts within the industry and business.
Course Objectives	**(b)**	1) The students of B.Tech course shall get an opportunity to work on live problem 2) He/She shall apply his leaving concepts in the real work situation. 3) He/She shall get an exposure to the industrial environment and thereby enable himself/herself to appreciate the other related aspects of industry via, human, economic, commercial and regulatory. 4) He/She shall identify career paths taking into account their individual strengths and aptitude. 5) He/She shall contribute for the achievement of economic goals and aspirations of the industry and our country as a whole.
	(c)	The curriculum for B.Tech students of Final Year Course of Part-II shall consist of; 1) In-plant training for a period of one full term, and the period of the term shall be as prescribed by the university from time to time 2) A project on live problems of the industry shall be undertaken by the student/group of students undergoing training in the same establishment. 3) The term work shall consist of the In-plant training record-daily diary, work diary, progress report, a record containing the literature survey in the field of appropriate branch of Engineering, a

		preliminary report related to project work etc. 4) Seminars will be arranged after successful completion of period specified in the scheme of semester VIII of B.Tech. The date and times will be decided according to the convenience of guide and student.
	(d)	**Memorandum of understanding:** Maharashtra Institute of Technology, Aurangabad will enter into an agreement with the industry through 'Memorandum of Understanding' for creating facilities of In-plant training in the appropriate branch of Engineering according to the Course Curriculum and keep this agreement for a period of 10 years to foster a healthy industry-institute interaction for mutual benefits of both.
		Admission to In-plant training: No student will be deputed for In-plant training unless he produces testimonial of having kept one term for the subject under B Tech Semester –VIII of final year course satisfactorily in Maharashtra Institute of Technology after passing the TY B Tech Examination (in the appropriate branch).
		Period of In-plant training: The period of In-plant training will be the period of one term for the subject under B Tech course semester-VIII, which will be notified by Dr.Babasaheb Ambedkar Marathwada University, Aurangabad.
		Contract of In-plant Training : • The student of Maharashtra Institute of Technology shall enter into a contract of In-plant training with the employing industry. • The In-plant training shall be deemed to have commenced on the date, on which the contract of In-plant training has been entered into. • Every contract of In-plant training will contain the Terms and Conditions to be agreed by both the parties. • Every contract of In-plant training shall be registered with the Maharashtra Institute of Technology within15 days from entering into the contract.
		Violation of contract: Where an employer, with whom a contract for In-plant training has been entered into, is for any reason, unable to fulfil his obligation under the contract, the contract end with the consent of Maharashtra Institute of Technology. It is agreed between the employer, the student and any other employer that the student shall be engaged as an "In-plant trainee" under the other employer till the expiry period of the In-plant training. The agreement on registration with Maharashtra Institute of Technology shall be deemed to be the contract of In-plant training between the student and other employer, and from the date of such registration, the contract of In-plant training with the first employer shall terminate and no obligation under that contract shall be enforceable at the instance of any party to contract against the other party thereto.
		Termination of Contract: The contract of In-plant training shall terminate on the expiry of the period of In-plant training. Either party to the contract of In-plant training make an application to Maharashtra Institute of Technology, Aurangabad for the termination of the contract. After considering the content of the application, and objection, Maharashtra Institute of Technology by order in writing, will terminate the contract, if it is satisfied that the parties to the contract have/has failed to

		carry out the Terms and Conditions of the contract. Provided that where a contract is terminated- • For the failure on the part of the Employer, Maharashtra Institute of Technology will depute students to another Employer for providing facilities of In-plant training to the remaining period of training. For the failure on the part of the student, the student will not be allowed to continue his/her In-plant training in that term. The student shall be deputed for In-plant training in next coming term.
		Expectation from the Employer / Industry / Establishment: The following expectations are derived for effective In-planttraining. 1. To provide legitimate facilities for the training and learning of all the processes. 2. To guide the student for understanding a project of immense importance to industry and to help him/her for his/her career advancement.
		Obligation of Students: • To learn his/her subject field in Engineering or Technology conscientiously and diligently at his place of training. • To carry out all orders of his Employer and the Superior in the establishment. • To abide by the Rules and Regulations of the Industry/Establishment in all matters of conduct and discipline. To carry out the obligation under the contract of In-plant training. • The student shall maintain a report of his work during the period of his In-plant training in a pro-forma (form no: 2) made available in Annexure. Except in case of extreme urgency, the B.Tech student shall submit an application for all other leaves except the medical leave to the Manager/Gen. Manager (Personnel) of the concerned industry, where he is undergoing an In-plant training and obtain sanction before the leave is taken. In case of Medical Leave, he shall submit an application to Maharashtra Institute of Technology, Aurangabad. The shortage in attendance will be subjected to extending the period of In-plant training in which case, the student may not be allowed to appear for the test, project seminar and assessment of term work etc. which will be held immediately after successful completion of the In-plant training.
		Maintenance of Record: Every student of B.Tech course shall maintain a daily record of the work done by him/her relating to the In-plant training in the pro-forma (Annexure).
		Industry Sponsored Student Projects: The scheme envisages working out suitable programme for B.Tech students. They are required to complete their In-plant training in a given period. During this period, they shall be familiar with the understanding of the shop process and activities. The students can be asked to solve the mini-shop problem, which will make them think and try out short experiments as an improvement in the process, tools and equipment.The student here is not expected to acquire the skills in operating machines values. He should appreciate the application of theory learnt. The students in a group alone can undertake a project of immense importance for the benefit of the industry and also useful for the students for their advancement of career. Industry staff and Maharashtra Institute of Technology faculty can plan in advance to effectively complete the practical training with the project for preliminary studies on the floor. The projects should aim mainly- • Cost reduction

		• Reducing cycle time • Enhancing productivity • Energy conservation measures • Process Improvement technique • Inventory control • Quality control Technique • Improvement in Material handling system • Bottlenecks in material flow system and so on. • Live problems in the industry. • Application development using electrical related knowledge. • EMI/EMC related issues
		What will form a good project? Through the project, it is hoped to provide the students an exciting experience in solving line problems under practical constraints. Hence it is desired that the project should be a well-defined problem, which can be completed and implemented within the project period. It may be a problem, evolving analysis, design, fabrication and / or testing.
		Time Schedule for the Project: The following time schedule should be planned by each student or groups of students, who undertake28 the project. • Proposal to be received before specified date. • Project acceptance before. • Commencement of the project. • Completion of the project.
		Commitment on the part of the Institute: • Providing a faculty member to supervise the project. • Providing the Institute facilities to complete the project. Coordinator from industry will be invited to participate in the stage wise assessment of the students performance.
		Assistance for completion of the Project: All the projects undertaken by the students are time bound. Although, every attempt results may not be achieved within the period available for the student. In such cases, the services of the associated faculty members can be sought for the completion of the same on mutually agreed terms.
		Monitoring of In-plant Training: The B.Tech students are expected to follow all the rules and discipline of the industry. However, because of other academic requirements and the nature of the project, the student may have to work in other places outside the industry. The faculty and Industry supervisor will work out a suitable arrangement to review the progress of the work from time to time. Maharashtra Institute of Technology, Aurangabad will monitor the progress of In-plant training in association with industry authority.
		Conduct and Discipline: In all matters of the conduct and discipline, B.Tech student shall be governed by the rules and regulations (applicable to employees of the corresponding category) in the Establishment, where he/she is undergoing a training.

		B.Tech Students are Trainees and not Workers: • Every B.Tech student undergoing an In-plant training in the respective branch of Engineering & Technology in any Establishment shall be treated as a trainee and not a worker and- • The provision of any law with respect to labour will not apply to such a trainee.
		Settlement of Disputes: Any disagreement or dispute between an industry and a B.Tech student trainee arising out of the contract of In-plant training shall be resolved both by Maharashtra Institute of Technology and the industry with mutual cooperation. The decision of both Maharashtra Institute of Technology and the industry shall be final.
		Holding of Test and Grant of Certificate: The progress in In-plant training of every student shall be assessed by the industry and Maharashtra Institute of Technology faculty from time to time. Every B.Tech student undergoing an In-plant training shall be issued a certificate of Proficiency on completion of his training to the satisfaction of the industry.
		Offer of Stipend / Other Welfare Activities and Employment: It shall not be obligatory on the part of the Employer / Industry to offer any stipend and other welfare amenities available, if any, to the students of B.Tech courses undergoing an In-plant training. However, if the industry desirous to do so, at will be a privilege for the students and also for Maharashtra Institute of Technology in view of the bonding of better understanding and cooperation forever.
		PRACTICAL EXAMINATION The Practical examination will be conducted after successful completion of the In-plant training for which guide will be internal examiner and external examiner will be appointed by the university. The date of practical examination will be same for the students of a branch and will be notified by the university. The assessment of the practical examination shall consist of 1. Seminar Performance 2. An oral on the project work done. Assessment of the term work / report.